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Annotation. The Proceedings of the Congress which be organized with the theme and declare by the UN General Assembly “The International Year of the Soil”. The Congress provided a great opportunity to learn and discuss recent advances in the soil science in general and to establish contacts and collaborations with participants from many different parts of the word. The congress will focus on multidisciplinary approach to soil science, with special interest on basic research, latest and technological developments for soil use and management. This scientific book emphasizes basic concepts of soil. The book also provides multiple opportunities for interaction among scientists from public and private institutions that will help accelerate the transfer of knowledge about soil science into action for the benefit of society and the environment.

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CONTENT

A Study on the Compatibility of the Data Obtained in the Removal of Zinc Pollution in Soil through Phytoremediation with Certain Experimental Models

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Key words: Heavy metal, mathematical models, pollution, zinc.

Introduction

Heavy metal pollution in soils due to increasing industrialization, practices for transition to modern agriculture, mining activities and waste removal methods has become an important environmental problem in many parts of the world. Zinc is one of the heavy metals that cause pollution when it is above a certain concentration. The average Zn content in soils is between 20 and 135 mg/kg in the areas where industrial emissions directly affect, whereas this value reaches 80.000 mg/kg in heavily polluted areas (Barker and Pilbeam, 2010). The best known anthropogenic source of Zn pollution is the emissions of non-Fe metals that come out of casting areas.
Other sources of Zn pollution can be listed as the burning of coal and wastes, metallurgy industry, waste muds of municipal services and the wear of vehicle tires (Rauch and Pacyna, 2009). Traditional soil cleaning methods are based on certain physical and chemical approaches such as solidification and stabilization, soil washing, electrokinetics and redox reactions. These treatment methods are generally costly, energy consuming and may have negative effects on soil structure (Wu et al., 2010).

In recent years, compared to other soil refinement technologies, phytoremediation technology has attracted increasing interest due to certain advantages such as being economical and ecological, not requiring special equipment and allowing the later reuse of the applied areas (Vanlı and Yazgan, 2006). Phytoremediation can be defined as the use of plants to remove pollutants from the soil.Hyperaccumulator plants that can carry the metals in the soil to the roots and harvestable parts are used in phytoremediation technologies. Various plants that have the ability to accumulate Zn at substantially high concentrations are classified as hyperaccumulator plants. Verbruggen et al. (2009) defined 14 plant species from 6 families that have the ability to accumulate Zn at rates higher than 1%. Several plant species are practically used and tested for the phytoremediation of polluted soils. These plant species can be listed as *Thlaspi caerulescens*, *Festuca rubra, Brachiaria ramose* (Dmuchowski et al., 2014).

In their study, Barbafieri et al. (2011) detected Zn content in the root, stem and leaves of *D. Viscosa* plant as the result of a sampling they conducted in an abandoned mining area and reported the Zn content as 200–370, 210–430 and 770–2900 mg/kg, respectively. In another study, Bech et al. (2012) collected soil and plant samples from mining areas where more than one metal was processed in Peru and determined the Pb and Zn concentrations of the samples. In their study, 5180 mg/kg Pb and 9900 mg/kg Zn were detected in the roots of *Bidens triplinervia* L. plant. However, it was found out that 4250 mg/kg Pb and 3870 mg/kg Zn was accumulated in the shoots of *Senecio* sp.

The availability of different cultigens for the removal of pollution in Zn polluted soils was investigated in the present study. The compatibility of different experimental mathematical models was examined with the results obtained from greenhouse experiments conducted with this aim.

Materials and Methods

In this study, cultigens that were found to show tolerance to high Zn concentrations in the soil in previously conducted preliminary greenhouse experiments were selected and different doses of Zn was applied to these plants. The plants selected were barley (Larende type), bread wheat (Karahan 99 type), triticale(Alperbey type), flax, chickpea(Gökce type) and colza(Turan type). Zinc sulfate (23%) was applied to the trial pots as 0-100-200-400-800 mg kg^{-1} Zn before planting.Thin river sand was used as the cultivation medium in the experiment, which was conducted in 4 repetitions in a total of 120 pots under controlled greenhouse conditions.

At the end of the experiment, the plants which reached the flowering period were cut at soil level and subjected to necessary pre-treatments. Afterwards, Zn analyses were performed on the samples taken from plant shoot, plant root and the soil samples taken from the pots at the end of the experiment. The data obtained from the analyses were examined in terms of compatibility with the mathematical models by using Statistica software (Forster and Ronz,1979). Parameter values and graphs of the discussed models were determined through 'Hooke-Jeeves and quasi-Newton' method by using MINITAB and SPSS statistical software package.

Results and Discussion

In this study, the data regarding plant shoot Zn content, root Zn content and Zn concentration that remained in the soil after use by the plant obtained from different cultigens subjected to high doses of Zn applications was examined in order the determine the compatibility of the data with experimental models. With this aim, the compatibility of linear model, irrational model, parabolic model and binomial model applications with the data was investigated. The model identification studies and the related results are presented in Table 1 and the obtained graphs are shown Graph 1, 2 and 3 in Fig.1. As it can be seen in the table, the model that represents our data in the most compatible way is the Binomial model:

$$\tilde{y} = a_0\, x_1^{a_1}\, x_2^{a_2}\, e^{b_1 x_1 + b_2 x_2} \qquad (1)$$

It is seen in Table 1that when compared to the other models, the position of Parameter

$$\eta = \sqrt{1 - \frac{\sum_{i=1}^{n}\left(y_{1i} - \tilde{y}_{1i}\right)}{\sum_{i=1}^{n}\left(y_{1i} - \overline{y}_{1}\right)}} \qquad (2)$$

which is the determination coefficient, is at the highest level in the Binomial model for all 3 cases.

Table 1

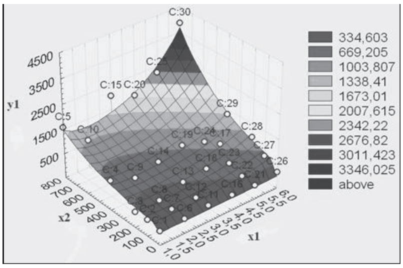
Different Experimental Models Adjusted To The Experimental Data Coefficients Of The Model

		Models coefficient						η
		a_0	**a_1**	**a_2**	**b_1**	**b_2**	**b_3**	**%**
		Linear model: $\tilde{y}(x_1, x_2) = a_0 + a_1 x_1 + a_2 x_2$						
$\tilde{y}_1$	**Root Zn**	-490,383	160,992	2,255	-	-	-	81,12
$\tilde{y}_2$	**Plant shoot Zn**	17,819	51,228	0,819	-	-	-	60,22
$\tilde{y}_3$	**Soil Zn**	29,376	-7,574	0,222	-	-	-	69,81
		Irrational Model: $\tilde{y} = a_0 + a_1\sqrt{x_1} + a_2\sqrt{x_2} + b_1 x_1 + b_2\sqrt{x_1 x_2} + b_3\sqrt{x_2}$						
$\tilde{y}_1$	**Root Zn**	1910,4002	-2060,563	-100,465	568,742	43,542	2,951	85,47
$\tilde{y}_2$	**Plant shoot Zn**	1018,119	-1458,03	29,659	489,484	-5,440	0,188	66,29
$\tilde{y}_3$	**Soil Zn**	302,047	-413,674	7,774	127,430	-4,124	0,212	79,30
		Parabolic Model: $\tilde{y} = a_0 + a_1 x_1 + a_2 x_2 + b_1 x_1^2 + b_2 x_1 x_2 + b_3 x_2^2$						
$\tilde{y}_1$	**Root Zn**	493,428	-217,612	-1,116	32,429	0,505	0,002	87,69
$\tilde{y}_2$	**Plant shoot Zn**	92,266	-96,113	1,882	23,997	-0,069	-0,001	64,35
$\tilde{y}_3$	**Soil Zn**	96,063	-75,459	0,350	11,276	-0,037	0,000001	78,63
		Binomial Model: $\tilde{y} = a_0\, x_1^{a_1}\, x_2^{a_2}\, e^{b_1 x_1 + b_2 x_2}$						
$\tilde{y}_1$	**Root Zn**	111,0006	-1,1229	0,000016	0,587	0,0025	-	90,72
$\tilde{y}_2$	**Plant shoot Zn**	17,1548	-1,8905	0,5209	0,6846	0,00005	-	69,27
$\tilde{y}_3$	**Soil Zn**	14,4066	-3,5532	0,000025	1,1491	0,00287	-	93,31

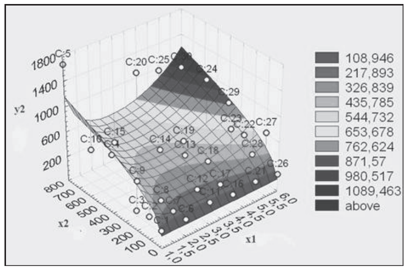
The graphs of this model which represents our experiment results are given below.

Conclusion

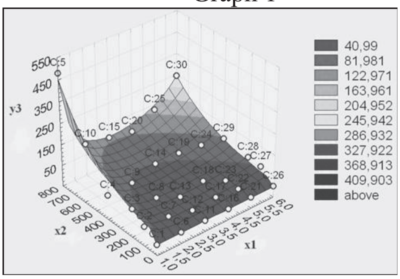
In the models, the primary criterion that determines the degree of representing the experimental data is the determination coefficient. When these coefficients were calculated, it was found out that the highest value was in the Binomial model. It was determined that for each of the three data(plant shoot Zn content, root Zn content and Zn concentration that remained in the soil after use by the plant), Binomial model provided the best representation of the experimental data. Thus, it was found out that the Binomial model could be used for estimating the amount of zinc in the plant, the root and that remained in the soil depending on different doses and types. In the study, we suggest this model for data estimations.



Graph 1



Graph 2



Graph 3

Fig.1. Graphics of the function $\tilde{y}_i = a_0 \, x_1^{a_1} \, x_2^{a_2} \exp(b_1 x_1 + b_2 x_2)$. For i=1 Root Zn, i=2 Plant shoot Zn, i=3 Soil Zn.

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Microbial biomass in a clay loam soil with addition of *Philoscia muscorum* (Isopoda; Philosciidae) and wheat straw

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Key words: Soil, isopod, microbial biomass

Introduction

Organic matter decomposition is one of the main processes in material cycling and energy transformation in terrestrial ecosystems (Magdoff and Weil, 2004). Decomposition of organic waste can be substantially affected by the interactions of soil microflora and fauna. Whereas the soil microflora play a primary role in the chemical transformation and mineralization of soil organic matter, soil fauna contribute to litter decomposition by digesting substrates, increasing substrate surface area through fragmentation, and enhancing microbial activity (Lavelle and Spain, 2003; Coleman et al., 2004).

Soil organisms are an integral part of ecological environment and contribute greatly to the disintegration of the plant and animal based wastes, especially in agricultural areas. Moreover, they have importants effects on plant nutrition and soil fertility because they are actively involved in the biological processes and sometimes they direct these processes (Bardgett, 2005). The effects of earthworms on the distribution of organic matter in the soil profile and on decomposition and carbon sequestration have been well studied, but less is known about effects of other macrofauna including terrestrial isopods (Lavelle and Spain, 2003; Coleman et al., 2004; Bardgett, 2005). Isopods mainly inhabit the litter layer; by fragmenting leaf litter, they facilitate litter decomposition and nutrient cycling. As a consequence, terrestrial isopods indirectly affect the activity and community composition of the soil microflora. The isopod *Philoscia muscorum* is a common and abundant member of the saprophagous soil macrofauna in Turkey. The objective of this study was to determine effect of *Philoscia muscorum* (Isopoda; Philosciidae) on microbial biomass in wheat straw added clay loam soil.

Materials and Methods

In the experiment the soil (14.45% clay, 42,65% silt, 42,9% sand) which was used as material, has no salt (Electrical conductivity 0.11 dSm^{-1}) little calcareous (5.76 %) and mild acid reaction (pH 6.86).In the experiment wheat straw (Organic material %91.16, N %0.42, P_2O_5 %0.25, K_2O %4.77, C/N 170.05) has been used, and after being dried and grounded it was mixed with the soil (<0,5 mm). Also *Philoscia muscorum* (Isopod; Philosciidae) which was used in the experiment, has been collected from the field of Ondokuz Mayıs University Campus.

Experimental design: On top of 50 gr air-dried soil which was contained within 150 ml glass containers, 10% (5 g) wheat straw has been added. Afterwards, the moisture content of the soil has been moistened with distilled water enough to be at field capacity level. Subsequently, on top of the soils *Philoscia muscorum* has been added in increasing numbers (0, 5, 10, 15 and 20 piece/50gr). The glass containers containing the soil, organic material and *Philoscia muscorum* has been left to incubation (25±2^{o}C) in the laboratory. The experiment established as 3 replications, and formed with 60 glass containers. During incubation, by weighing every day, the diminished water from the soil re-added to the medium, and microbial biomass C content of the soil samples which were taken in 7th, 14th, 21st and 28th days of the incubation has been determined in 3 parallels as the way reported by Anderson and Domsch (1978). In order to perform the ANOVA test for the results obtained from the experiments and to demonstrate the statistical differences, the LSD test has been performed with SPSS 11.0 statistical software package.

Results and Discussion

The most important function of the soil microflora is to decompose the organic materials. Since this phenomenon is a property of all heterotrophic microorganisms in the soil, it is evaluated as an indicator of microbial activity as well, and accordingly microbial biomass C forms an important parameter used for this purpose. In the experiment, the changes within the microbial biomass C content of the soil which were caused by isopod *Philoscia muscorum* added in increasing numbers to the soil mixed with 10% wheat straw, and their statistical evaluations are given in figure 1.

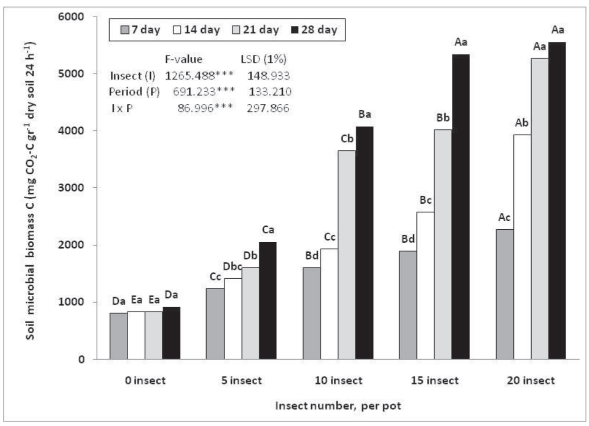

Fig. 1. The impact of isopod *Philoscia muscorum* added in increasing numbers to the soil mixed with 10% wheat straw, on the microbial biomass C content of the soil.

As it can be seen from Fig. 1 1, it is determined that the isopod *Philoscia muscorum* added in increasing numbers to the soil significantly increases (P <0.01) the microbial biomass C content of the soil, and the said increase prominently emerges as the incubation period increases. Without doubt, this condition shows that the microorganism activity which is primarily responsible from the decomposition and degradation of organic materials in agricultural soil, is not only affected by the soil characteristics, addition of organic materials to the soil and environmental conditions, but also from the macro fauna activity in the soil. Especially, in the event of agricultural pest control influences the macro fauna other than the targeted organism, it is obvious that, this condition not only will disrupt the ecological balance but also will cause to a reduction of microbial activity which is responsible for the decomposition of organic materials in soil. It is particularly determined by the studies conducted that the synthetic pesticides have negative impacts on the population of many organisms other than targetted organisms (Eijsackers, 1981; Akça et al.,2009; Paoletti and Hassall, 1999; Al-Zaidi et al., 2011). However, in recent years, in the fight against the pests which are negatively impacting the yield efficiency and quality in crop production, Azadirachtin like organic pesticides of plant origin are also being used. It is determined that their usage in agriculture, both has a positive impact on the biological properties of the soil and does not adversly affect the activity of isopod *Philoscia muscorum* (Akça et al., 2006; 2015; Kızılkaya et al. 2012a,b). Similarly, it is thought that promotion of the activity of macro fauna which doesnt has any potential damage on crop production is both provides the increase of soil microorganism activity and also will be crucial in the waste management applied to the soil by promotion of the mechanical decomposition of organic materials by these organisms in the soil.

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The Clay mineralogy features at clayey plains in the Areas with land subsidence and cracking in Iran

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Key words: diffractogram, arid to semiarid climates, interstratified smectite and mica

Introduction

Land-surface subsidence due to the reduction of ground water table by man has become relatively common in Iran since 70x years when traditional water supplying replaced by electrical and motor pumps from deep wells. Since 90x years with beginning in drought years and more intensive water supplying from deeper wells land subsidence and cracking became more apparent and obvious. The purpose of this research is to find relationship between clay mineralogy features and land subsidence and cracking intensities. These results can be used as one of the input data for surveying hazard maps in civil engineering. The principles involved in the compaction of sediments and of aquifer systems, basically the increase in effective stress, are examined briefly, together with their application to subsidence problems involving head decline both under water table and confined conditions. The amount of compaction that a confined aquifer system will experience is a function of compressibility. Other factors that influence compaction (and, in part, compressibility) include particle size and shape, clay mineralogy, geochemistry of pore water in the clayey beds and of the water in contiguous aquifers, and secondary compression (Poland & Davis, 1969). Subsidence range rate from about 1-50 cm per 10 meters drop in ground-water level, depending on thickness and compressibility of the formation. Lateral movement of the land surface of several meters has been reported in conjunction with removal of oil and gas (Bouwer, 1977). Land subsidence from groundwater extraction in the San Joaquin Valley has been called the greatest human alteration of the Earth's surface. This report confirms that land subsidence in the San Joaquin Valley is not just an historical occurrence, but that it is an ongoing problem. Subsidence is occurring today at nearly historically high rates (almost 1 ft/yr) in some areas. The report presents key examples of significant historical subsidence and current active occurrences of subsidence, including the impacts and costs. Land subsidence has taken its toll on the San Joaquin Valley. The cost of remediating subsidence in the San Joaquin Valley alone during 1955-1972 was estimated to be over $1.3 billion in 2013 dollars not including the significant damage to canals, river levees, and flood channels (Luhdorff et ales, 2014).

Materials and methods

Iran is a mountainous country with two major mountains, in north (Alborz) and in west (Zagros). In the centre of Iran exist minor central mountains that have formed central watersheds. In all parts of Iran different geological periods from Precambrian, Paleozoic, Mesozoic and to Cenozoic can to have rock outcrops therefore clay mineralogical types are often paragenetic. The studied locations have specified on Fig. 1. Because of the fertility of clayey plains, in there have developed major cities and agricultural areas and so in this era, industry developing have added new feature to them. From different height from sea level (from sea level to more than 5000m) has given to Iran the character of vertical zones with different soil climates. Abarkuh clayey plain with aridic moisture regime and thermic temperature regime has fed with deposits from downer parts of Zagros with Mesozoic formations but itself located on Cenozoics (west1 in Fig. 1). Shahrekurd clayey plain with xeric moisture regime and mesic temperature regime located in middle part of Zagros in the west of Iran. Cretaceous formations are the most geological period in Mesozoic that has rock outcrop in Shahrekurd (west2 in Fig. 1). Mashhad clayey plain with aridic moisture regime that in some parts borders on xeric. Its Soil temperature regime is mesic. It located between Alborz mountains with Mesozoic formations (North-East in Fig. 1). Yazd clayey plain with aridic moisture regime and thermic temperature regime has fed with deposits from Precambrian to Cenozoic that have rock outcrop in Central Iran (Centre in Fig. 1). The Soil samples were collected where land subsidence or cracking was happen. Clay particles in size of less than 1 micron were separated for XRD analyses by Philips Analytical X-Ray, from 2 [°2Th.] to 40 [°2Th.], generator setting of 40 kV, 30 mA. And anode of Cu. Before Analyses of the clays were doing the treatments of ethylene glycol and heating in 550 Celsius degree for 2 hours. The semi quantitative calculations on diffractometers were done according to Biskaye (1964).

Results and Discussion

The common property between diffractograms is illite with maximum quantities in all clay samples (54%-87%). The most severe status of land subsidence with land sliding exist in weast1 (Fig.1) samples in Abarkuh. The diffractograms of this position has a special property which shows an interstratified mixture of mica and smectite randomly. Because according to Sawhney (1989) a complete collapse to 1.0 nm on heating at 550 Celsius degree precluded the presence of chlorite (Fig. 2, left). The diffractograms of Shahrekurd are similar to Abarkuh (Fig. 2. right) because of similar lithologic formations. But in Shahrekurd because of higher height from sea level and more moisture climate, the quantity of smectite in clay fraction 2 times is more than Abarkub (30%). Although this location is with an interstratified mixture of mica and smectite like as Abarkuh but because of more moisture of climate show low features of land subsidence and cracking. The XRD diffractograms of Mashhad (Fig. 3. right) has a simple character with high Illite (to 87%) with a low component of smectite, chlorite and kaolinite. Although in this clayey plain human activities are very intensive but land subsidence features there are no accordingly. In Yazd clayey plain the situation is different. In this area quantity of amorphous silica has increased. And in B horizon to be formed secondary carbonates and silica of Bqk (Fig. 3. Left). The giant cracks are the specification of these areas.

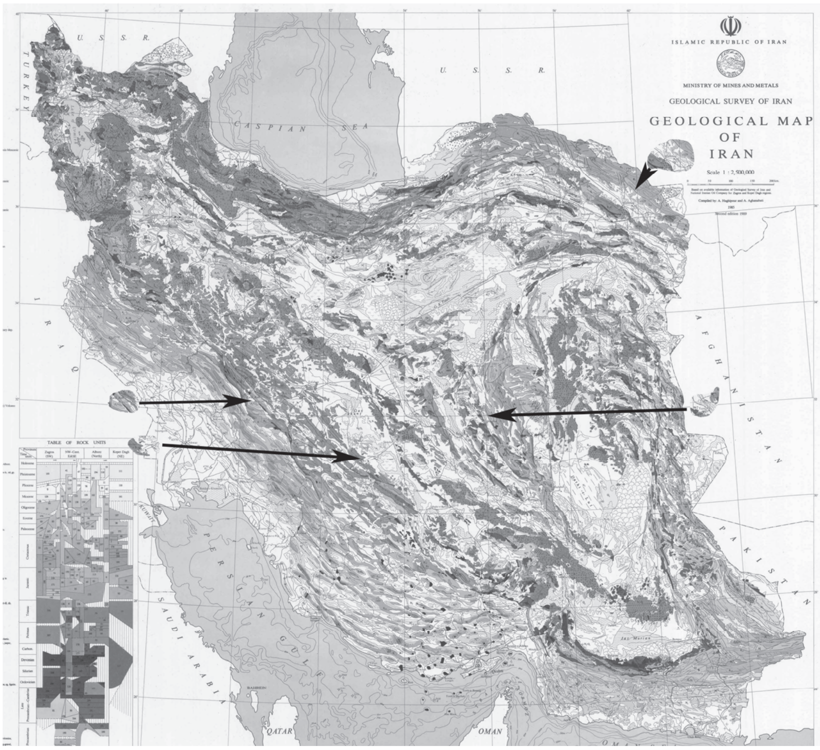

Fig. 1. With arrows on the shape (geological map of Iran) were shown 4 studied areas (1. West1 (Abarkuh) 3. West2 (Shahrekord), 3. North-East (Mashhad) and 4. Center (Yazd))

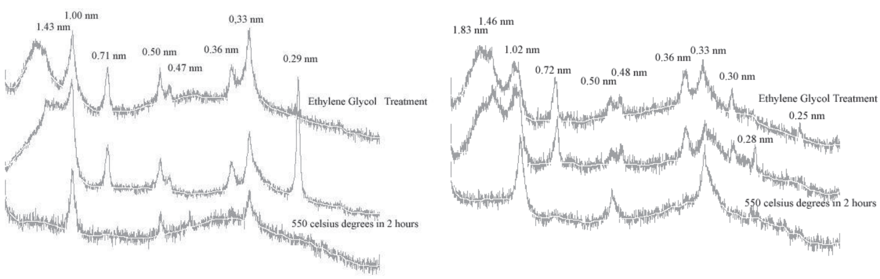

Fig. 2. The complete collapse to 1.0 nm on heating at 550 Celsius degree (lower curves) for Abarkuh(left) and Shahrekurd (right) XRD diffractograms.

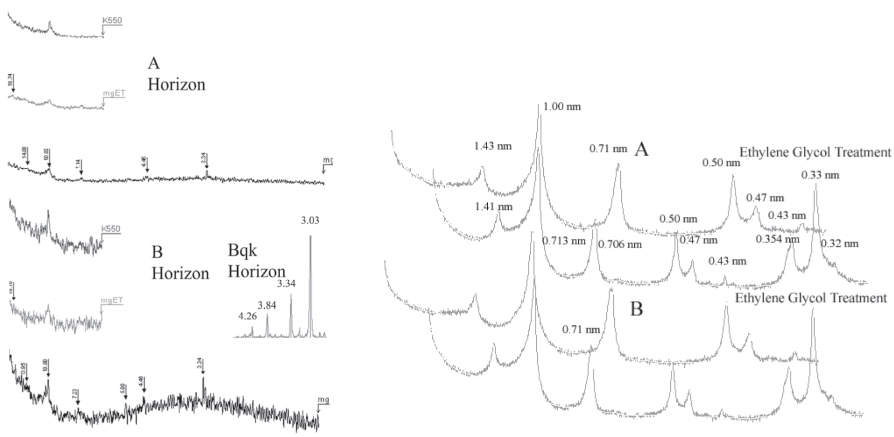

Fig. 3. Diffractograms of Mashhad clayey plain with maximum Illite(87%) and a low component of smectite, chlorite and kaolinite(right) and from Yazd clayey plain(left) with high amorphous silicates and with features of secondary carbonates and silica in B_{qk}.

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Acidity forms of selected soils of the Northern part of Yamal region

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Introduction

Polar soils play a key role in polar biome functioning and evolution. They affect polar terrestrial landscapes geochemistry and regulate processes of contaminants absorption in terrestrial environment **[5]**. Soil cation exchange capacity depends strongly from soil acidity because soils are the buffer systems. Unfortunately, pedological diversity of the Polar Regions is still poorly studied. An actual material is insufficient, poorly generalized. Polar ecosystems are very vulnerable and geochemical response of the polar soils in current science is underestimated.

Until recently, the soil cover, soil diversity and basic soil chemistry of the polar regions was considered not in deep details. Soil cover of the polar region has been investigated dominantly in trend of bioclimatic peculiarities interpretation, while the lithological aspect has not been took into account during the soil chemical and physical data processing **[1]**.

There are a lot of key questions in the study soils of the polar regions: soil diversity, soil evolution, soil geography and interpretation of soil properties via the prism of bioclimatogenic or geogenic approaches.

That is why aim of current study is to estimate the variance of soil acidity forms through different combinations of bioclimatic and geogenic local conditions of Northern part of Western Siberia on example Yamal region.

Materials and methods

In order to characterize active soil acidity (pHH20) and its potential forms (pHKCl and titrated forms of hydrolytic acidity) more than 120 individual samples from Yamal and Gydan Peninsula, Beliy Island have been investigated (fig. 1).

This study was concentrated on investigation of soils of the northern part of the Yamal region (North-west Siberia, Russian Federation) on examples of the landscapes of the Gydan peninsula. The examples were collected during the complex "Yamal-Arctica-2013" expedition in August-October 2013. The soils of the Yamal region are not very well investigated. Few studies on soil morphology and geography have shown that soil cover of this region is quite diverse and is expressed by at least four soil zones (deserts, barrens, tundras and forested tundras) [2,4]. The soils of the Yamal and Gydan peninsulas are represented mainly by Gleyic and Cryogenic soils with low levels of chemical and biological pollution [3].

The soils of the Yamal region are represented mainly by Cryosols, Gleysols, Histosols and some Al-Fe humus soils (Podzols) in the case of sandy textured grounds, e.g. on Belyi Island (Tomashunas and Abakumov. 2014). The principal areas of investigation were situated mainly on the Gydan peninsula (Fig. 1).

Fig. 1. Investigated sites of the Gydan peninsula. 1 – Haranasale cape, 2 – Yavay cape, 3 – Mamont cape, 4 – Enisey gulf, 5 – Beliy Island

Results and Discussion

Data obtained shows that about 65 % of samples are characterized by acid (pH = 4,5-5,5) or slightly acid (pH = 5,5-6,5) values of active acidity (table. 1). These soils are located mostly in areas adjacent to the coasts. About 20 % of samples shows the slightly alkaline (pH=7,0 – 7,5) or alkaline (pH=7,5-8,5) values of active proton reaction. This is usually the lower part of the profile or humus horizons or a part of buried humus horizons, which are located also in areas adjacent to the coasts. Finally, about 10 % of samples shows neutral (pH = 6,5-7,0) values of active proton reaction. These soils are situated mostly in a local watersheds and other types of drained relief elements.

Also data obtained shows that about 50 % of samples are characterized by strongly acid (pH < 4,5) values of potential acidity. About 25 % of samples shows the acid (pH = 4,5-5,0) or slightly acid (pH = 5,0 – 5,5) values of potential acidity. And about 25 % of samples are characterized by almost neutral (pH = 5,5 – 6,0) values of potential acidity.

Table 1. Examples of soil acidity values distribution download the soil profiles

Depth, sm	pH in water	pH in salt	Exchangeable acidity, cMolp+/kg	Hydrolytical acidity, cMolp+/kg
		Yavay Cape, Histic Gleysol		
0-5	5,80	5,09	0,50	0,70
5-10	6,32	5,32	0,10	0,20
7-12	6,06	5,55	0,10	0,30
15-30	7,52	Not det	0,10	0,20
30-40	6,92	5,55	0,10	0,15
50-65	6,57	6,1	0,10	0,30
65-70	7,80	6,81	0,20	0,30
		Mamont Cape, Histic Gleysol		
0-1	5,50	4,95	1,00	1,00
1-17	5,70	4,25	1,00	2,00
1-20	6,41	4,55	0,15	0,25
20-45	5,70	4,8	0,20	0,30
45-50	6,31	5,47	0,10	0,10
50-55	6,90	6,19	0,15	0,15
		Haranasale cape, Entic Podzol		
0-1	6,27	3,87	1,00	0,70
1-10	4,56	3,71	0,50	0,50
11-30	6,86	4,38	0,30	0,50
30-50	5,11	4,43	0,10	0,10
50-80	6,6	5,85	0,15	0,20
80-110	5,39	5,01	0,10	0,20
110-130	7,91	Not det	0,15	0,30
136-140	8,3	Not det	0,10	0,10
		Enisey gulf, Gleysol		
0-5	6,3	5,87	2,00	3,00
5-18	6,79	5,74	0,10	0,25
30-40	6,99	5,95	0,20	0,80
40-50	6,12	5,63	1,00	2,00
50-70	5,21	4,33	2,00	2,00
		Beliy Island, Cryic Podzol		
0-5	5,94	4,71	0,05	0,10
5-7	6,72	5,95	0,10	0,20
7-20	4,62	3,83	1,00	0,80
20-47	5,9	5,11	0,30	0,30
47-80	7,18	Not det	0,10	0,50

Conclusions

Data obtained shows that acid soils prevail on the neutral ones in case of Yamal region. On the base of these data it can be conclude that there is a trend of predominance of acid values of active acidity and strongly acid values of potential acidity in comparison with other group of values. The prevalence of acid reaction of soil solution indicates a low content of exchangeable bases, existing in soils. The most acid reaction of soils is observed mostly in the lowlands, where the soils have a Histic horizons. In the soils with a buried humus horizons vertical distribution of the acidity values is more complicated. Samples from the buried humus horizons usually have a more neutral acidity than the samples of surrounding (underlying and overlying) horizons.

Acknowledgments

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Carbon dioxide emission and respiration activity of microbial community of Chernozems typical under anthropogenic transformation of terrestrial ecosystems

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Key words: soil, greenhouse gas, land-use management, microbial biomass, microbial respiration, fungi / bacteria ratio

The soil CO_2 emission is provided by soil microorganisms and plant roots. Anthropogenic transformation of terrestrial ecosystems impacts significantly on these components by changing the biomass (and quality) roots and soil microorganisms functioning (abundance and respiration activity). Our research was focused on finding a relationship between the total soil CO_2 emission and the functioning parameters of soil microbial community along a gradient of ecosystems disturbance, this is urgently needed to assess the carbon balance (especially at the local level) and prediction of environmental changes.

Materials and methods

The typical Chernozems (Kursk region, Russia: 51°33′50″-51°39′40″ N / 36°04′58″-36°07′41″ E) of native (virgin steppe, oak forest) and anthropogenic transformed (bare fallow, industrial zone of Kursk, the factory "Kurskrezinotechnika") ecosystems were studied. Steppe, forest and fallow were located in CCSBNR area. Five spatially distant points of each ecosystem were selected on a flat plot (20×20 m). The total soil CO_2 emission (ground vegetation cut) was measured (6-8 May 2015) with LI-820 in these points (20 total) and expressed as g CO_2 m^{-2} d^{-1}. The contribution of microbial component to soil total CO_2 emission of the steppe, forest and city (in 2 points from 5) was determined by the substrate-induced respiration (SIR) method [6, 7]. In each of these points four "collar-base" were set into soil (7.5 cm depth), two of which were undisturbed soil (with roots), and another two were disturbed (the roots removed by sieving, mesh 3 mm). Water or glucose solution was added into soils. The liquid volume was 0.6, 0.9 and 1.0 L for forest, steppe and city, respectively, the glucose concentration was 5 mg g^{-1} soil, after the glucose addition time waiting was 4 h (found in preliminary experiments). The contribution of microbial respiration (MR) to total soil CO_2 emission was calculated. Soil samples (upper 10 cm mineral layer) were taken for measurement of microbial biomass carbon (C_{mic}) by the SIR method and basal respiration (BR) rate [1, 3]. The fungi / bacteria ratio of soil steppe and city was determined by selective inhibition technique with antibiotics: streptomycin sulfate and cycloheximide [2, 5]. The C_{mic} content, BR rate and fungi / bacteria ratio were measured in pre-incubated soil (22°C, 55% WHC, 7 d).

Results and Discussion

The highest CO_2 emission was found for steppe, and the lowest was for fallow (7 times the difference), for forest and city it was about the same (Table 1). The high C_{mic} and BR were found in native ecosystems, the low ones in anthropogenic transformed. However, the qCO_2 values of steppe, forest and fallow were 2-3 times less than that of city, which might be illustrated less "optimal" functioning of soil microbial community under disturbance [4].

Table 1. **Soil CO_2 emission, temperature (T) and soil water content (W), soil microbial biomass carbon (C_{mic}), basal respiration (BR) rate and specific respiration of microbial biomass (qCO_2, µg C-CO_2 mg^{-1} C_{mic} h^{-1}) of typical Chernozems in different ecosystems (May 2015, Kursk region). Values with different letters were significantly ($p \leq 0.05$) differed for each parameter separately**

E [a]	A [b], yrs	Emission, g CO_2 m^{-2} d^{-1}	Soil (0-10 cm), mean ± sd, n = 5				
			T, ºC	W, %	C_{mic} µg C g^{-1} soil	BR, µg C-CO_2 g^{-1} soil h^{-1}	qCO_2= BR / C_{mic}
Steppe	74	23.22±3.36 ***a***	11.4	27.0	1710 ± 370 ***a***	1.01 ± 0.17 ***a***	0.60 ± 0.10 ***a***
Forest	80	12.14±9.33 ***b***	9.3	36.0	1580 ± 451 ***a***	0.92 ± 0.11 ***a***	0.62 ± 0.21 ***a***
Fallow	62	3.29±1.14 ***b***	14.5	20.2	372 ± 130 ***b***	0.28 ± 0.10 ***b***	0.76 ± 0.21 ***a***
City	68	15.68±2.59 ***ab***	12.6	27.3	284 ± 101 ***b***	0.48 ± 0.15 ***b***	1.72 ± 0.26 ***b***

[a] E, ecosystem; [b] A, age

The MR values of different Chernozems ecosystems were ranged from 4.78 to 11.28 g CO_2 m^{-2} d^{-1}, and its portion to total CO_2 emission made up from 27 to 91% (Fig. 1). The high contribution of MR was found in the forest (average 71%), the low was in steppe and city (average 48 and 52%, respectively). Moreover, the most difference of MR between the points was found in forest and city. So, the point 5 of forest was coved by rare bushes (few roots), and the point 3 was with thick brush (many roots). The point 1 of industrial city zone was coved by thick grass and had a soddy layer (low MR), and the point 5 was practically without grass cover (high MR).

The positive correlation relationship was found between total soil CO_2 emission and C_{mic} and BR values (r = 0.53 and 0.64, respectively, $p \leq 0.05$), but this was insignificant for soil temperature and water content (r = - 0.33 and 0.23, respectively). Between MR (*in situ*) and BR (*lab test*) was revealed the regression relationship with

satisfactory R^2, which allow us to predict the time and labor-consuming definition of studied ecosystems MR in the field condition (Fig. 2).
The assessment of fungi and bacteria portions of soil microbial biomass is connected with the highest SIR inhibition by each antibiotic and its combination, which controlled by inhibitor additivity ratio equal 100±5% [5]. In our experiments the highest SIR inhibition by antibiotics was achieved 41-51% (Table 2). The fungi portion in soil city and steppe was about the same (82-85%), wherein the fungi / bacteria ratios were approximately equal (3.4 and 3.8, respectively). However, the C_{mic} / C_{org} (indicator of soil organic matter "quality") and C_{fungi} / C_{org} ratios for city soil were 2.6 and 2.4 times less than those of steppe. It might be indicated the essential "deterioration" of soil microbial community functioning under anthropogenic impact.

Table 2. Soil organic carbon content (C_{org}), soil microbial biomass carbon (C_{mic}), C_{mic} portion of C_{mic} in C_{org}, the highest inhibition of substrate-induced respiration (SIR) by streptomycin and cycloheximide both, fungi / bacteria (F / B) and C_{fungi} / C_{org} rations in different ecosystems of typical Chernozems

Ecosystem	C_{org}, %	pH_w	C_{mic}, µg C g^{-1} soil	C_{mic} / C_{org}, %	F / B	Inhibition of SIR, %	C_{fungi} / C_{org}, %
Steppe	5.57	6.24	1606±130	2.9	3.8±1.2	51	2.4±0.43
City	1.71	7.97	191±32	1.1	3.4±0.1	41	1.0±0.0

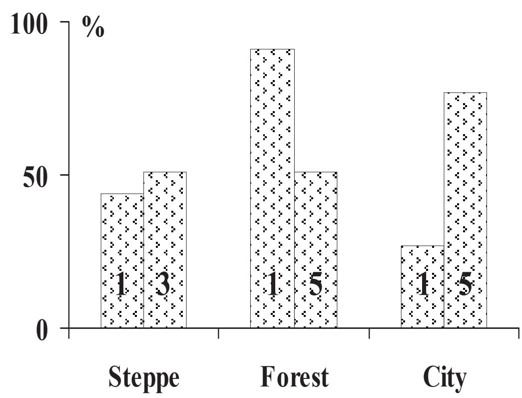

Fig. 1. Microbial respiration portion into soil total CO_2 emission of different ecosystems Chernozems (point number in column)

Conclusion

The most CO_2 emission was found virgin steppe, and the lowest one was arable land (bare fallow). Soil emission activity of the city is not "inferior" to that of native ecosystem (forest). Significant decrease of C_{mic} (4.6-6.0 fold), BR (2.1-3.6 fold) and C_{fungi} / C_{org} ratio (2.4 fold) was showed along gradient of anthropogenic disturbance (steppe, forest, fellow, city), but qCO_2 was increased, which may indicate "deterioration" of microbial community functioning of Chernozems in anthropogenic transformation ecosystems. Basal respiration is able to characterize the microbial respiration in natural condition.

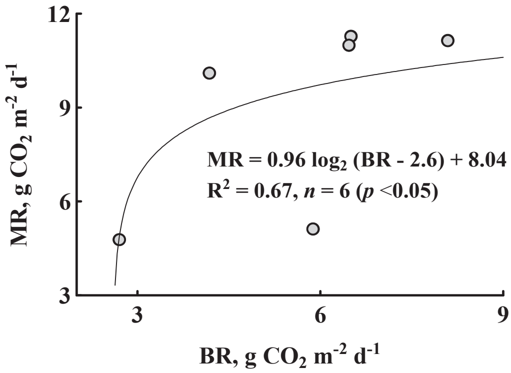

Fig. 2. Relationship between microbial (MR) and basal (BR, 0-10 cm) respirations in typical Chernozems of steppe, forest and city

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The soil aggregate stability influenced by hazelnut husk compost application: main effects of soil texture and sampling period

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Key words: Hazelnut, compost, soil, aggregate stability

Introduction

Today, environmentally friendly agricultural activities draw attention.Organic wastes are healthy inputs for agricultural soils. Organic matter affects soil chemical, physical and biological properties and its overall health. Soil properties influenced by organic matter includes such as; soil structure and aggregation, soil erodibility, moisture holding capacity, diversity and activity of soil organisms, both those that are beneficial and harmful to crop production, and nutrient availability. Also soil organic matter determines the related to soil sustainability and soil erodibility.

A soil aggregate is "a group of primary soil particles that cohere to each other more strongly than to other surrounding particles." Soil aggregates form through the combined action of aggregation and fragmentation processes. Important physical aspects of aggregates include their size, density, stability, structure, and their effect on the transport of fluids, solutes, colloids, and heat (Nimmo, 2004). Aggregate stability determinations are to give a reliable description and ranking of the behavior of soils under the effect of water, wind and management in soils. Soil organic matter status and soil aggregate stability are the key factor for assessing of soil quality related to soil quality monitoring.The temporal variability of the soil aggregate stability was shown for instance by Chan et al. (1994), and Yang and Wander (1998). Yang and Wander (1998) suggested that the higher aggregate stability was found due to crop roots, exudates microbial by-products and wet/dry cycles.

The farmers prefer environmentally friendly agriculture activities by emphasizing on the environmental and human and animal health, had to use some alternative products with organic origins that could replace agricultural inputs such as chemical fertilizers and pesticides; and had to increase the effectiveness of the products used. For this purpose, they firstly had to use compost products, which have been used for centuries to increase the level of soil organic matter (SOM). Approximately 600–650 thousand tons of hazelnuts are produced annually on 621000 ha in Turkey. At the end of the hazelnut harvest, nearly the same amount of HH residues remain as agricultural waste. Dried hazelnut husk has 93.16% organic matter content. Moreover, hazelnut husks are suitable for agricultural use in terms of their pH and salinity. In terms of nutritional elements, while nitrogen and phosphorus were inadequate as limit values, potassium and micro-elements were adequate. Husk is difficult to decompose as it has a high C/N ratio (>50/1). After mixing hazelnut husk into soil, it can take about 2 or

2.5 years for microbial processes to decompose it. Therefore, HH must be applied soil after composting to increase SOM level and nutrient availability in soil.
In this study, in order to determine the changes in the soil aggregate stability when the HHC, which is obtained through composting HH by using molecular biotechnological methods (Kızılkaya et al. 2015a,b), is applied on the hazelnut orchard soils with different textures such as; SL and CL and at increasing levels (0, 1.25, 2.5, 5.0, 7.5 and 10 ton da^{-1}). Then, WAS was investigatedin different sampling time such as; spring, summer, fall and winter.

Materials and Methods

HH (C/N ratio 55.71; pH 5.81; $EC_{25°C}$ 1.93 dSm^{-1}; 0.97% N) was collected from the hazelnut orchard as a waste material, was inoculated with this HH, C and the microorganisms used as an energy source (Kızılkaya et al., 2005a,b), was composted by windrow method and was used as a material in experimentsusing a windrow machine in the Research Facility of Soil Science and Plant Nutrition Department in OndokuzMayis University, Samsun, Turkey. HHC properties are as follows: pH is 6.76, EC 25°C is 3.56 dS m^{-1}, organic matter (OM) content is 94.75%, total N content is 2.48%, and C/N ratio is 22.16. Field experiments were conducted in two different hazelnut orchard with different textures (sandy loam - sand% 76.14, silt% 9.62, clay% 14.24, pH 6.23, $EC_{25°C}$ 0.04 dSm^{-1}, SOM 1.41%- and clayey loam - sand% 33.55, silt% 27.86, clay% 38.53, pH 6.69, EC $_{25°C}$ 1.43 dSm^{-1}, SOM 2.58%-) soil located in Ordu at the Black Sea Region of Turkey.Experiments conducted in hazelnut orchards with SL and CL textured soils in November 2012, were based on with randomized complete block design.HHC was incorporated into the top 20 cm of the soil around the plant canopy without mixing any other material using a hoe in six application doses with three replication.Total experiment consisted of 36 parcels in order to increase the content of SOM by 0, 0.5% (1.25 ton da^{-1}), 1% (2.5 ton da^{-1}), 2% (5 ton da^{-1}), 3% (7.5 ton da^{-1}) and 4% (10 ton da^{-1}). Soil samplings were done at the end of the March, June, September and December 2013)to determine soil aggregate stability. In statistical analysis, MINITAB Statistic 17.0 program was used.

Results and Discussion

Soil aggregate stabilitydid not significantly affectedby the HHCtreatments in hazelnut orchards. Although the aggregate stability was not affected by the dose increasing of HHC, was effected by soil texture, sampling time and their interactions(Table 1 and Fig. 1).
It was found out that due to the increases in the dose of HHC applied on soils with different textures, the soil aggregate stability increased. HHC treatments showed no significant relationships with the soil aggregate stability according to the control.The highest aggregate stability was measured in clay loam textured soil. The change HHC application caused on the soil aggregate stability was found to be more distinct in clay loam soil(Table 1, Fig. 1).
The highest aggregate stability was measured at the end of June while the lowest was at the end of September which is the nearly same with winter sampling time (31 December 2013 in sampling time). There were significant differences on aggregate stability (as mean values). Our results were the compatiblewith the other researcher's

findings.Veronica et al., informed that soil aggregate stability depends on stage of the root zone development, soil management and climatic conditions.The highest aggregate stability was measured at the end of April in the years 2007 and 2008 in HaplicLuvisol and GreyicPhaeozem, and at the end of June in the year 2007 and at the beginning of June in 2008 in HaplicCambisol (Veronica et al., 2010).Dimoyiannis (2009) reported under typical Mediterranean climatic conditions, WAS of air-dried aggregates appreciably varies seasonally according to a nearly cyclic pattern, being in general lowest in winter and highest in summer.Eventually, it was concluded that the most convenient level of HHC to be added into the soils is 5 ton da^{-1}, considering the aggregate stability in the soils and consequently the management principles of the organic substances added into the soils.

Table 1. ANOVA for soil aggregate stability values (*n=144*).

Source	DF	Seq SS	Adj SS	Adj MS	F-Value	P-Value
Soils	1	5215,2	5215,2	5215,25	198,53	0,000
HHC Doses	5	142,1	142,1	28,43	1,08	0,375
Sampling time	3	11819,9	11819,9	3939,97	149,98	0,000
Soils x HHC Doses	5	358,7	358,7	71,73	2,73	0,024
Soils x Sampling Time	3	2156,7	2156,7	718,92	27,37	0,000
HHC Doses x Sampling time	15	1262,7	1262,7	84,18	3,20	0,000
Soils x HHC Doses x Sampling Time	15	715,7	715,7	47,72	1,82	0,043
Error	96	2521,9	2521,9	26,27		
Total	143	24193,0				

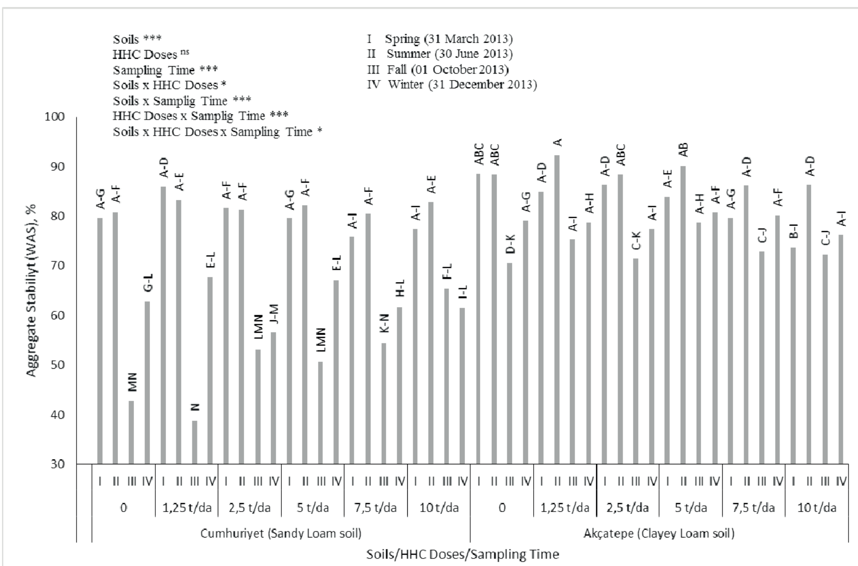

Fig. 1. Effects of soil texture, HHC application and sampling time on the WAS. (ns: non significant; *: p<0,05; **: p<0,01; ***: p<0,00; Means that do not share a letter are significantlydifferent at p<0,05).

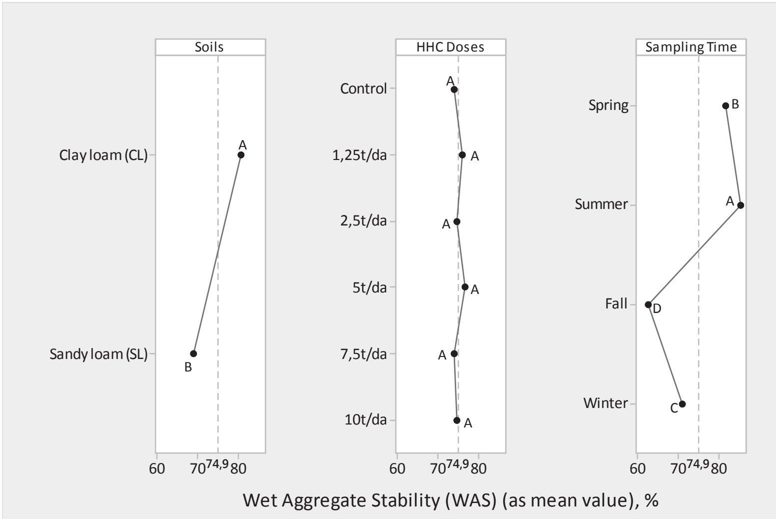

Fig. 2. Main effects plot of soil texture, HHC doses and sampling time on the WAS. (Means that do not share a letter are significantly different at p<0.05).

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Development of standard Russian and Kazakhstan scenarios of mathematical models of pesticide behaviour in soils

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Keywords: Pesticides; Groundwater; Soil; Risk-assessment; PEARL;

Introduction

Mathematical modeling is an efficient technique to predict pesticide behavior in soil, air and groundwater. The main advantages of mathematical modeling include efficiency, time saving and ability to cover a large variety of pesticides application in natural conditions. Mathematical models enable the prediction of pesticides concentrations in soils and groundwater. This data is used the risk assessment of pesticides negative impact to the soil organisms, and contamination of drinking water sources.

The models and standard scenarios have become common in use with pesticides registration in EU [1]. In Russia, mathematical modeling as a tool to assess the pesticides concentration in the environmental objects has been used since 2007, when according to the Ministry of Agriculture order № 357, the form “Data on Pesticide” was approved for pesticide registration in the Russian Federation. Currently, the pesticides behavior predicting based on the PEARL model designed in the EU as well as the standard Russian scenarios [2] are a part of a multilevel risk assessment of the pesticides, being registered in Russia.

Taking into account the Euroasian Economic Union (EAEU) foundation and the unification of the
ways of estimating the risks of the pollution of soil and groundwater with registered pesticides in the EAEU, the present research is aimed to: 1) adding on the list of Russian standards data-input scenarios three scenarios of the Kazakhstan Republic; 2) illustrating of PEARL model and standard scenarios operation with predicting concentrations of the 4 test-compounds in the run-off the soils from 12 regions; 3) defining the EAEU regions, most vulnerable to pesticide contamination of the groundwater.

Materials and methods

PEARL model

PEARL mathematical model is the most popular and widely used tool in the EU [3, 4] and the Russian Federation [5] to predict pesticide behavior in soils and groundwater. The short description of the model represented in table 1-2.

Pesticides – hypothetical test-substances

PEARL model and standard scenarios have been tested at 4 pesticides – hypothetically active substances which had been initially proposed for this aim in the EU [1].

Application scheme of test substances
A, B, C and D substances are supposed to have been used to process the bare soil (the worst case scenario) annually on the 1 of June for 20 years with the application rate – 1 kg a.s./ha.
Output data of prediction
The operation of PEARL model and standard scenarios of the EAEU regions are illustrated with the prediction of pesticide concentrations in water flux in the 1 meter deep run-off (a 90th percentile of this values).

Table 1

Input files for PEARL

Pesticide	Coefficient of equilibrium sorption on organic matter - K_{om} (l/kg); half-life in equilibrium domain at reference temperature - DT_{50} (d); saturated vapor pressure at reference temperature (Pa); solubility in water at reference temperature (kg/l); application rate (kg a.s./ha); application methods
Data of the standard scenarios	
Soil	The mass content of organic matter (kg/kg), the dry bulk density (kg/m^3), pH, the textural distribution, parameters of the Van Genuchten functions.
Weather data	File with weather: minimum and maximum air temperature, precipitation, solar radiation, wind speed, vapor pressure.
Crop properties	Crop parameters describing pesticide interception by the crop canopy

Table 2

Output files for PEARL

Water balance	Flux of water in run-off (mm), soil evaporation (mm).
Pesticide	Concentration in the soil system (μg/kg); total pesticide mass flux and accumulated mass flux at the lower boundary; substance concentrations in the liquid and solid phase; mass flux of pesticide volatilization through the soil surface

Results and Discussion

Standard input data scenarios
A standard scenario should be understood as a data complex of soil, climate and agronomic characteristics of agricultural region which represent mathematical model's input data. The PEARL model standard scenarios of nine agricultural regions of the Russian Federation had been developed before and realized as input files weather data for 20 years (1986-2005) and of the typical soils properties of these regions. Now they have been added with the standard scenarios of three regions of the Kazakhstan Republic (table 3)
The model PEARL standard scenarios are recommended for the EAEU countries to predict the pesticide concentrations in soils and ground water, as well as at the following assessment of these pesticides risks for the non-target organisms.

Prediction of the test-substance concentration in the soil percolate

The results of the prediction of the maximum-possible values (90th percentile) of the average annual percolation and leaching pesticide concentrations of A, B, C and D test-substances in the 1-meter deep soil run-off (table 4).

As assumed, the maximum concentrations of substance in run-off are predicted for the most stable (A) and mobile (B) substances, while the minimum concentrations – for the substance with the highest coefficient of equilibrium sorption value (C). D substance takes an intermediate position.

Table 3

Characteristics of the selected EAEU scenarios

Location	Annual average temperature (^oC)	Annual average precipitation (mm)	Texture class (USDA) 0-25 cm	Organic matter (%) 0-25 cm
Russia [5,6]				
Moscow	3,6	548	Silty loam	1,5
Kursk	5,0	571	Silty loam	4,4
Saratov	5,2	467	Silty loam	2,0
Krasnodar	10,8	643	Silty-clayed loam	2,5
Novosibirsk	0,3	442	Medium-textured loam	3,0
Vladivostok	2,8	634	Silty loam	1,5
Pscov	6,0	697	Loamy sand	0,2
Nizhy Novgorod	4,9	658	Loamy sand	1,1
Kurgan	3,0	400	Light loam	4,1
Kazakhstan [7,8]				
Kastanay	3,3	389	Clay-silty loam	3,2
Ust-Kamenogorsk	2,0	451	Sandy loam	2,0
Almaty	9,3	557	Silty loam	2,2

The most vulnerable to pesticides getting into groundwater regions in Russia are Moscow region, Nizhny Novgorod region, Pscov region and Vladivostok where heavy precipitation along with low average annual temperatures preventing pesticides degradation. These same regions are known to have low content of humus in the soils which doesn't promote keeping pesticides in their upper layers. In the Kazakhstan Republic the probability of pesticides percolation into ground water is normally lower than in Russia. The only exception is Ust-Kamenogorsk region, where the stable A substance's migration is promoted by a lighter texture class of soil and the low average annual temperature.

Table 4

Percolation and pesticide leaching concentrations for the selected Russian and Kazakhstan scenarios

Location	Percolation, mm	Pesticide concentration, µg/l			
		A	B	C	D
Moscow	485	53,040	26,378	0,447	10,105
Kursk	396	0,006	0,287	0,000	0,000
Saratov	242	0,000	0,058	0,000	0,000
Krasnodar	566	0,607	1,415	0,000	0,007
Novosibirsk	267	4,678	9,096	0,000	0,107
Vladivostok	586	30,184	29,791	0,079	5,429
Pscov	465	26,890	19,845	0,030	3,116
Nizhy Novgorod	491	50,430	21,990	1,320	9,190
Kurgan	165	0,000	0,008	0,000	0,000
Kastanay	136	0,247	2,341	0,000	0,000
Ust-Kamenogorsk	193	20,384	28,874	0,000	1,478
Almaty	247	1,264	1,608	0,000	0,017

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Morphological and diagnostic characteristic of the genetic horizons of grey-brown soils located in the sphere of influence of cement and superphosphate plants

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Key words: genetic horizons, contaminated and cultivated soil.

Introduction

The intensive development of various industries reflecting the economic progress while at the same time manifested in an increasing pressure on the environment techno genic waste of various etiologies, leading to significant degradation of natural resources.

Cross-cutting human activities fundamentally change not only the geochemical pattern, but also qualitatively converts ecological relationship between the individual components of the environment that naturally appears on many vital processes in the ecosystem.

Influence of technological waste on the environment manifests itself most noticeably in the industrialized countries. As a result of entering of industrial waste in the ecosphere there is a reduction of areas under crops and animal species diversity, degrade soil and vegetation, polluted bodies of water and air quality change of ecological and morphological characteristics of different soil types, violated the established evolutionary relationship between biotic and abiotic factors of natural and cultivated biogeocenosis. Research on these fundamental issues related to the changes of morphological traits of genetic soil horizons under the influence of techno genic products, is essential and a priority for Azerbaijan.

It is paid much attention to the problem of anthropogenic soil degradation and ecological communities in different geographical areas, both from the point of view of studying their morphogenetic features based on environmental monitoring, and to develop various methods of resuscitation technogenic-polluted landscapes. The study of physical and chemical, biological, cartographic issues of anthropogenically altered, as well as technologically-contaminated soil were carried out in Azerbaijan [10; 6; 12; 13].

However, in the study of characteristic changes of natural and cultivated gray-brown soils of Absheron peninsula, as well as their classification especially relevant not only legislative and legal, but also basic research, the search for optimal methods of recovery and reclamation [2; 9; 3]. Considering that the issues of diagnosis and classification of man-caused contaminated soils, as well as identifying characteristic changes in the morphological characters under the influence of technogenic products require a more in-depth and comprehensive study, we conducted a comprehensive and

comparative study of the influence of man-made waste cement and superphosphate plant morphological characteristics of genetic horizons gray brown soil natural and cultivated cenoses.
As can be seen from the above, the main criteria of selection of classification units is diagnostic genetic horizons, characterized by its specific quality, morphological, physical and chemical biological indicators.
Therefore, issues related to the diagnosis and classification of soils should have a modern orientation, including all aspects of natural evolutionary and anthropogenically altered indicators of soil, use of which is necessary for a proper understanding of the complex process of soil formation at various stages of its development.
The main purpose of this article is to compare the morphological characteristics of the genetic profile of a gray-brown soils of natural and cultivated cenoses located in the influence of cement and superphosphate plants. Considering that the Absheron peninsula in comparison with other regions of the country most heavily exposed to anthropogenic (man-made) load, to study the influence of man-made waste of various etiologies to change morpho-diagnostic features gray-brown soils on the example of cement (Garadagh array) and superphosphate (Sumgait array) plants is an urgent problem that has scientific and practical significance.

Matherials and methods

In Garadagh array objects of study were virgin soil, located in the sphere of influence (200 km) cement plant (Garadagh settlement) and cultivated (over 40 years) soil orchard (Sangachal settlement). In Sumgait array similar to the previous virgin soils were selected, located 200 meters from the superphosphate plant (Sumgait) and cultivated soils under irrigated cereals (Z. Tagiyev settlement).
On each of the arrays experimental model-specific key fields were chosen where soil profiles were laid to a depth of 1 m and then, a comparative morphological description of genetic horizons, technogenic-polluted and cultivated gray-brown soils.

Results and discussion

Garadagh array.
Area 3, the cut 5 - virgin, soil salinity, located in the area of influence of a cement plant (pos. Garadagh) - includes the following genetic horizons. The landscape of semi-desert.

Genetic horizons
AY_V 0-5 sm - Pickled horizon with easy grading
AY'_a 5-12 sm - Light gray, the structure is weak, sometimes porous, pickled horizon enriched root residues
$AB_{S,CH}$ 20-30 sm - It differs from the upper horizon darker color, particle size distribution of heavy

$BC_{S,CS}$ 30-50 sm - Clearly expressed carbonate spots, salt crystals, root remnants, gradual transition

$C_{CS,S}$ 50-100 sm – Clay, diluvial origin, marine sediments

Area 4, the incision 7 – The Sangachal settlement. Cultivated irrigated gray-brown soil - orchard. Mastered since 1951. Irrigated by Kura river water

Genetic horizons

AY'_V 0-5 sm - Structured horizon, porous, enriched with root residues. Gradual transition.

$AY_{a,z}$ 5-12 sm - Color dark gray, structured, abound earthworms horizon enriched coprolites porous.

$AY''_{a,z}$ 12-20 sm - An analogue of the upper horizon, much domesticated.

AB_a 20-30 sm – Gray color, structured, plant residues, individual spots salts and remnants of stones are marked. Sharp transition.

B 30-50 sm - Loess, carbonate, illuvial origin of the parent material.

C 50-100 sm - Loess, carbonate, illuvial origin of the parent material.

Sumgait array

Area 2, slit 3 - Located in the sphere of influence of superphosphate plant. The soil is gray-brown virgin under sparse natural vegetation.

Genetic horizons

AY'_V 0-5 sm - Weak sod layer, gray color

AY' 5-12 sm - Humus-accumulation layer, dense, rough structure, there are the remains of the root, gradual transition

AY'' 12-20 sm – Gray color, whitish carbonate spots, crop residues. The structure is rough, gradual transition.

AB_c 20-30 sm - Whitish-gray color, with large carbonate spots, cloddy structure, prismatic, root remnants, gradual transition observed

B_S 30-50 sm - An increase in the accumulation of calcareous stains and salt is marked, root residues

$C_{S,CS}$ 50-100 sm - Loess, carbonate, talus, sandy loams of marine origin

Area 1, the incision 2 - Irrigated gray-brown soil under cereals (pos. Z. Tagiyev)

Genetic horizons:

AY_V 0-5 sm – Aggregated horizon, root residues marked

$AY'_{a,z}$ 5-12 sm - The top layer of humus, finely cloddy structure, observed root crop residues.

$AY_{a,c}$ 12-20 sm - Plant (roots) residues are observed, porous, structured, gradually transformes into the illuvial horizon B.

$AB_{m,cs}$ 20-30 sm – Gray color, there are plant residues, some carbonate, gradual transition.

$B_{c,s,s}$ 30-50 sm - There are signs of accumulation of carbonate and salt crystals, down the profile carbonates increases.

$BC_{c,s,s}$ 50-100 sm - Carbonate-loess soil-forming rock.

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The preparation of the classification of Azerbaijan soils according to the World Reference Base for Soil Resources

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Introduction

The soil classification problem was always distinguished by its urgency, and was a subject of the most serious scientific discussion and investigation in all the development stages of soil science [1,2, 9]. Lately, the soil classifications of the Russia (also European countries next to it) and America soil science schools are used [3,7,10,11]. In the middles of the last century amount of soil maps (world, country) composed on the basis of the national soil classifications in the World soil science over the different countries existed. In this connection idea of the World common soil map composition necessity appeared. Composition of the international soil classification was a very important question for it. Generally, the Russian soil scientists I.R. Gerasimov and E.N.Ivanova (1958) separated three directions in the soil classification; Soviet (Russian), West European, American soil classification. This difference prevented the international integration process. Therefore, there was a need for an establishment of the single international soil classification system in the world scale. It is possible to calculate a beginning date for such international soil classification setting since 1970. At the same period professor R. Dudal put forward an idea to use from the Soil Map of the World (FAO/UNESCO) legend as a ground of reference base over the World Soils. In this area the practical works were started from 1974. Afterwards establishing of the International Reference Base for Soil Classification (IRB) and continuing works in the direction soils grouping on the basis of the Soil Map of the World (FAO/ UNESCO, 1971-1981) were decided in the world leading soil scientists’ meetings, together with the UNEP (United Nations environment program) and International Soil Scientists’ Society in 1980-1981. The Soil Scientists’ International Congress (1982) held in India supported this initiative and received a special program in connection with this problem. At the same time Congress a working group was established. Junction of the working group’s action was decided over FAO World Soil Map composition by a commission on the the International Reference Base for Soil Classification (IRB) in XIV Congress (France, 1992). Such junction of the programs got a name of “World Referative Base” and was continued to set on the basis of the FAO Soil Map Legend by turning into IRB official legatee. Afterwards, a name of the project was changed “The World Reference Base”. It was widely used as a short form “World Refence Base for Soil Recourses” and correspondingly WRB abbreviature. The WRB first official theme was presented in the International Soil Scientists' Society Congress of Montpelier (France, 1998). The International Soil Scientists' Society presented WRB terminology for soil classification and names in 1998. At the same time is was decided that a change in this system will be passed through approbation, the necessary correctives will be discussed in the next Congress which that was intended in 2006. A new version that was formed as WRB soil scientists' international language was presented for XVII Congress of the International Soil Scientists' Society held in Philadelphia in 2006. Beginning from 1998 all the Europe countries began to correspond their reference bases to WRB version according, to the decision of Europe Unite. The Azerbaijan Soil Scientists also performed researches in a direction of the correlation with the national classification of WRB version in 1998 and published the scientific research consequences in a form of monograph called "Correlation of Azerbaijan Soil classification with the WRB system" (2002, Mammadov G., Babayev M., Ismayilov A.) according to the International Soil Scientists' Society rules. Though most of the countries passed to 1998 version of WRB according to the official recommend of the International Soil Scientists' Society but in Azerbaijan the new investigations weren't conducted in this direction and transition to this version wasn't provided. Although the 2006-version application was late in Azerbaijan, in 2004 the "International Soil Classification System" was offered for composing of the soil map legend and soil names by FAO Working Group. This new version is called "World Reference Base for Soil Resources (WRB)". As is shown Azerbaijan Soil Science was late in solution of this problem that is very actual on scientific and practical side. The international integration of the Azerbaijan soil science isn't possible without fulfillment of these works. The project scientific and practical essence consists of Azerbaijan soil classification suggestion which will be in an international scale, establishment of correlation for the WRB system by developing national soil classification. From this point of view, using of urgency of the soil classification according to the WRB system for soil resources" in Azerbaijan and performing of the corresponding scientific researches don't raise doubts.

Results and discussion

A main scientific idea of the scientific work consists of the modern soil classification fulfillment correlated with this system and meeting the requirements of WRB system for provision in raising of Azerbaijan soil scientists to an international level.

At present 1998-version of WRB using in Azerbaijan got renewed in 2006 and WRB 2006-version is already used in the whole world. Fulfillment of the Azerbaijan Soil Classification preparation is intended according to the WRB- new version.

The following work plan is intended for the scientific work fulfillment.

1. 1998-and 2006 of WRB versions classification structure will be analyzed.
2. Azerbaijan soil classification will be equipped.
3. The soil section descriptions according to the WRB 2014 year version standards will be established, for this purpose the field and cameral works will be fulfilled.
4. The diagnostic parameters will be defined in a type level of Azerbaijan soils and will be composed according to the WRB standards. With this purpose:

a) The field researches over the soil climatic zones will be performed;
b) A disruption of the standard soil types will be prepared in a format of the modern standards under the field and cameral conditions;
c) The necessary laboratorial analyses will be conducted to specify the soil morphogenetic parameters;

Conclusion

The Azerbaijan specialists working in the fields of soil science, ecology, agronomy will obtain a chance to use of the WRB system conveniently for scientific investigations with an international level.

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Effect of macro (NPK) and micro (B, MN) elements on crops of the beet-sugar root-crops growing under bogharic conditions in the little Caucasus from the Azerbaijan republic

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Key words: beet-sugar, mountainous leaching chernozems, mineral fertilizer, macro fertilizer, optimal norms

Introduction

A very important and actual problem as increasing of the productivity in technical plants, including the beet-sugar plant and improving of the crop quality stands before the agricultural specialists in the Azerbaijan Republic at present. The sugar-beet is one of the valuable agricultural plants in the world agriculture. This plant has a very important significance in increase of the cattle-breeding's fodder base and in the food industry. The sacchariness in its root-fruits reaches 15-20 %, it doesn't allow to produce sugar from this. Under the present market economy one of the tasks standing before is to compensate the population's need for sugar at the expense of the local production. [1, 2]

At present there is a definite experiment in growing of the beet-sugar and sugar producing. Besides, the specialists' scientific investigations and researches prove that we can provide our population with the sugar at the expense of our production. But we can achieve this problem solution as a result of fulfillment of agrotechnical, agrochemical and technological measures based on scientifical side. Our research works were dedicated to such important and actual problem solution.

Materials and Methods

An experiment over the following scheme was put in 4 secondaries, 8 versions with the "Romanskaya-06" beet-sugar sort in the leached mountain-black soils of Azerbaijan under unirrigated condition in order to determine an influence of macro (NPK) and micro (B, Mn) fertilizers on beet-sugar plant productivity and quality: 1. Control (unfertilizer); 2. N60P90K60; 3. N90P120K90; 4. N120P150K120; 5. N90P120K90 + B 3,0; 6. N90P120K90 + B 6,0; 7. N90P120K90 + Mn 1,5; 8. N90P120K90 + Mn 3,0. A nourishment area was 60x25 cm. Each section area over the separate versions was 100 m^2, a tillage norm of the seed per hectare was 6,7 kg. The tillage was performed before April (in the 1st ten-day). From macrofertilizers (NPK) 50 % of the nitrogen annual norm, 100 % of phosphorus, 50 % of potassium were applied under main tillage; 25 % of nitrogen, 25 % of potassium under harrow before the sowing, but 25 % of nitrogen, 25 % of potassium in a stage of 7-8 real leaves formation. Mixing of the micro (B, Mn) fertilizers whole annual norm with macrofertilizers, distributing into 2 (two) they were applied under harrow before sowing and interrows in a stage of 7-8 real leaves formation, into the depth of 10-12 cm of soil. In the field experiments the ammonia salt-petre (34 %) of nitrogen, simple superphosphate of phosphorus (18 %), potassium sulphate of potassium (47 %), borat acid of bor (17,5 %), manganic sulphate of mangan (20 %) forms are used. A mathematical calculation of the crop account was performed by A.M.Mesheryakov's [4] method. Sugar (saccharoza) was determined by an optic metod in saccharimeter.

Results and Discussion

The scientific-research works were performed and are continuing in some countries of the world at present in order to define the optimal fertilizer norms of the beet-surgar plant under different soil-climatis condition. In these researches an influence of the fertilizers (whole mineral fertilizers, microfertilizers, organic fertilizers) various norms and correlations on growing of the beet-sugar, development and productivity, crop quality was determined.

One of the main reasons in intensively fertilizing of the beet-sugar is its high quantity in nutrient being taken from soil by it with crop and vegetative organs. It was determined that in comparison with the other plants the beet-sugar takes 2-3 times more of nutrient from soil. A main reason of taking the nutrient from soil in very much quantity is explained that a need of this plant for nutrient is high. This plant having a long period shows a need for nutrient in a plenty number to provide the life activity nearly for 7 months. Therefore the beet-sugar growing under the different soil-climatic condition is very pretender to be fertilizered. An effect of fertilizers on root crop and its quality of the beet-sugar has been studied by some investigators [3, 5, 6, 7].

In order to get a high and quantitative product from the beet-sugar plant the most important of agrotechnical measures being applied in agriculture is fertilizing system. At this time applying of the microfertilizers in a mineral fertilizing phone is considered advisable. The applying fertilizers influenced on productivity to a different degree depending on their norms and correlations. So, the highest productivity was got under N90P120K90+B6,0 version. Though a rootfruiet crop is 231,5 cen/h on average under unfertilizing (control) version for 3 years, N90P120K90+B6,0 was applied – 383,2 cen/h, but an increase was 151,7 cen/h or 65,5 % than unfertilizing area.

The consequences show that the surface mass crop was high under the given version of N90P120K90+B6,0. So, the surface mass crop was 87,1 cen/h on average in the unfertilized area for 3 years, but under a version of N90P120K90+B6,0 it was 142,3 cen/h, an increase was 55,2 cen/h, or 63,3 % in comparison with the unfertilized area. Basing on the research result we can comment that applying of macro and microfertilizers together is very rational in comparison with applying separately.

An elevation of the correlative relation ($r=\pm0.98\pm0.02$) between the root and leave crop getting from the effect of macro and microfertilizers on beet-sugar was determined. The rationality of the fertilizers application was calculated mathematically, it was known that the crop increase got at the expense fertilizer is reliable.

Not knowing the main qualitative indications of the produced agricultural crops we can't come to a conclusion about some or other agrotechnical measure rationality. One of the factors influencing on beet-sugar crop qualitative indices a rational application of fertilizers. The fertilizers intensifies its qualitative parameters besides the crop growth.

During the researches to determine the got main crop qualitative indications an effect of fertilizers on beet-sugar saccharineness was learnt. It is obvious from the consequences that not only sacchariness but also sugar gathering quantity rises. It was determined that sacchariness was 17,6-20,3 % on average, sugar gathering was 47,08-77,78 cen/h for three years. Sacchariness was 16,0 % under unfertilizing version but sugar gathering was 37,04 cen/h. The highest sacchariness and sugar gathering was observed under a version of N90P120K90+B6,0, these indices were accordingly 20,3 % and 77,78 cen/h.

Depending on the given fertilizer norms and correlations a nutritiousness value of the beet-sugar rises. That is nutritious unit and assimilated protein quantity from a unit area rose. The highest nutritious unit and assimilated protein outlay was observed under a version of N90P120K90+B6,0. The nutritious unit was accordingly 92,2 and 27,8 cen/h, assimilated protein was 410,8 and 303,6 kq/h in the beet-sugar rootfruits growing under this version and on the surface parts. The nutritious unit increase was 41,3 cen/h or 52,4 % in comparison with the unfertilizing version.

Table 1.

An effect of fertilizers on saccharine quantity in a rootfruiet crop of the beet-sugar (from 3 years on average)

Versions	Sacchariness average, by %	Mean crop, cen/h	Sugar gathering, cen/h	Increase	
				cen/h	%
1. Control (unfertilizer)	16,0	231,5	37,04	-	-
2. N60P90K60	17,6	267,5	47,08	10,04	27,11
3. N90P120K90	18,2	314,2	57,18	20,14	54,37
4. N120P150K120	18,6	357,8	66,95	29,51	79,67
5. N90P120K90+B3.0	19,3	351,8	67,90	30,86	83,32
6. N90P120K90+B6.0	20,3	383,2	77,78	40,74	110,0
7. N90P120K90+Mn1.5	19,4	329,5	63,92	26,88	72,57
8. N90P120K90+Mn3.0	19,6	345,2	67,66	30,62	82,67

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Influence of mineral fertilizers on the potato crops, quality and guarding

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Key words: a potato, mineral fertilizers, crop, starch, nitrate

Introduction

The measures over the improvement of the population’s needs satisfaction for the fruit-vegetable product generally and potato particularly are commented the main directions of the economical and social development in the Azerbaijan Republic.

A potato – one of the important agricultural plants in the many-sided utilization. First of all, this valuable food product which is correctly called “the second bread”. Its nutrious valuation is determined by an optimal correlation with the organic and mineral substances, necessary for human.

Among the agrotechnical methods, providing of high and stable productivity of the potato, an application of the mineral fertilizers extremely occupy an important place. It is enough to say that the potato quality is also improved besides the increase of productivity at an application of the mineral fertilizers [1].

Materials and Methods

The field experiments over the study of the mineral fertilizers effect on nutrient enleaching and soil fertility level optimization under the potato plant were put in the leaching mountain chernozems under bogharic conditions in Azerbaijan.

For the purpose of investigation of the mineral fertilizers balanced norms effect on the potato crop and qualitative indices in the leached mountain chernozems of Azerbaijan the field experiments in 4-sided secondories with the potato sort of “Lorkh” were put. An experiment scheme was included in the following version: 1. Control-unfertilizer. 2. N60P60K60. 3. N90P60K60. 4. N90P90K60. 5. N90P90K90. 6. N120P90K90. 7. N120P120K90. 8. N120P120K120. 9. N150P120K120. 10. N150P150K120. 11. N150P150K150. An area of one section 100 m^2 (calculated) total – 125 m^2. An area of the food in one plant is 70x30 cm. A row in every version – protective.

Nitrogen is applied in a form of ammiac saltpeter, phosphorus as superphosphate, potassium as chlorous potassium. The whole dose of the phosphorus and potassium fertilizer enleached under follplowed land in depth of 20-22 cm in spring. The nitrogen fertilizer is applied in 2 methods: 25 % under follplowed land in spring and 75 % in feeding after mass sprout.

All the agrotechnical measures beside the applying fertilizers, are performed according to agrorules, received for a given zone.

The phenological observation for plants is carried out during the whole vegetative period.

The crop data are exposed to mathematical processing over the simplificated method of the dispersion analysis, being worked out by A.M.Mesheryakov [4], but starch in the potato bulbs was defined over a specific weight.

Results and discussion

Fertilizer is one of the main powerful means of the productivity increase in the agricultural plants. In getting of high product from the potato bulbs an important role concerns the mineral fertilizers.

It was established by many authors' investigations that mineral fertilizers render a positive effect on potato productivity [2, 5, 6, 7].

Our researches showed that an application of the mineral fertilizers influence positively on the potato productivity in the leached mountain chernozems. In this connection the potato bulb productivity rised on average for 3 years from 18,8 to 51,6 c/h in the field experiments.

An efficiency of the mineral fertilizers is in direct dependence on the applied fertilizer doses and correlations.

An application of the mineral fertilizers from the calculation of N60P60K60 rises the potato crop on average for 3 years till 82,2 c/h, under the crop of 63,4 c/h in unfertilizing (control). Under an application of N90P90K90 and N120P120K90 an addition of the potato crop forms accordingly: 12,1 and 17,1 c/h in comparison with the version of N60P60K60.

Increase of the phosphorus and potassium fertilizer doses are seemed too effective. So, under the versions of N120P120K90, N150P150K120 the potato crop formed accordingly: 105,6 and 108,1 c/h. It was established that the best and optimal dose of the mineral fertilizers under the potato is N120P120K120 under which was got 115,0 c/h of the potato crop. An addition of the crop of the unfertilizer version was relatively: 51,6 c/h or 81,4 %. The further increase of the fertilizer doses (N150P150K150) were seemed less effective.

So, a significant addition of the potato crop was provided by the mineral fertilizers.

The potato is used as food, nutritious and technical plant. That's why a need for its quality isn't the same. A main aim of the industrial sorts of the potato growing getting of starch. [8]

There is an opinion in practice that an application of mineral fertilizers leads to the potato quality aggravation. But it isn't so. Many experiments were conducted in our country and abroad, all these show that under the correct application of mineral fertilizers the qualitative aggravation isn't observed. The main parameters over which a quality of the potato product is evaluated are the followings: bulb bigness, the eyehole situation form, peel peculiarity, taste, starch content, raw protein, vitamin C, mineral salts, loss at storage; damage under harvesting and so on.

Last years an opportunity of growing of not only high crops but also ensurement of the high-qualitative bulbs in potato is investigated in many countries.

An application of the mineral fertilizer doses and correlations is subjected to change of the potato bulb qualitative indices. In our experiments the different mineral fertilizer kinds were found in the qualitative indices of the potato bulbs. As is obvious from the table, under application of the fertilizers, a content of the dry substances in the potato on average for 2 years formed in limits 19,9-23,4 %, raw protein – in limits of 2,3-3,8 % or accordingly – 0,3-3,8 and 0,4-2,1 % increased in comparison with the control without fertilizer.

The less extraction of the starch is noted in unfertilizing control and forms 10,3 c/h. Using from the rising doses of the mineral fertilizers the starch extraction increases and its highest limit – reaches 19,6 c/h under an application of N120P120K120.

Nitrates content in the potato bulbs on average for 2 years under fertilizing versions vibrates in limits of 61,5-79,0 mg/kg, under control without fertilizer 58,5 mg/kg, what is significantly less maximal admissible concentration of nitrates in the potato bulbs.
For the seedy potato it is important to keep the bulbs without aggravation of their sowing and productive qualities. The researches show that the mineral fertilizers don’t render an available effect on the potato bulbs preservation. So, if under the control unfertilized version a procent of the spoiled bulbs under the preservation for 6 months forms 4,4 then under an application of the mineral fertilizers N90P90K90 – 4,5 %. The highest procent of the spoiled bulbs is observed under application of fertilizers in a dose of N150P150K150 - 4,7 % [3].

Table 1

Influence of the different doses and correlations of the mineral fertilizers on qualitative indices in the potato bulbs (on average for 2 years)

Experiment versions	Dry substances, %	Extraction of the dry substances, c/h	Starch, %	Starch extraction, c/h	Raw protein, %	Nitrates, mg/kg
1. Control (unfertilizing)	19,56	11,7	17,3	10,3	1,90	58,5
2. N60P60K60	19,89	15,6	17,9	14,1	2,25	61,5
3. N90P60K60	20,29	16,4	17,8	14,4	2,62	65,5
4. N90P90K60	20,79	18,0	18,1	15,7	2,59	64,5
5. N90P90K90	21,30	19,2	18,4	16,7	2,81	66,0
6. N120P90K90	22,62	21,3	17,8	16,8	3,31	70,5
7. N120P120K90	22,49	22,5	18,3	18,3	2,96	72,0
8. N120P120K120	23,38	24,6	18,6	19,6	3,84	73,5
9. N150P120K120	23,09	23,6	17,8	18,2	3,31	78,0
10. N150P150K120	23,22	23,5	18,0	18,2	3,68	78,5
11. N150P150K150	23,31	24,1	18,3	18,9	4,03	79,0

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Manganese fertilization of vineyards on the sandy soils of Chechen republic

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Keywords: grapes, soil, mineral nutrition, manganese, productivity.

Introduction.

Grape plants need a manganese throughout all vegetation period. The form of manganese intake in grapes plants is ions Mn^{2+}. The average of manganese content in the shoots of grapes on sandy soils is 9-11mg/kg of dry mass according to our data. The forms of manganese content in grapes plants are Mn^{2+}, Mn^{3+}, Mn^{4+}.The role of manganese in the metabolism of plants is similar with magnesium and iron functions. This com-pound activates the numerous ferments, especially during the process of phosphorylation. Manganese is involved in photosynthesis and Vitamin C synthesis. Manganese is involved in water photolysis and it is necessary for maintaining the structure of chloroplasts. It activates ferments involved in the oxidation one of the plant hormones - indoleacetic acid (IAA), which is essential for the hormonal regulation of plant growth. The average manganese removal with the grapes harvest is nearly 1.2-1.5 kg/ha. The manganese deficiency affects many metabolic processes, in particular for the synthesis of hydrocarbons and proteins, since activates ferments in the plant. Manganese deficiency becomes noticeable firstly on young leaves by a lighter green color or discoloration (chlorosis). Also, very soon appear brown necrotic spots. The leaves die faster than at iron deficiency besides. The known sign of manganese lack is brown spotting, especially in demanding to manganese by Euro-Amur grape hybrids.
The aim of the research is to determine the content of manganese in soils of Tersky sands and to identify the physiological reaction to manganese fertilizer of Platovsky grapes. To determine the effect of root feeding time and doses to productivity of vineyards.

Materials and Methods

Studies were carried out on fruiting vines Terek-Kumskiy sands of vine producing farm "Burun" of Shelkovskoy District of the Chechen Republic. The methods of agrobiological counts (the number of buds, shoots, buds on the bushes, accounting harvest berries from the bush and 1 hectare, and the average mass of clusters) were performed on establishing the vineyards on industrial scale.

Soil and plant samples were collected simultaneously for the determination of nitrogen, phosphorus, potassium, calcium, magnesium and boron microelements, cobalt, manganese, molybdenum, zinc by atomic absorption method. Selection of soil samples was carried out according state standard methods (GOST, 2008); general requirements for conducting soil analyzes (GOST, 2005); nitrate nitrogen in the soil (GOST, 1986); exchange ammonium in the soil (GOST, 1985); mobile forms of phosphorus and potassium in the soil by the Machigin exchange method (GOST, 1992).

Sugar content of the berries and titratable acidity were determined according to according state standard methods (GOST, 1987; GOST, 2000). Statistics of results were determined by Statistica 7.0.

The purpose of field experiment is investigation of different doses and timing effects of manganese fertilizer on growth, development and productivity of plantations. The scheme of the field experiment:

1. Variant: control (without micronutrients N90 R90 K90 Background).
2. Variant: background + Manganese (2 kg/ha).
3. Variant: background + Manganese (4 kg/ha).
4. Variant: background + Manganese (6 kg/ha).
5. Variant: background + Manganese (8 kg/ha).

The field experiment was carried out in 2011 year.

In the work were used different fertilizers: sulphate manganese, ammonium silitra, super phosphate, potassium salt. Fertilizers were injected into the soil during the phases of sap flow, or the flowering stage, or the phase growth and the beginning of the ripening berries by the hydro drills method at the distance of 80 cm from the bush, to a depth of 30 cm per year. There were totally 16 wells in performed by hydro drills in each experimental variant. The Platovsky type grapes were planting upon to 3 x 1.0 m scheme. Variants of experience were laid in four replicates four plants in each. Forming of vineyards is long sleeved, unsheltered.

Results and Discussion

The content of humus in the 0-20 cm soil layer of studied sandy soils is 0.67%, in the 20-40 cm soil layer - 0.66%, and in the 60-150 cm soil layer - 0.95%. pH ranges from 8.5 to 8.8. The phosphorus content in the 0-20 cm soil layer is 14.3 mg/kg, in the 20-40 cm soil layer - 10 mg/kg, and in the 60-150 cm soil layer – 13.0 mg/kg of dry substance.

The average of potassium total amount at all soil profile depth varied from 121 to 143 mg/kg. The total carbonate content in studied soils is 2.1-2.3%. The content of nitrogen in the sandy loam soil is observed only in total analysis in a very small amount 0.02-0.04%. The average content of total manganese in studied soils employed in the test area is from 8.5 to 24.3 mg/kg (Table 1, Table 2). The content of water-soluble manganese in studied soils on the average is 5.7 mg/kg or about 1.2% of the total amount (Table 1).

The share of firmly bound compounds more than 90% accounts for the major part of the total manganese content in the soil. Firmly bound compounds of manganese are included in the primary and secondary minerals of silicate (clay minerals), and non-silicate origin (ox-ides, manganese hydroxides, salts). Firmly bound in the organic wastes manganese and compounds of its transformation (including humic substances) have less effect at the total level of manganese in the soil due to the relatively low share and significantly lower stability compared to mineral manganese matrixes.

Table 1

Nutrients content at different depths of sandy soil state farm Burunny of Shelkovskoy District in the Chechen Republic, 2011

Selection depth, cm	pH	Humus, %	Nutrients, mg/kg of dry soil		Content of microelements, mg/kg			
			P_2O_5	K_2O	Zn	Cu	Mn	B
0-20	8.8	0.7	14.3	143	0.8	1.9	16.8	0.4 0.53
20-40	8.8	0.7	10.0	121	0.7	1.3	14.4	0.5
40-60	8.8	0.7	12.0	143	0.7	0.8	24.3	0.4 0.12
60-150	8.8	1.0	13.0	132	0.5	0.3	8.5	0.8 0.12

Table 2

Influence of manganese fertilizer on root development of Platovsky grapes in phase of sap flow (2011)

Variant of field experiment	Air-dry weight of roots		Number of skeletal roots	
	total	% to control	pieces	% to control
I. Control (without micronutrientsN_{90} $P_{90}K_{90}$ background)	385±24	-	400±54	-
II. Background + Mn (2 kg/ha)	398±31	103	422±28	106
III. Background + Mn (4 kg/ha)	426±45	110	462±34	116
IV. Background + Mn (6 kg/ha)	419±37	108	451±46	113
V. Background + Mn (8 kg/ha)	416±29	108	453±27	113

It should be noted that weather conditions were varied during the research that allowed examining their effects on grapes plants. Average monthly spring and summer temperatures of 2011 were higher than historical averages (from 1.0°C in April to 4.2°C in July). The summer was hot and the maximum temperature recorded +39.6°C 28 of July. Maximum soil surface temperature on that day was 50°C. In summer months, the air tem-perature was above perennial indicators (1.8, 4.2 and 1.6°C, respectively). The sum of active air temperatures during these months exceeded the long-term data on the 237.7°C. Winter in 2011 was snowless, with frequent thaws.

The maximum value of average length of shoots reached in the variant with fertilization by 4 kg/ha Mn into the phase of sap flow. Using the lower and higher doses of manganese sulphate reduced its effectiveness on grapes morpho biometrics characteristics (Table 3). The study of the nature of the leaf surface Platovsky grapes showed that the number of leaves on the bush, the area of the leaf blade, as well as the total area of leaves on one bush and 1 ha, changed depending on the dose and timing of manganese fertilizing. Climatic conditions in 2011 were favorable for overwintering and growing of grapes during the growing season. When determining the average weight of fruits found that manganese stimulates berries significantly increasing their weight. Yield increased on a variant with the adding of

N90R90K90+Manganese (2 kg/ha) compared to the control without manganese adding was 1.7 kg/ha. Also the in-crease in sugar content of berries was 1.8 g/dm^3.

Table 3. Time and dose effect of manganese fertilizer adding on growth, and productivity of Platovsky grapes plants (2011)

Variant of field experiment	The average length of shoots, cm	The average diameter of the shoots, mm	Yield, t/ha	Sugar content of the berries, g/dm^3	Increase to control	
					t /ha	g/dm^3
Adding into the phase of sap flow						
I. Control (without micronutrientsN_{90} $P_{90}K_{90}$ background)	154.6±36.4	5.6±1.1	69.9	174.0±24.3	-	-
II. Background + Mn (2 kg/ha)	172.4±41.3	5.8±0.8	71.6	176.2±32.1	1.7	1.8
III. Background + Mn (4 kg/ha)	180.0±37.4	6.0±0.9	74.6	185.6±32.6	4.7	11.6
IV. Background + Mn (6 kg/ha)	171.4±21.4	5.9±1.5	73.3	183.8±28.4	3.4	9.8
V. Background + Mn (8 kg/ha)	160.5±18.5	5.9±1.2	70.5	176.4±31.5	0.6	2.4
Adding into the flowering phase						
I. Control (without micronutrientsN_{90} $P_{90}K_{90}$ background)	153,9±22.7	5.4±1.6	69.9	174.0±24.3	-	-
II. Background + Mn (2 kg/ha)	160.3±32.1	5.5±1.3	71.0	174.3±13.4	1.1	0.3
III. Background + Mn (4 kg/ha)	164.4±26.4	5.7±0.7	73.0	176.8±26.5	3.1	2.8
IV. Background + Mn (6 kg/ha)	161.5±22.4	5.6±0.9	72.3	175.5±27.8	2.4	1.5
V. Background + Mn (8 kg/ha)	161.0±32.1	5.5±0.5	70.0	173.8±32.6	0.1	-0.2
Adding into the phase of growth and beginning of grapes ripening						
I. Control (without micronutrientsN_{90} $P_{90}K_{90}$ background)	140.0±14.3	5.1±1.1	69.9	174.0±24.3	-	-
II. Background + Mn (2 kg/ha)	141.6±18.6	5.1±1.8	70.1	171.0±32.5	0.2	3.0
III. Background + Mn (4 kg/ha)	149.4±22.1	5.2±1.5	71.6	173.5±19.8	1.7	1.5
IV. Background + Mn (6 kg/ha)	140.6±14.5	5.1±1.9	71.0	172.0±22.6	1.1	2.0
V. Background + Mn (8 kg/ha)	139.4±23.6	5.0±0.7	71.0	172.0±25.7	1.1	2.0

The differences on experience options of yield were significant. The highest rates in development and productivity of plants are obtained by manganese insertion into the phase of sap flow in the amount of 4 kg/ha. In this variants the yield was 74.6 t/ha or above 3 kg/ha, compared to the dose of manganese 2 kg/ha. The most intensive restoration of root Platovsky grapes after a harsh winter in 2012 occurred with the introduction of manganese in the phase of sap flow at a dose of 4 kg/ha (Table 2). This is confirmed by an in-crease in the amount of skeletal roots at 40 pcs of grape plants in the variant with the adding of the manganese of 4 kg/ha. Adding manganese fertilizer at a dose of 4 kg / ha promotes the formation and growth of the root system that is interconnected with the life of the aerial plant organs.

Conclusion

Manganese content in the soil profile studied soils varies greatly, ranging from 8 to 24.3 mg or 15 times less than in the alluvial soils of the Chechen Republic. Manganese fertilizer is effective farming techniques promot-ing the growth of development, hardiness and productiv-ity of grape plants in Shelkovskoy District of Chechen Republic. The most effectiveness is manganese fertilizing by adding active manganese into the phase of sap flow at a dose of 4 kg/ha on the background of N90, K90, P90. It is recomended to add to the sandy soils of Chechen Re-public of 4 kg of active ingredient per hectare manganese in the phase of sap flow in order to accelerate the recov-ery of vineyards damaged by frost, to enhance the devel-opment of reproductive organs.

Acknowledgements

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Contribution of invertebrate in organic matter of cryogenic forest soils of Central Siberia

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Key words: macrofauna biomass, carbon, nitrogen, cryosols turbic, podzols rustic, podzols haplic

Introduction

The questions of participation of soil animals in the processes of accumulation and transformation of matter and energy in cryogenic soil are particular significance for understanding peculiarity of biogeochemical cycle in forest ecosystems of permafrost zone.

Soil invertebrates have same function in biological cycle [1, 2]:

- plants part consumption and accumulation in their biomass;
- chemical substances input into the soil and into the atmosphere;

as metabolic products as well as dead animals;

- organic residues destruction by soil invertebrates and microorganisms.

Invertebrate contribution in organic matter transformation is direct and indirect: trophic activity, assimilation, mineralization and decomposition and fragmentation, transfer and mix of indigested organic residues, stimulation and inhibition of soil biota.

The direct invertebrate biomass contribution in soil organic matter of cryogenic forest soils of Central Siberia was investigated. These studies are part of a comprehensive ecosystem research.

Our studies were realized in forest tundra in spruce and larch open forests (68ºN 86ºE); in northern taiga in larch forests (65ºN 89ºE); in middle taiga in pine forests (60ºN 89ºE); in southern taiga in pine forests (58ºN 98ºE) as well as in pine, spruce, birch and aspen forests (56ºN 92ºE). Invertebrates (macrofauna group) of cryosols turbic of forest tundra ecosystems, entic podzols of northern taiga, carbic podzols of middle taiga and greyic phaeozems albic of southern taiga were studied (WRB, 2006). Direct methods conventional in soil- zoological studies were used to control macrofauna representatives (*Lumbricidae, Enchytraeidae, Myriapoda, Arachnida, Insecta*): the layer- to- layer sampling with the following taking samples to pieces using columns of soil sieves [3]. Samples (sized 25x25 cm) were taken on each sample plot in fivefold replication in layers: forest floor, 0- 5 cm, 5- 10, 10- 20, 20-30, 30-40 cm. Depth of sampling varied depending on depth of active inhabited layer: in forest tundra and northern taiga – up to 20 cm, in the middle taiga – up to 10 cm, and in southern taiga – up to 40 cm.

Climate continentality of Central Siberia, cryogenic factor result in high variability of biotopic conditions (peculiarity of ground cover and forest floor).

Soil invertebrate biomass increases from forest tundra to southern taiga more than 6 times reaching its maximum in leafy communities in southern forest.

The minimum amount is characteristic of carbic podzols of middle and southern taiga (Fig. 1). Gray soils of south taiga are characterized by the most biodiversity of invertebrates taxonomy groups, which correlates with max value of biomass in the same habitat. Min biodiversity is characteristic of south taiga subzone podsol. Soils of northern taiga and forest-tundra have the middle value of this parameter.
Dominating saprophagous complex with the complex of secondary organic matter destructors is characteristic of the whole edaphon of siberian forest zone. Saprophagous block reaches its maximum development under southern taiga regime in zooms being formed on soils with heavy granulometric structure.

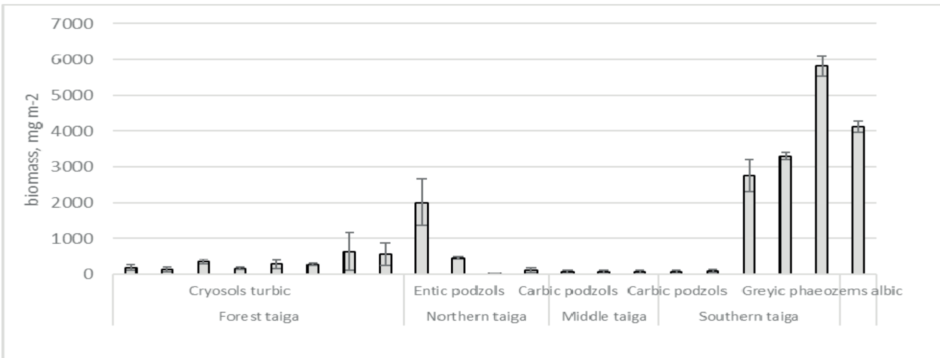

Fig. 1. Invertebrate biomass in soils of forest ecosystems of Central Siberia.

The carbon and nitrogen concentration analyze in absolute dry biomass of different invertebrate taxonomy groups showed that concentration of carbon is 27-60 % and one of nitrogen is 5,2-11,1 %. On base of gathered data the estimation of share of invertebrates in biogenic element accumulation in relation with climatic conditions has been carried out. Min amounts of carbon (0,03-0,04 t ha^{-1} x 10^{-2}) and nitrogen (0,004-0,007 t ha^{-1} x 10^{-2}) are accumulated by macrofauna biomass of carbic podzols. Carbic podzols distinct by extreme low water keeping capacity and low concentration of light available organic matter. Solar radiation and periodic drying of duff and upper soil layers limit both fauna biomass and biogenic element accumulations. The short vegetation period (69-89 days) and closed to surface permafrost (20-50 cm) are main limit factors in forest-tundra and northern taiga zones. However, the quality consistent of plant residues, accumulation of organic matter being at the different stages of decomposition and favorable combination of heat and moisture regimes during no frost period result in sufficiently high level of invertebrates biomass and accumulation in it of carbon and nitrogen 0,04-0,85 and 0,01-0,15 t ha^{-1} x 10^{-2}, respectively. Invertebrate biomass in greyic phaeozems albic of south taiga forest ecosystems and max accumulation in it of biogenic elements (091-1,49 t C ha^{-1} x 10^{-2} and 0,22-0,34 t N ha^{-1} x 10^{-2}) allow conclude that the same soil-climatic conditions are the most favorable between investigated habitats.
On the base of soil cover structure of forest-tundra and taiga zone of Central Siberia region [4] we have received such assessments: in cryosols turbic (about 3 % of region soil fond (SF)) biomass load is 83 000 tone of absolute dry matter, where carbon

shares 50 % and nitrogen –10 %. In entic podzols of northern taiga (11 % of SF) 142 000 of fauna biomass are located, with carbon and nitrogen sharing 38 % and 7 % respectively. Carbic podzols (3 % of SF) and greyic phaeozems albic (1 % of SF) of southern taiga have 4 and 53 of absolute dry invertebrate biomass, where carbon and nitrogen shares are 34,0 and 8 % respectively in carbic podzols and 49 and 9 % in greyic phaeozems albic.

Earlier field experiments with bags [5] allowed to obtain the following quantitative assessment: soil invertebrates assimilate 40% of consumed phytodetritus, then about 3% organic matter accumulated by biomass and return in soil after death. About 60% organic matter coprolithes return in soil.

Conclusion

1. Invertebrate biomass formation in forest ecosystems of Central Siberia is determined by climatic and soil factors on this area: maximum of biomass is typical for soils of southern taiga forest.

2. Role of invertebrate biomass in accumulation of main biogenic elements increases under improvement of soil-climatic conditions: minimum C and N are accumulated by invertebrate biomass of carbic podzols of middle and southern taiga forest. In greyic phaeozems albic of southern taiga forest invertebrate biomass is accumulated maximum biogenic elements.

3. Carbon and nitrogen accumulation values of soil invertebrates much less then overall organic matter load in forest ecosystems soils. But direct and indirect invertebrate contribution to soil organic matter transformation increases from forest tundra to southern taiga.

Acknowledgements

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Soils of the middle-boreal subzone (middle reaches of the Stony Tunguska)

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Key words: forest ecosystems, permafrost, Podzols, properties

The forest ecosystems of middle-boreal subzone are formed on the permafrost deposits. These deposits are not continuous they form patches. Larix stands grow in the places which are located on the permafrost deposits. Pinus silvestris stands and Pinus sibirica stands grow on the non-frost deposits. Their particular properties contribute to the formation of different soils.

The aim of the study is to determine the influence of permafrost on the formation of soils.

Three test points investigated in the village Baykit in the middle basin of the river Stony Tunguska. Soils were studied in different types phytocenoses.

Quantitative methods included, firstly, macro-morphological description, secondly, measurement of the content of humus, pH quantity of the water extract, number of carbonates, total exchangeable cations, content of active oxide (Fe_2O_3 and Al_2O_3), the fractional composition of humus, and, finally, granulometrical composition.

The first test point of Pinus sibirica stands were located on the non-permafrost deposits. The typical type of soils is Podzols Cambic (O_{ao}-BHF-C) (FAO, 1988). One color is characteristic of all horizons and they also contain a lot of organic matter. These soils are warm and there are ground vegetation of grasses, bushes and shrubs.

Podzols Cambic in terms of humus content can be characterized by high humus, its amount reaches 9.5%. Soil in terms of pH of the water extract is characterized by neutral reaction. Soils are not saturated with exchangeable cations. Their quantity slightly increases down the profile. The content of active oxide Fe_2O_3 decreases down the profile to 74 mg/100 g soil. This takes place in a close location of the permafrost. There nonflushing water regime of the soil prevents the removal of chemicals from the soil profile. The soil is classified as loamy (table 1).

The next point is Larix stands that grow on the permafrost deposits. The typical type of soils is Podzols Gleic (O-BH-G-CG) (FAO, 1988). The gley materials in mineral and organic soil horizons show evidence of cryoturbation (frost churning). Ice melts in the active layer that is a seasonal thaw layer and remains in the upper part of the permafrost. These soils are always moistened, therefore the quantity of biomass and organic matter in these landscapes is smaller than in the others. The ground vegetation consists of lichens and mosses.

Podzols Gleic in terms of humus content can be characterized medium humus soils. Its amount is not more than 3.2 %. In terms of pH of the water extract is characterized by weak-acid reaction – acidity goes down to the soil-forming rock. There are small carbonates content in this soil. Soils are not saturated with exchangeable cations. Exchangeable cations migrate down the profile. The content of active oxide Fe_2O_3 increases down the profile to 1678 mg/100 g soil. The soil is classified as loamy (table 2).

Table 1

Some chemical and physico-chemical properties of Podzols Cambic

Horizon, depth, cm	C, %	pH of the water extract	CO_2 carbonates, %	Σ exchangeable cations, mg*equ/100g soil	Fe_2O_3, mg/100g soil	Al_2O_3, mg/100g soil	P_2O_5, mg/kg soil
O_{ao} (0-9)	11.0	-	-	-	-	0.008	0.15
BHF (14)	9.7	6.57	0.33	24.22	125.61	0.004	0.15
BHF1 (1 25)	9.2	6.80	0.31	-	109.95	0.000	0.13
C (25-…)	9.5	6.75	0.25	36.81	74.43	0.000	0.10

- dimension has not been

Table 2

Some chemical and physico-chemical properties of Podzols Gleic

Horizon, depth, cm	C, %	pH of the water extract	CO_2 carbonates, %	Σ exchangeable cations, mg*equ/100g soil	Fe_2O_3, mg/100g soil	Al_2O_3, mg/100g soil	P_2O_5, mg/kg soil
O (0-9)	3.2	5.62	0.13	19.22	168.81	0.00	0.05
BH (9-14	1.5	6.04	0.15	23.21	283.52	0.00	0.03
(14-21)	1.0	6.21	0.13	26.80	1492.10	0.00	0.03
(29-33)	0.4	6.82	0.18	24.03	1175.71	0.05	0.03
G (33-74	0.0	7.12	0.15	35.40	1024.81	0.00	0.02
CG (74-	1.0	7.48	0.18	35.80	1678.92	0.00	0.00

The third test point is Pinus silvestris stands were located also on the non-permafrost deposits. The Podzol Ferric (O-E-BF-C) (FAO, 1988) is a typical one, they are of a characteristic buffy color. This depends on the presence of iron cutans in mineral horizons. These are specific properties which are due to light granulometrical composition of the soil.

Podzols Ferric in terms of humus content can be characterized nonhumus soils. The humus amount is not more than 1%. In terms of pH of the water extract is characterized by weak-acid reaction – acidity goes down to the soil-forming rock. The amount of exchangeable cations varies from 7.2 mg*equ/100g soil (horizon E) to 12 mg*equ/100g soil (horizon C). The active oxide profile is unevenly distributed. Minimum amount of the active oxide Fe_2O_3 was found in the horizon E (279.8 mg/100g soil), maximum amount in the horizon C (1837.2 mg/100g soil). Distribution of active oxide Al_2O_3 is characterized by radial migration down the profile. The soil is classified as sand (table 3).

In terms of the fractional composition of humus all the examined types of the soil are characterized by humate-fulvate humification. Fulvic acids are produced mainly in a powerful epipedon. The proportion of humic acid is small because of the low microbiological activity of the soil. Moreover, is dominated among them the most simple in structure, slightly condensed brown humic acids that are close to the properties of fulvic acids (table 4).

Table 3

Some chemical and physico-chemical properties of Podzols Ferric

Horizon, depth, cm	C, %	pH of the water extract	CO_2 carbonates, %	Σ exchangeable cations, mg*equ/100g soil	Fe_2O_3, mg/100g soil	Al_2O_3, mg/100g soil	P_2O_5, mg/kg soil
O (0-8)	-	-	-	-	-	-	-
E (8-15)	0.0	5.04	0.12	7.02	279.80	0.48	0.10
BF (15-2(	0.0	4.89	0.07	6.61	1251.80	0.35	0.10
(20-2	0.0	5.06	0.13	7.83	1535.42	0.33	0.08
(27-4(	0.5	5.45	0.09	9.22	1842.21	0.14	0.08
C (40-…)	1.2	5.95	0.09	12.03	1837.21	0.00	0.03

Table 4. Fractional composition of humus soil study

Soil	C, %	Fractions of humic acids				Fractions of fulvic acids					HA/FA	HA+FA	Humin
		1	2	3	Total	1a	1	2	3	Total			
Podzols Cambic, profile 1	11	3,47	7,59	14,98	26,04	21,34	10,92	5,36	6,12	43,74	0,59	69,78	30,22
Podzols Cambic, profile 2	12	1,27	7,56	7,89	16,72	3,74	12,75	4,17	4,25	24,91	0,67	41,63	58,37
Podzols Cambic, profile 3	10	3,94	14,42	6,85	25,21	3,74	13,41	5,81	6,85	29,81	0,84	55,02	44,98
Podzols Gleic, profile 1	3,2	14,2	0	6,01	20,21	43,21	6,82	0	3,75	53,78	0,37	73,99	26,01
Podzols Gleic, profile 2	3,6	16,6	0	7,1	23,61	27,4	12,8	2,4	4,4	47	0,51	70,61	29,39

Thus, it has been found that the permafrost deposits influence the distribution of soils in the middle-boreal zone. The typical type of soils are Podzols. Three subtypes of the characteristic of the diagnostic horizon Podzols Cambic (O_{ao}-BHF-C), Gleic (O-BH-G-CG), Ferric (O-E-BF-C) were identified **[1]**. Physico-chemical and chemical properties all off the examined types of the soil depend on the presence of permafrost.

Acknowledgements

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Contribution to the inventory of Bryophytes of national parc of el-kala (north-eastern Algeria)

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Introduction

The plant kingdom is a polyphyletic assemblage of photosynthetic organisms.
This group is composed of two lines, one alga, and the second of land plants, which include Bryophytes or Bryophyta, ferns, gymnosperms and angiosperms.
Bryophytes are small plants; mainly, terrestrial, but looking wet sites; especially, in boreal and alpine areas, and they are an important part of rocks, and tree trunks. Bryophytes include liverworts, hornworts and mosses.
The North-eastern Algeria is known by its humid and sub-humid bioclimatic floors housing a dense vegetation and diversify whose Mosses occupy an important place but they remain little known.
At the end of the study, which was conducted in the National Park El-Kala in northern Algeria, , and after a number of successive walk on land, the inventory of mosses brings up the existence of 62 species of which the latter exists only in an only station throughout Algeria.

Materials and Methods

The PNEK (Fig.1) is located in the extreme north-eastern Algeria, it was created by Decree No. 83/462 establishing the National Parks like statue in July 1983 and erected by UNESCO as Biosphere Reserve in 1990, defines an area of 78438 ha, surrounded by the following geographical coordinates: 8 ° East longitude 27 latitude 36 ° North is 54 and 10 m altitude, it is characterized by an important biological richness and diversity of forest ecosystem marine mountain, lakeside, and agro-ecosystem.

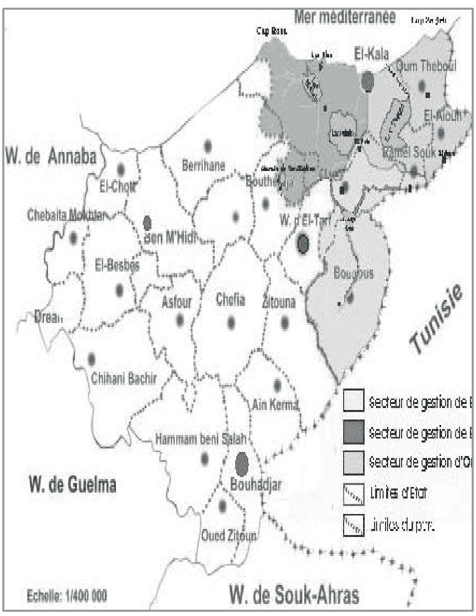
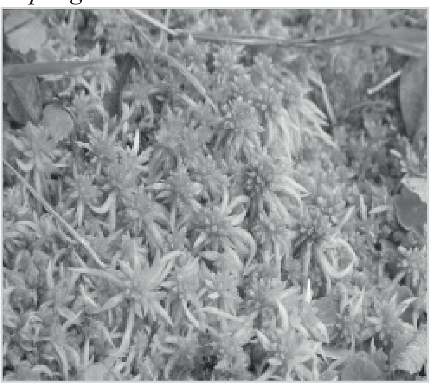


Fig.1. Map D`El-Kala National Park (north-east of Algeria).

View the steppe of Mosses, their great abundance in wet and rainy environments and their identification difficulties, our research has been made during the period of optimal growth of the species.
Harvest hardly presents particular difficulty, terricolous species and muscicoles are easily removed from their substrate eventually using a penknife,
While some species cling to the substrate, it is then necessary to detach fragments of the substrate with an adequate instrument.

Results and Discussion

Sphagnumdenticulatum



The plants are green, yellow-brown to dull coppery red, sometimes with a violet tint.
The branches of external capitulates are swollen and smooth in outline, leaves with flat edges, which cladding and tighten those above.
At least some of the branches are curved in top view, with the leaves towards the point of the branch learned narrowly enough to each other, forming a pointed end object.
Of the directorate general, Leaves are large and no or only very lightly turned to one side when viewed from above.
Booklets are looking for similar 3-4 branches, sometimes with a fifth residual branch. The stems are green, dark brown or black.

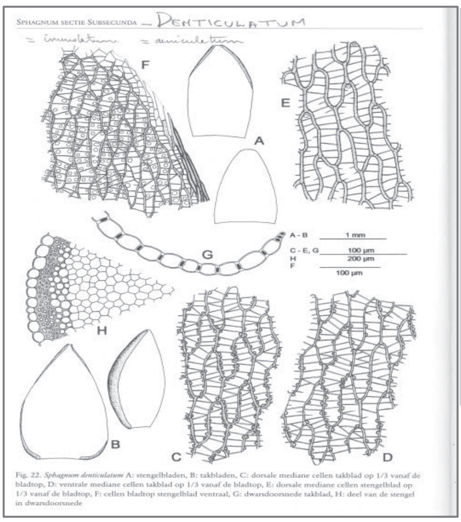
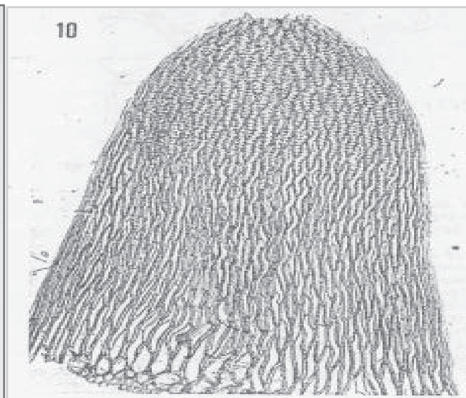


Fig. 22. *Sphagnum denticulatum* A: stengelbladen, B: takbladen, C: dorsale mediane cellen takblad op 1/3 vanaf de bladtop, D: ventrale mediane cellen takblad op 1/3 vanaf de bladtop, E: dorsale mediane cellen stengelblad op 1/3 vanaf de bladtop, F: cellen bladtop stengelblad ventraal, G: dwarsdoorsnede takblad, H: deel van de stengel in dwarsdoorsnede



Strains leaves are large, concave, parallel sided below or larger over the base, with a rounded tip.
However, they can appear somewhat triangular in the area, because of the concave shape and wide on the insertion stem.

They are usually shorter and less concave than the branch of leaves. Capsules are occasional.
This species found in swampy pools, flashes acids, springs, ditches and rock slabs irrigated.
Usually, in habitats highly acidic and low in nutrients, but occurs in habitats who are moderately enriched with nutrients.

Distribution station

The species Sphagnum denticulatum found in only one station in Algeria, it is Bergougaya’s Ain in the National Park of El Kala.

Conclusion

Bryophytes often live in humid conditions.
It is observed in these foams the phenomenon of revival: they can withstand prolonged desiccation, passing a slow state of life.
When conditions are viable return, they do go back their metabolism.

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Soil-water contact angle: significance and research methods

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Introduction

The soil is sensory and reflex boundary surface between the biosphere, hydrosphere, atmosphere, and lithosphere. It is a dynamic and hierarchically organized system of living organisms, various organic and inorganic components, which determine a large complex and heterogeneous surface section. Due to physical, chemical and biological heterogeneity of these surfaces of these interfaces soil is the source of many of the habitats, supporting extensive abundance, biological and functional diversity of ecosystems and mediates most of biogeophysical and biogeochemical interactions between the landscape, its surface, groundwater and the atmosphere.
To investigate the role of soil as a filter, the manufacturer, transformer and regulator of biogeochemical processes it is necessary to carry out a systematic search and research aimed at understanding the architecture and functioning of biogeochemical interfaces in soil. Analysis of published data shows that the understanding of the interactions and interdependencies of existing processes (physical, chemical and biological) on the formation and properties of biogeochemical interfaces pave the way for data management processes. In soil science, new devices that measure the pore space in 3D-images (tomography), the contact angle, rheological characteristic, etc. New devices and methods require a lot of methodological work on determining and identifying the boundaries of their applicability, the optimal ranges of measurement and standardization of procedures for experimental determination.
The aim of this present work is to standardize the procedure for measuring the soil-water contact angle to identify the limits of applicability of the measurement of the contact angle by the sessile drop method.

Materials and Methods

Measurement of contact angle was performed on digital goniometer - drop shape analyser - DSA 100 (KRÜSS, GmbH, Germany) using the sessile drop method (SDM). The process of determination can be described as follows. Device's dosing system delivers a test liquid (deaerated distilled water) on the surface of the prepared samples with a droplet volume of 1.5 µl at a rate of 200 µl/min. The system records the process of the drop deposition and its gradual absorption in the video. On the resultant video the moment, when a drop "sit down" (that means, that the drop completely touches the surface of the soil, but also does not start to be absorbed) is searched and at this moment appropriate computer program is measured CA.
To obtain adequate CA data using SDM it is very important to choose the best way of preparing a test sample for analysis.
Empirically we were picked up the following preparation schemes:

A.

9. air-dry samples are grinded with a rubber pestle and sifted through a sieve with the diameter of the mesh 0.25 mm;
10. sieved samples are placed for 24 hours in an oven with a temperature up to 45 ° C;
11. pieces of double-sided adhesive tape (approximately 0,5x0,5 cm) are glued on glass slides;
12. on the tape's adhesive layer an even layer of prepared soil is applied, then it covered with another slide and pressed;
13. not pasted soil particles are gently shaken off;
14. to obtain the most even layer paragraphs 4 and 5 are repeated.

B. This is a modified version of the first method, steps 1-3 are repeated. The changes are in applying the sample to the adhesive tape - it evenly applied on the glass slide, then the sample is covered with the another glass slide, on which we place a weight of 300 g for one minute. Then not adhered soil is shaken gently. To avoid uneven application, the soil is applied a second time in the same manner.

C.

15. air-dry samples are sieved through a sieve with a mesh diameter of 250 microns;
16. on a microscope slide a uniformly thin strip of acetate lacquer with a size a little more than 0,5 × 0,5 cm is laid down;
17. prepared soil is applied on the acetate lacquer's layer and gently pressed down with another glass slide;
18. glasses are placed for 4 hours in an oven heated to 60 ° C for complete drying of the lacquer;
19. excess soil is removed with a brush.

With the help of the first method of preparation, we study the influence of the sample's fineness on the obtained CA-data: the sample has been sieved through a sieve with the mesh's diameter of 250, 100, 50 and 20 microns. In these sample's fractions soil-water CA was measured by two analysts to study the analyzer's error.
The object of study is the arable horizon (0-20 cm) of typical chernozem (CCR, Kursk region) with the content of organic matter of 3.42%.

Results and Discussion

Table 1 shows the results of test sample's CA measurement with various preparation methods. For comparing of means t-test was used.
Depending on the method of the sample's application, the averages CA vary from 20 to 45 degrees. The first method does not give reproducible results (average values of CA, measured by different analysts differ significantly (p-value = 0.05). This is due to the fact, that different analysts pressed down the glass with different force, and as the result, on the adhesive tape the soil layers of various thicknesses are glued. The thicker layer of soil, the more the capillary force begins to act on a drop, and we obtain the less CA values.
The influence of soil's particle size on the CA is not always observed. The results of the first analyst provide a significant difference only for fractions 0,05-0,02 mm and 0.25-0.1 mm, while the second analyst provides results, significantly differ for all fractions except 0.1-0.05 mm and 0.25-0.1 mm.
To standardize the sample preparation procedure we propose the modification of the first method, in which the glass is pressed with a weight, and the option with acetate lacquer. These methods provide higher CA values (43,5 and 36.9 degrees

respectively) and the most appropriate due to the fact, that soil is applied to the substrate as thin layer and its thickness and, as the result, obtained CA-data, will not depend on the analysis, i.e. they will be objective.
The results obtained with different preparation techniques, differ significantly (p-value = 0.05). For all methods of preparation, the confidence interval for an average is less than 5 degrees, which indicates a sufficiently high accuracy of measurements.

Table 1

Descriptive statistics for different methods of sample's preparation for CA measurement

	Valid N	Mean	Median	Lower - Quartile	Upper - Quartile	Variance	Std.Dev.	Coef.Var.	Standard - Error
Method A (1st analyst)									
<0,25 mm	157	22,5	22,9	19,5	24,8	20,05	4,48	19,91	0,36
0,25-0,1 mm	17	20,9	21,7	18,8	23,0	23,76	4,87	23,29	1,18
0,1-0,05 mm	21	22,3	22,3	19,0	26,4	24,40	4,94	22,10	1,08
0,05-0,02 mm	99	23,2	23,0	20,9	25,1	9,78	3,13	13,46	0,31
Method A (2nd analyst)									
<0,25 mm	89	34,3	34,0	30,3	38,6	56,62	7,52	21,91	0,80
0,25-0,1 mm	27	24,8	24,0	21,0	26,0	26,79	5,18	20,90	1,00
0,1-0,05 mm	33	25,8	25,4	22,5	28,6	16,38	4,05	15,66	0,70
0,05-0,02 mm	36	36,8	38,1	34,6	40,7	34,15	5,84	15,86	0,97
Method B									
<0,25 mm	125	38,1	38,0	33,9	41,6	41,95	6,48	17,01	0,58
Method C									
<0,25 mm	92	45,4	44,0	39,2	51,4	84,12	9,17	20,19	0,96

Conclusion

The soil-water CA's measurement is a rather new for soil science challenge. While the solution of this problem it is necessary to pay attention to the sample's preparation for analysis. Not all methods of preparation give reproducible results by different analysts, although the measurements, obtained by one analyst, are well reproduced. To obtain the most adequate data it is important to prepare a sample in the way, where the thickness of the soil layer is minimal to prevent the underestimated CA values due the process of absorption of water by the sample. It is recommended to fix the samples on a sticky tape or by using acetate lacquer.

The effect of mixed cultures of plant growth promoting bacteria and mineral fertilizers on tea (C*amellia sinensis* L.) growth, yield, nutrient uptake, and enzyme activities

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Key words: Mixed inoculations , bio-fertilizers, plant-growth-promoting bacteria

Introduction

Tea, a well-known important ancient beverage crop, is consumed as a drink and cultivated all over the world for its commercial value and beneficial effects. Tea is a perennial leaf crop which requires more nitrogen than most other crops and N application significantly increases both the yield and quality of tea (Han et al., 2008). Also, phosphorus-deficiency is frequently observed in tea plantations and inhibits photosynthesis in tea (Salehi and Hajiboland, 2008; Lin et al., 2009). Excess amounts of fertilizer application can cause tea orchard soil acidification, water pollution, contribute in low N use efficiency and also cause serious environmental pollution. In general, beneficial free-living N_2-fixing and P-solubilizing bacteria are usually referred to as plant-growth-promoting rhizobacteria (PGPR), which have been considered as one of the possible alternatives to inorganic fertilizer for promoting plant growth and yield. Enzymes play important role in the antioxidant system of plant, in the oxidation and formation of the tea compounds, in the biosynthesis of flavonoids and in tea manufacturing process. Polyphenol oxidase (PPO) and peroxidase (POD) are thought to play a role in the oxidation and formation of the black tea compounds such as polyphenols. PPO plays a vital role in black tea production, and plant defence mechanism and tea quality is positively correlated with its content. To alleviate osmotic stress, plants have evolved an effective antioxidant system composed of antioxidant enzymes such as glutathione reductase (GR) and glutathione S-transferase (GST). Glucose-6-phosphate dehydrogenase (G6PD) and 6-phosphogluconate dehydrogenase (6PGD) catalyse the biosynthesis of polyphenols, while 5-dehydroshikimate reductase (DHSK) is important in the biosynthesis of flavonoid compounds. The synthesis of the flavonoids in tea requires enzymes of the shikimate pathway, and the DHSK reductase is a key regulatory enzyme in the process. Also, the oxidation of plant aldehydes to their corresponding alcohols is due to an alcohol dehydrogenase (ADH) activity. Also, little is known about the inoculation of PGPR and their effect on the activities of different oxidative, catalytic, hydrolytic and anti-oxidative enzymes in tea plants. This study was conducted in order to investigate the effects of different potential PGPR strains from a pool obtained from the tea rhizosphere on growth, yield and enzyme activities in the leaves of tea plants under field conditions.

Materials and Methods

The objective of this study was to evaluate possible effects of mineral fertilizer (NPK), one commercial liquid bio-fertilizer and ACC deaminase-containing, N_2-fixing, and P-solubilizing bacteria based bio-fertilizers in triple strains combinations (YF7: *Paenibacillus polymyxa* RC05+ *Pseudomonas fluorescens* RC77+ *Bacillus subtilis* BB2; YF8: *Pseudomonas putida* 53/5+ *Bacillus megaterium* 21/3+ *Arthrobacter globiformis* FA1; YF9: *Paenibacillus polymyxa* RC35+ *Pseudomonas putida* 29/2+ *Rhodococcus erythropolis* HA3; YF10: *Paenibacillus macquariensis* 69/6+ *Pseudomonas fluorescens* 58/3+ *Bacillus atrophaeus* IA1; YF11: *Pseudomonas fluorescens* 53/6 +*Bacillus subtlis* RC63+ *Bacillus pumilus* IB2; YF12: *Pseudomonas putida* HB2+ *Arthrobacter globiformis* FA1+ *Bacillus pumilus* IB2; HKF7: *Pseudomonas putida* 2B1+ *Bacillus subtilis* 5A2+ *Rhodococcus-erythropolis* CA2; HKF8: *Pseudomonas fluorescens* AA7+ *Bacillus licheniformis* 5B2+ *Bacillus pumilus* 7A1) on the growth and enzyme activities in tea under natural acidic conditions by conducting field experiments in two years. The experiment was arranged as a completely randomized design with eleven treatments and three replicates (each having four tea bushes). For this experiment, pure cultures were grown in 50% strength tryptic soy broth on a rotary shaker (120 rpm; 25 °C) for 3 days. Bacteria were then harvested by centrifugation (ca. 3000 x g for 10 in), washed and re-suspended in 10 mM sterile phosphate buffer, pH 7 to a density of 10^9 cfu ml^{-1} for the bacterial strains. For triple inoculation, equal volume (10^9 cfu ml^{-1} of each inoculant) of three cultures were mixed and then used for tea saplings. Bacterial suspension was injected into each uniform six-year-old saplings root zone at the time of fertilizer application. Tissue samples were washed three times with 50 mM Tris–HCl+0.1 M Na_2SO_4 (pH 8.0), and each was homogenized by liquid nitrogen, transferred to 100 mM PVP + 10mM NaN_3 + 50 mM Tris–HCl+0.1 M Na_2SO_4 (pH 8.0) buffer, and centrifuged at 4°C, 15,000 g for 60 min (Çakmakçı et al. 2009). The activities of GR, GST, G6PD, 6PGD, PPO, POD, DHSK and ADH were assayed by the method of Carlberg and Mannervik (1985), Habig and Jacoby (1981), Beutler (1984), Lee et al. (1991), Mei et al. (2009), Sanderson (1966) and Hatanaka et al. (1974), respectively. All enzymatic activities were determined spectrophotometrically at 25°C using a Shimadzu 1208 UV spectrophotometer (Kyoto, Japan). Protein concentrations were calculated from measurements of the absorbance at 595 nm according to the method of Bradford (1976).

Results and Discussion

All bacterial formulations tested increased Total fresh leaf yield, Chlorophyll contents Second leaf area of tea plants significantly compared to the control; the maximum total dry leaf yield in tea were found in YF12 formulation (Table 1a).. GR, POD, ADH and DHSK activities were greatest with the application of YF13, whereas the highest levels of GST and POD activities were determined in treatments with NPK and YF13 (Table 1b). G6PD activities were greatest with the application of YF8, whereas the highest levels of 6PGD were determined in inoculation with YF14. Except for YF9 formulations, all treatments significantly increased N contents in tea leaves. Except for YF14 formulation, all treatments tested significantly increased P and Ca content of tea. All treatments tested increased leaf Fe, Mn, and Cu concentrations of tea leaf significantly compared to the control; the maximum Zn content was found in YF12 and YF13 inoculation, followed by YF11.

Table 1

The effect of different combinations of bacteria and fertilizer applications on the leaf yield (total at three times tea-picking), vegetative growth components, enzymes activities and nutrient concentrations in tea leaves

a. Leaf yield, second and third leaf area, chlorophyll and anthocyanin (ACI) contents

Treatments	Fresh leaf yield (g/sapling)	Dry leaf yield (g/sapling)	Chlorophyll contents	Anthocyanin (ACI) contents	Second leaf area (cm^2)	Third leaf area (cm^2)
Control	548,7 d	242,2 d	66,6 c	21,8 d	16,0 c	23,6 b
NPK	730,6 a	319,7 ab	78,5 a	26,6 ab	21,4 a	31,4 a
BF	629,6 bc	269,4 cd	75,7 ab	21,8 b-d	18,0 bc	23,6 b
YF7	696,5 ab	298,9 bc	75,4 ab	23,1 a-d	19,3 ab	28,0 ab
YF8	637,0 bc	274,8 b-d	75,2 ab	21,2 cd	19,3 ab	28,0 ab
YF9	673,0 ab	316,7 ab	76,2 ab	23,6 a-d	18,6 b	28,7 a
YF10	670,6 ab	312,7 a-c	75,8 ab	23,4 a-d	18,7 b	28,9 a
YF11	658,3 ab	315,5 a-c	76,6 ab	23,9 a-d	19,0 ab	29,3 a
YF12	686,4 ab	346,8 a	75,3 ab	24,2 a-d	19,4 ab	30,2 a
HKF7	699,8 ab	320,7 ab	79,1 a	27,5 a	20,1 ab	31,1 a
HKF8	678,5 ab	305,7 a-c	77,6 a	25,3 a-c	19,5 ab	29,3 a

b. Oxidative, catalytic, hydrolytic and anti-oxidative enzymes activities

	Units mg^{-1} protein				Units g^{-1} leaf DW			
	GR	GST	G6PD	6PGD	PPO	POD	ADH	DHSK
Control	1,87 b	1,94 d	1,07 d	1,13 e	6,44 c	16,1 d	1,14 d	2,41 e
NPK	2,60 a	3,29 a	1,62 ab	1,69 a-d	8,71 a	20,2 cd	1,10 d	2,43 e
BF	2,45 ab	2,54 b-d	1,76 ab	1,53 b-e	7,66 a-c	20,9 b-d	1,11 d	2,67 de
YF7	2,78 a	2,36 cd	1,96 ab	1,51 b-e	8,09 a	32,0 a	1,52 a-c	3,26 b-d
YF8	2,66 a	2,43 b-d	2,05 a	1,74 a-c	6,65 bc	34,6 a	1,50 a-c	3,15 b-d
YF9	2,46 ab	2,42 b-d	1,73 ab	1,39 b-e	7,49 a-c	26,8 a-c	1,33 b-d	3,56 a-c
YF10	2,72 a	2,98 a-c	1,50 bc	1,90 ab	8,13 a	28,0 a-c	1,64 ab	3,54 a-c
YF11	2,65 a	2,84 a-c	1,61 a-c	1,66 a-e	7,76 ab	31,5 a	1,56 a-c	3,75 ab
YF12	2,45 ab	2,44 b-d	1,61 a-c	1,32 c-e	8,17 a	30,5 a	1,45 a-d	3,23 b-d
HKF7	2,94 a	3,10 ab	1,55 bc	1,72 a-c	8,35 a	33,6 a	1,72 a	3,86 a
HKF8	2,49 ab	2,59 b-d	1,85 ab	2,13 a	7,48 a-c	29,7 ab	1,40 a-d	3,14 b-d

c. Macro- and micro-nutrient concentrations in tea leaves

	N	Macro-nutrient (g kg^{-1} DW)				Micro-nutrient (mg kg^{-1} DW)			
	(%)	P	K	Ca	Mg	Fe	Mn	Zn	Cu
Control	1,89 c	1,85 e	17,5 d	7,7 e	1,92 e	98 d	700 d	42,0 d	11,2 d
NPK	2,47 a	2,96 cd	17,7 d	21,1 a	3,04 ab	210 b	1324 b	52,8 b-d	24,2 ab
BF	2,21 b	2,90 cd	21,7 b-d	12,7 b-d	2,68 b-d	239 ab	982 cd	53,3 b-d	20,1 c
YF7	2,19 b	2,71 d	23,7 a-c	14,5 b	2,84 a-c	194 b	1279 b	57,4 bc	25,6 a
YF8	2,19 b	3,54 a-c	20,9 cd	22,3 a	3,13 a	219 b	1292 b	50,9 b-d	22,1 a-c
YF9	2,04 bc	3,20 a-d	24,6 a-c	10.0 c-e	2,68 b-d	196 b	1179 bc	46,5 cd	23,8 ab
YF10	2,17 b	2,88 cd	20,9 cd	12.0 b-d	2,61 b-d	187 bc	1219 bc	60,0 ab	20,2 c
YF11	2,13 b	3,13 b-d	28,6 a	12.0 b-d	2,57 cd	176 bc	1302 b	51,7 b-d	21,5 bc
YF12	2,28 ab	3,63 ab	26,9 a	13,5 bc	2,73 a-d	292 a	1730 a	70,7 a	22,3 a-c
HKF7	2,20 b	3,77 a	25,8 ab	15,4 b	2,99 a-c	245 ab	1664 a	70,3 a	25,1 ab
HKF8	2,13 b	1,96 e	28,2 a	9,7 de	2,34 d	180 bc	1143 bc	63,5 ab	21,5 bc

PGPR formulations caused high growth, leaf weight and enzymes activity, but it was strongly dependent on the inoculant strain formulations and parameters evaluated. Co-inoculation with multi-traits bacteria could change the tea orchard soil fertility, microorganisms, and can also affect the tea quality, yield and enzyme activity. Since PGPR inoculation caused a differential increase in leaf defence and quality-related enzymes like alcohol dehydrogenase and PPO activity, as well as activation of other plant enzymes, this may indicate that activation of these enzymes in tea leaves would be differentially affected by different formulations. In conclusion, inoculation with rhizobacteria-based bio-formulations and growth-promoting substances produced by PGPR strains might have induced a greater amount of enzymes and thereby simultaneously increased growth and yield would have been recorded. Additional studies are required to confirm the effects of PGPR strains on the different enzyme activities and to explain the mechanism by which PGPR affects the quality and antioxidant enzyme responses.

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Humus soil profiles in the Northern Urals («Vishercky» natural reserve)

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Keywords: natural reserve, mountain soils, organic matter, the profile, the optical density, process.

Introduction

Among organic compounds forming humus, the most specific are humic acids and their derivants since they are the basis for the soils humic condition characteristics. Soils humic profile characteristics such as change of the quantitative characteristics of groups of humic substances and their ratios fix the stages and phases of soil forming [1, 2].
The purpose of the research is to study humic profiles of mountain soils in Northern Urals.

Materials and Methods

Subject of the research: mountain soils in "Vishersky" Natural Reserve. It is located in the extreme north-east of the Perm region in the riverVishera headwaters. Its territory is situated within mountains with 800–1200 meters asl level difference embracing fragments of central backbones of the Urals. To the east from river Bolshaya Moiva (left feeder of Vishera river) dominates the highest mountain plexus of the reserve, and this is where the Molebny Kamen Ridge is located (1322 m asl). We conducted the pedological survey in 2014 on the Homgi Nёl mountain (Molebny Kamen Ridge) in a subgoltsy and mountain forest belt. Soil cross sections were made in a sub-belt of mesophilic subgoltcy meadows (cross section 6-14), subgoltcy light forest sub-belt (cross section 4-14) and mountain forest sub-belt (cross section 1-14). Based on acquired morphological and analyticals results, the soils were classified using 2004 year classification [3] and WRB [4]. The following parameters were evaluated at soil samples: organic matter content by Antonova's modification of Tyurin's method [5], easily oxidized organic matter by Egorov, rapid determination of humus composition in mineral soils by M.M. Kononova and N.P. Belchikova. Sodium humates extracted during the analysis of the humus composition were utilized to determine the light-transmitting ability. We determined this parameter using spectrophotometer PD-303 with seven optical filters at wavelengths of 440, 465, 494, 533, 574, 619, 665, and 725 nm.
Profile structure shows than the soils are clearly differentiated into genetic horizons. On a mesophilic meadow among parkland light and crooked forest *mountain meadow gray-humic* (*Umbrisols*) has formed. It has a stretched humus profile with gradually changing color from gray-brown to black. In light parkland forests with tallgrass

meadows on gentle slopes, *brown forest ferralitic* (*Stagnosols*) soils have formed. On more gentle slopes in the lower part of mountain forest belt under the fir-spruce taiga we have found *soddy-podzolic ferrous illuvial (Umbric Ferralic Gleyic Albeluvisols*) soils.

Results and Discussion

Total carbon distribution in *brown forest ferralitic* and soddy-podzolic ferrous illuvial soils is similar. In *mountain meadow gray-humic* soil in the middle humic horizon there is a geochemical barrier where accumulation of organic matter appears. Below this horizon (*AYm*) the sharp decline in the feature occurred. Organic matter (OM) in soils is very mobile as so as more that 50% of soil carbon is extracted. Humic matter mobility changes through the profile either gradually, increasing with depth (c.6-14), or in a differentiated manner (c. 4-14, 1-14). Humic acids (HA) content varies in a wide range of 21–74 %. Humic nonhydrolyzable residue (NR) content in the profiles of *brown forest ferralitic* and soddy-podzolic ferrous illuvial soils is similar – bimodal. Only in *mountain meadow gray-humic* soils the gradual decrease of NR through the profile is noted. The content of fulvic acids (FA) in *mountain meadow gray-humic* soil dynamically increases with depth. Changes in FA content in *brown forest ferralitic* and *soddy-podzolic ferrous illuvial* soils are also similar, the maximum is in the middle of the profile.

The *Cha:Cfa* ratio is extremely high (>1) in *mountain meadow gray-humic* soil which is due to the presence of immature (brown) HAs formed in large quantities as a consequence of lush miscellaneous grasses. In *brown forest ferralitic* soil the *Cha:Cfa* ratio changes sharply through the profile suggesting that ecological conditions changed during the soil forming. In *soddy-podzolic* soil the *Cha:Cfa* ratio changes regularly but is more than 1 in the lower horizon. Perhaps this indicates a buried humus horizon in the past.

The curves of profile distribution of group humus composition features show that in different horizons (*AY* in c. 6-14; *BFMgr* in c. 4-14; *BFg* in c. 1-14) of studied soils in approximately the same depth (16-34 cm) the values are close by total carbon content (1.30-1.01-0.95, respectively) and HA (25.50-35.84-26.90) and FA (51.24-47.28-64.57) content. Furthermore, the lowest content of NR (23.27-16.89-8.52) and low values of *Cha:Cfa* ratio (0.50-0.76-0.42) are noted in the same horizons. Thus, we can assume that these horizons formed in similar environmental conditions and probably at the same time. Horizons *AY* (29-34 cm) in *mountain meadow gray-humic* soil, *BFMgr* (16-31 cm) in *brown forest ferralitic* soil and *BFg* (16-34 cm) in *soddy-podzolic ferrous illuvial* soil can be considered as markers since they are the interface between the upper and lower part of the profile, where values of humus group composition increase or decrease sharply. This suggests different ages of horizons within the profile and soils themselves as a whole.

Determined light-transmitting capacity showed that humic substances have an ascending light transmission with the greatest decrease in short wavelengths (400 nm) and the smallest decrease in the long wavelengths (725 nm), which indicates the uniformity of chemical nature of the soil humic substances (Fig. 1).

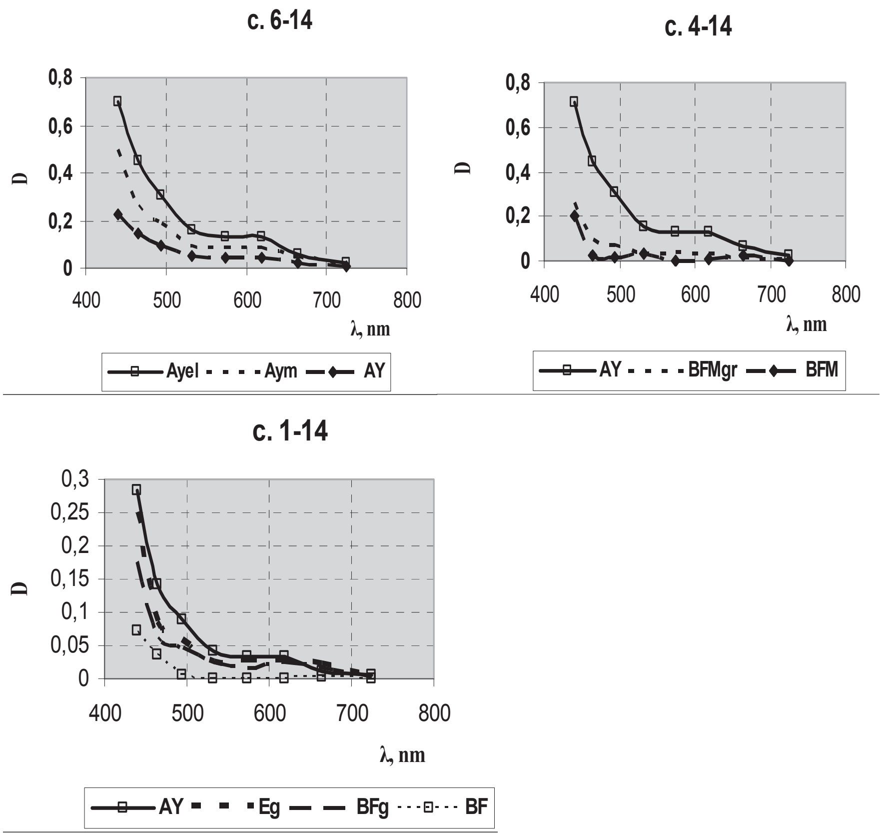

Fig. 1. The optical density of soils on Homgi-Nël mountain

Humic horizons of the soils have lower light-transmitting capacity and higher optical density of HAs. The studied samples of HAs had peaks of various degree of manifestation which indicates the presence of R-type HAs also known as green humic acids, the distribution of which is found mainly in soils experiencing excessive moisture. In *mountain meadow gray-humic* soil there is a small peak in wavelength range of 560-630 nm (see Fig. a). Organization of HAs differs in different horizons, since the curves of the absorption spectra coincide at a wavelength of more than 720 nm only. In *brown forest ferralitic* soils there are slightly expressed peaks and very low-sloped absorption spectra of iron-metamorphic horizons (see Fig. b). In *soddy-podzolic ferrous illuvial* soil the content and structure of HAs differs through horizons (see Fig. c). In the iron-metamorphic gley horizon there is a small peak at 480-510 nm and 590-610 nm. The presence of these peaks indicates excessive moistening. There are no peaks in the underlying structural and metamorphic horizon.
The extinction coefficient was calculated to characterize HAs. The optical density (D) of HAs is very low in soils of alfehumic (c. 4-14) and iron-metamorphic horizons. In *mountain meadow gray-humic* (c. 6-14) soils a very high D is marked through the whole profile. In *brown forest ferralitic* (c.4-14) and *soddy-podzolic ferrous illuvial* (c. 1-14)

soils the absorption coefficient varies from very high in humus horizon to very low. Thus, the HAs group is unstable in the soils which again confirms their youth and immaturity. We established the average direct correlation between the extinction coefficient (E465 and E665) and the content of readily degradable organic matter (0.59 and 0.61, respectively); also there is unstable weak inverse correlation with an area altitude.

Color coefficients ($Q=D_{465}:D_{665}$) were calculated in order to determine the degree of condensation of the aromatic ring of HAs. Wide range of Q ratio (0.88-12.00) are characteristic of the soils, which suggests a less complex structure of HA molecules due to the nature of mountain soil forming. HAs in humic horizons have the highest condensation. Low temperatures, high humidity, acidic pH, weakened microbial activity and enough OM biomass leads to the transformation of intermediate high-molecular decay products of humification hypothesis of L.N. Alexandrova. We have established an inverse correlation between the color coefficient and area altitude (-0.63).

Conclusion

Based on the study of indicator signs of humus condition in mountain soils on Homgi-Nël mountain on the west macroslope of Northern Urals, the buried soil horizons and soils of different ages interchanging along the slope were diagnosed. Humus profiles capture changes in the environment over the entire period of the soil profile formation, both quantitatively and by the ratio of the main components of humus. It is necessary to continue research on the reconstruction of the environmental conditions for the genetic soil horizons formation in the northern Urals.

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Agroecological evaluation of fertility of soils of forest-steppe of Krasnoyarsk region

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Keywords: soil-environmental index, soil combinations, soil contrast

Quantitative evaluation of soil's resource potential is the basis for distribution and implementation of adaptive-landscape systems of agriculture [1; 2]. One of evaluative indexes of land areas' soil cover is soil-environmental index (SEI), proposed by Karmanov I.I. [3]. SEI can be used to assess fertility of individual soils, soil combinations (SC) and arable fields with a complex soil cover structure (SCS). It is an integral index, which takes into account wide range of soil and climatic characteristics (moisture and continentality, density, granulometric composition, agro-chemical and agro-ecological properties of soils).
The report describes the results of SEI usage for assessment of fertility of arable lands of 4 agricultural enterprises located in the Krasnoyarsk forest-steppe (table 1). Gently rugged, knobby, hilly and pitted topography of this territory causes considerable complexity of the soil cover. Area of fields with non-uniform SCS in these farms is 15-49%. Structure of the soil cover consists mostly of automorphic soils (agroblack and agrogray) and half-hydromorphic (meadow black) soils in kettles and harrows. Soils on slopes often have signs of erosion or deflation. Granulometric composition of soils is mainly heavy loam and clay.

Table 1

Research objects

Agricultural enterprise (farm)	Coordinates	Arable land area, ha	Number of fields		complexity percent
			total	non-uniform SCS	
Taejniy	lat. 56º 24’ N long. 93º 38’ E	8 538.90			17
Shilinskoe	lat. 55º 32’ N long. 93º 03’ E	17 770.11			49
Mayak	lat. 56º 32’ N long. 93º 24’ E	15 703.40			15
Minderlinskoe	lat. 56º 26’ N long. 92º 54’ E	4 872.40			26

SEI was determined using method [4] on each object for all soils, SC and land area as a whole. The calculations used soil maps and agrochemical cartograms, databases describing each soil contour of farms, and experimental materials. Discussion of the results includes three components of SEI: climate (SEIc), agrochemical index (SEIa) and soil (SEIs).

At the same climatic conditions (SEIc = 3.71), which are characteristic for a limited area of distribution of these farms, crop yields will be determined by the unfavorable soil and agrochemical properties (table 2). However, a low value of SEIc is one of the reasons for relatively low grain yields (2-2.5 t/ha on average) in land utilization of the Siberian region compared to the same forest-steppe areas of the European part of the country in which SEIc (according to [5]) reaches value of 8 44.

Agrochemical index (SEIa) was determined depending on the ratio of the areas with different content of plant food compounds and with different area shares of arable soils with different pH values. Farms' soils are characterized by high and very high content of nutrients (P_2O_5, K_2O) and mostly neutral reaction of soil environment. Therefore, the final index for agrochemical farms in this research is 1.11-1.13.

Evaluation of soil component of SEI (8.23-11.33) varies depending on humus horizon depth, humus content and granulometric composition. As a rule, SEIs in soils with strong or moderately strong humus horizon and heavy loamy granulometric composition is higher than in shallow clay soils. The contribution of the humus content to the soil component of SEI is rather high (r=0.60-0.99).

In general, SEI values for different soils of examined farms range from 25 to 52 points, which characterizes a fairly wide range of fertility of these soils. Weighted average SEI values for farms are different and range from 38 to 46 points.

The potential fertility of arable lands is largely limited by SCS components with negative agronomic characteristics (table 2). Accounting for agronomic characteristics of SCS is composed of an integrated assessment of SC (weighted average SEI value by shares of soil cover components), SEI value range for SC components, and SC contrast. SC contrast means ratio of SEI components with maximum and minimum values.

Spread of SEI values within the farm shows intralandscape non-uniformity of the agro-ecological condition of soil cover. The "Taejniy" farm, being located on high ancient terraces of the Yenisei, is characterized by more smooth relief and more favorable soil conditions compared to other farms. SEI of all SCs here is 44-47 points, the range of SEI components of each complex is small, which leads to low soil-environmental contrast.

The greatest contrast was seen on farms "Shilinskoe" and "Mayak". SEI of some SCs varies between 27-47 points and range of SEI for different SC is more than 20 points. SC contrast here is increased to 1.58-1.62 compared to SCs of "Taejniy" and "Minderlinskoe".

In a series of the same type soil combinations of compared farms (fields 1-4, 8, 9, 11, 12 and 16), range of SEI values varies slightly. As a result, contrast is low. Soil combinations in fields 5-7, 10, 13-15, 17 and 18 have more diverse component composition. They are characterized by a fairly large range of SEI values (field 7 and 13). SC contrast here has maximum value. Consequently, tight interdependency (r=0.96) was discovered between SEI and soil contrast (see figure).

Table 2

SEI of soil combinations

Field #	Soil combination (SC)	Field area, ha	SEI		
			weighted average	range	contrast
Shilinskoe					
1	AGd$_3$'''cl (0,64), AGd$_3$'' cl (0,18), AG$_2$'' hl (0,1), AG$_2$'' cl (0,08)	47.3	34	35-31	1.13
2	AGd$_3$''' cl (0,45), AG$_2$'' cl (0,47), AG$_2$' cl (0,08)	48.8	27	28-26	1.07
3	AChy$_2$' cl (0,54), AChy$_2$'' cl (0,41), AChy$_3$ ^{оп} '' cl (0,005), AChm cl (0,045)	431.7	47	50-46	1.08
4	AChy$_2$' cl (0,40), ACcm $_2$' cl (0,60)	196.4	40	41-39	1.05
5	AChy$_2$'' cl (0,79), AG$_2$'''cl (0,14), AG$_3$'' cl (0,06), AG$_2$'' hl (0,01)	108.1	35	37-25	1.48
6	AGd$_3$''' cl (0,88), AG$_3$'' cl (0,05), AChy$_2$'' hl (0,02), AChy$_2$' cl (0,05)	294.1	27	35-26	1.34
7	AChy$_1$' cl (0,92), AG$_2$'' cl (0,06), AChm cl (0,02)	60.7	45	49-31	**1.58**
Taejniy					
8	AChy$_2$'' cl (30) + ACcm$_2$'' cl (0,70),	373.5	46	47-45	1.04
9	AChy$_2$'' cl (0,56), ACcm$_2$' cl (0,44)	252.8	44	47-42	1.12
10	AGd$_3$''' cl (0,02), AChy$_2$''hl (0,98)	102.5	47	47-36	1.31
Mayak					
11	AChy$_3$''lm (0,51), ACcm$_2$''hl (0,49)	468.4	45	46-44	1.05
12	AG$_2$'' cl (0,88), AG$_3$'' cl (0,12)	53.2	27	29-27	1.07
13	AGd$_3$'' cl (0,09), AChy$_2$''hl (0,67), AG$_2$'' cl (0,24)	465.3	41	47-29	**1.62**
14	AGd$_3$'''cl (0,02), AChy$_3$''hl (0,98)	498.0	46	47-35	1.34
15	AG$_3$'' cl (0,24), AChy$_3$''cl (0,29), AChy$_2$''лс (0,47)	77.5	36	40-31	1.29
Minderlinskoe					
16	AChy$_3$''hl (0,62), AChm hl (0,38)	26.2	49	51-48	1.06
17	AChy$_2$'cl (0,06), AGd$_3$'''hl (0,94)	321.7	36	45-36	1.25
18	AChy$_3$''hl (0,62), AGd$_3$'''hl (0,94), AG$_2$'' cl (0,24)	240.6	34	47-32	1.47

Notes: AGd – agro gray dark soil; AG - agro gray soil; AChy – agrochernozem luvic; ACcm – agrochernozem cryogenic micellar (standard); AChm – agrochernozem hydrometamorphed (meadow and black soil); lm - loam, hl – heavy loam, cl – clay (particle-size distribution); superscript is humus horizon depth; subscript is humus content.

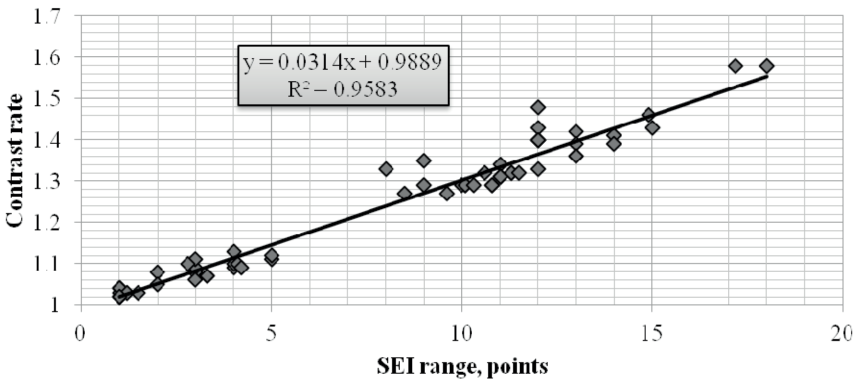

Fig. 1. Correlation dependence between SEI range and contrast rate

Conclusion

Environmental component in assessment of arable lands' soil cover plays more and more important role in evaluation of SC fertility. Usage of SC SEI for evaluating agro-environmental groups and types of lands allocated for the design of adaptive-landscape systems of agriculture and agro-technologies makes it possible to solve agronomic problems for the entire agricultural landscape and land use management.

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Effects of vermicompost extract (tea) on tomato seedling production

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Key words: Vermicompsot, vermicompost tea, tomato, plant nutrition

Introduction

Vermicompost-tea is beneficial for plant growth (Fritz et al., 2008), stimulate the germination of seeds (Arancon, 2012) and improve mineral nutrient status of plants and media (Pant et al., 2011). The vermicompost tea contains indole acetic acid (IAA), cytokinin, gibberellins, and humic acids (Arancon, 2012); therefore it could be responsible above mentioned beneficial effects. Although Fritz et al. (2008) reported improvement on plant quality rather than in quantity, Pant et al. (2011) and Zhang et al., (2014) report beneficial effects on both quality and quantity of products. Due to the extraction methods and the treatments after extraction varied in quite wide range, there is no consensus exists on both production and utilization methods of vermicompost tea. This research is carried out to represent one possible extraction method and application doses on tomato seedling production.

Material and Methods

Vermicompost was obtained from microbiologically pre-composted animal manure. A hundred of individual *Eisenia fetida* introduced to 1 kg of animal manure and after two weeks, earthworms are separated by 3 mm sieve. Afterwards, three-hundred gram of vermicompost made up to one liter using reverse-osmosis (RO) water and mixed thoroughly for 2 hours. Suspension decanted for 1 hour and filtered by 106 μ sieve. At the end, 770 ml of solution obtained. That solution was stored at 4 °C for few days until all preparations were done. Either 1 ml vermicompost extract or RO water applied to each viol hole according to experimental design given Table 1.

Table 1

Experimental Design

	Days after seed introduction					
Application Times	0	2	4	6	8	10
0	-	-	-	-	-	-
1	+	-	-	-	-	-
2	+	+	-	-	-	-
3	+	+	+	-	-	-
4	+	+	+	+	-	-
5	+	+	+	+	+	-

(+): 1 ml vermicompost extract (-):1 ml of RO water

Experiment was carried out at 10 replicates. At the end of the experiment stem diameter was measured 1 cm above the shoot. Then, plants were cut just over the root and dried at 65 °C until their weight stabilized. Plants dry weights determined using scale and their nutrient compositions were analyzed using atomic absorption spectrophotometer according to Kacar and Inal (2010).

Results

The effects of vermicompost extract on dry matter development and stem diameter are presented in Fig. 1 and Fig. 2, respectively. Both root and shoot dry weight influenced by repeated vermicompost tea (VT) applications. The highest plant shoot dry matter was found at three-time VT applied plants as 243 mg plant^{-1} whereas the highest root dry matter development and stem diameter was in one time applied pot as 63 mg plant^{-1} and 3.66 mm, respectively. Three and more times VT applications were not beneficial on root dry matter development comparing to control. There was no differences between control, 4 and 5 time VT application considering shoot dry weight. Total biomass production was observed at one time VT applied plants as 303 mg plant^{-1}. Similarly the total biomass parameter, the highest diameter observed at one time VT application and every increasing VT doses are decreased stem diameter parameter.

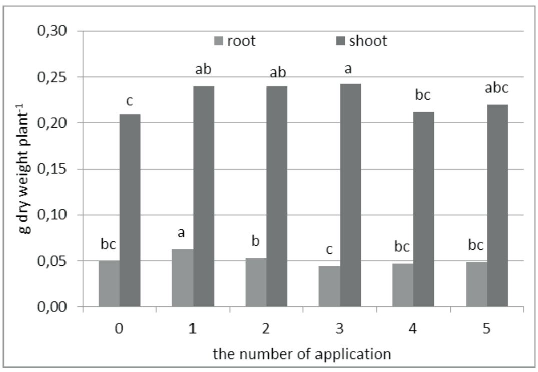

Fig. 1. Root and shoot dry matter developments (different letters on the bars are indicating statistical differences at p<0.001 level)

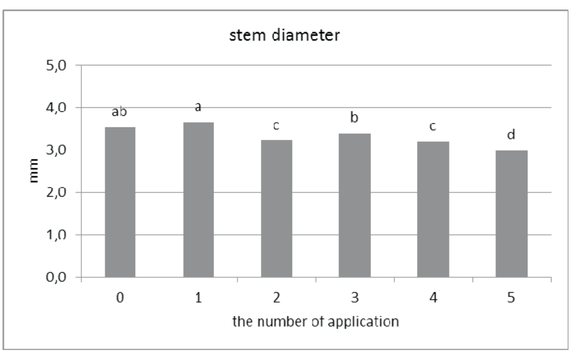

Fig. 2. Stem diameter measurements (different letters on the bars are indicating statistical differences at p<0.001 level)

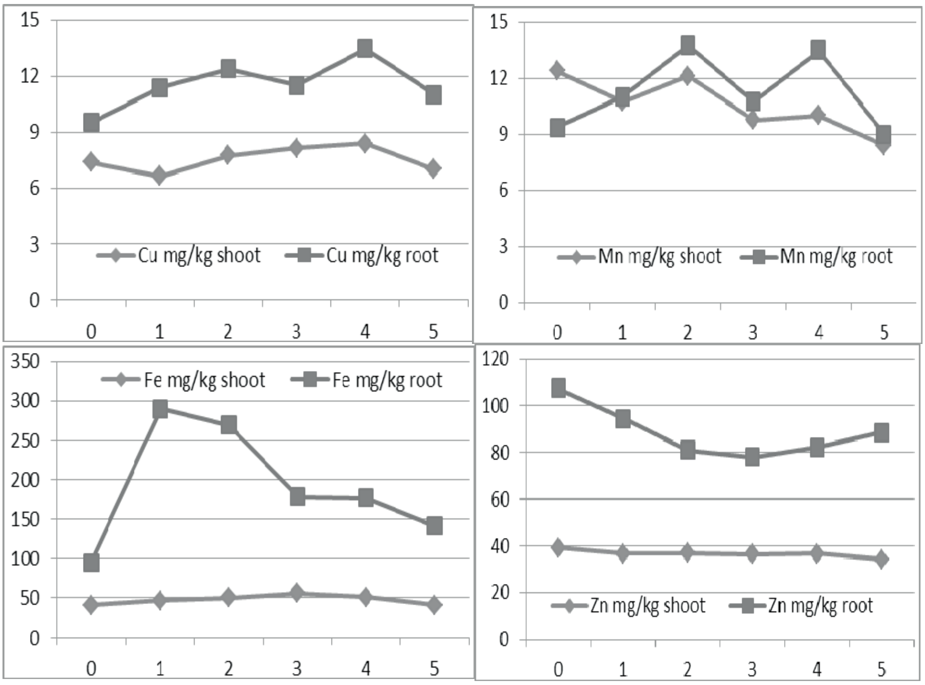

Fig. 3. Some micronutrient concentrations

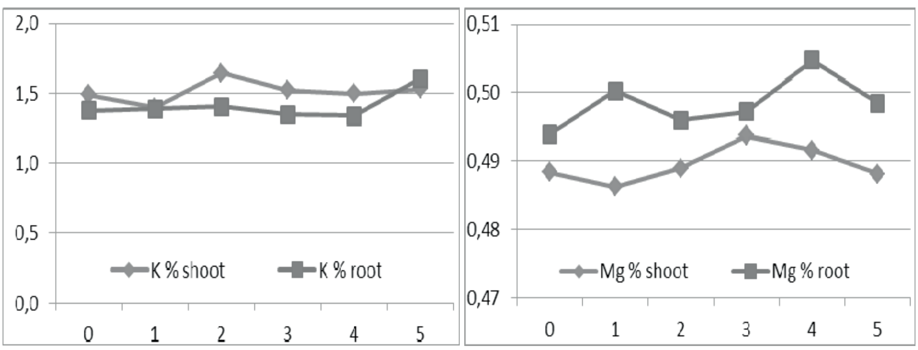

Fig. 4. Some macronutrient concentrations (note the vertical axis is started from 0,47 in Mg)

Some selected micronutrients (Cu, Mn, Fe and Zn) and macronutrients (K and Mg) are presented in Fig. 1 3 and 4, respectively. Root nutrient contents determined higher in almost all parameters than shoot contents. Shoot cupper concentration was tend to be increased up to 4 times application in accordance with root Cu contents. There were great fluctuation on Mn contents of the plants but in general, shoot Mn contents is decreasing by increasing application time of VT. Root Mn concentration increased

up to 2 time VT. Root Fe concentration reached its maximum value at first application and gradually reduced by repeated VT usage. Shoot Fe concentration tends to be increase by increasing application time. Both root and shoot micronutrients concentrations are decreased by increasing VT application time. There was great fluctuation on nutrient composition of the plants; therefore, no statistical significance was observed in any micronutrient results. Considering higher micronutrients contents of the root, the higher shoot biomass and/or higher shoot micronutrients contents would be observed if longer experiment would carried out.
Potassium concentration seems to be not effected by VT applications. Although slight changes observed, the differences do not have importance in practice. Similarly Mg content is not meaningfull in practice, only slight differences was determined.

Conclusion

Considering a number of researches carried out in the literature, here is no doubt that vermicompost itself or vermicompost tea have a beneficial effects on plant quality and/or yield. This study also confirmed the beneficial effects of vermicompost tea in smaller amount of application. But contrary to literature, unfavorable effect was determined in case of repeated application of highly concentrate VT. More experiments required to evaluate optimum doses and VT concentrations. Until more detailed results accumulate, suggestion of lower concentration VT would increase farmer profit. Arancon (2012) also advise lower concentration but longer application sequence to take advantage of bio-hormones in VT.

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The content of the organic carbon in grounds of the Caspian sea

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The main aim of the researches of conditions of forming of the marine water bodies is the assessment of a content of the organic carbon (the most representational indicator of the organic substance) in grounds.

The organic substance, being an active participant in sedimentation and diagenetic cycles of the polluting and biogenic components, plays a leading role in the circulation of chemical elements (1). The accumulation of the organic matter brings down the density of the grounds and influences on the intensity of the processes of secondary pollution of water (2). The level of accumulation of the organic matter in grounds also determines the trophicity of the water body (3). The organic matter in grounds is a basis of the nutrition of the most of organisms of the Caspian benthos (4).

776 specimens of soils were the material for the researches, which was collected in 1994-2012 in the Western part of the Caspian Sea. Organic carbon in soils was determined by the Tyurin's method) and State Standard 26213-91, granulometric composition – State Standard 12536-79. During the study period also were identified the following indicators: pH; oxygen – by the Winkler's method; phytopigments − spectrophotometry. In determining dissolved organic carbon was used the method of the bichromate burning.

The main type of soils of the Western part of the Northern Caspian Sea are of different size Sands with admixture seashell. Sludgy Sands are deposited in the Eastern part of the outfall space of the Volga River, aleuric silts and seashells deposits–spots, the oolites – in the Eastern part of the boundary with the Middle Caspian Sea.

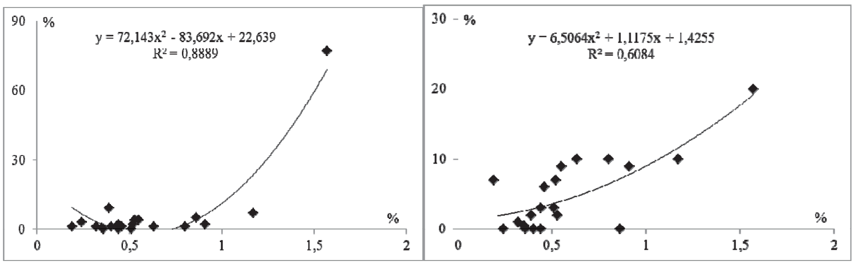
The studies revealed that the concentration of organic carbon in soils of the Western part of the Northern Caspian Sea during the period 1994-2012 was changed from 0.01 to 2.82 %. The spatial distribution of organic carbon was characterized by heterogeneity.

The content of the organic carbon in soils of the Northern Caspian Sea depends on the type of precipitation, hydrodynamic and productional parameters.

Oozy soils are the richest in organic matter. Seashells and oolitic soils are characterized by high organic carbon content, due to the deposition of recoverable by bio-filtration system of fine suspended material and high sorption activity (5).

Statistical analysis showed that the content of the organic carbon in soils is in direct correlation dependence on the percentage of pelitic ($d < 0.01$ mm) and aleuric ($d = 0,01\text{-}0,1$ mm) sediment fractions. The correlation coefficient between the studied components reached + 0,73 + 0,76 ($p < 0.05$), respectively (2008) (Fig. 1). This dependence indicates that the highest intensity of accumulation of the organic material inherent fine-dispersed soils having a higher active surface area and, consequently, the best ability for sorption of organics.

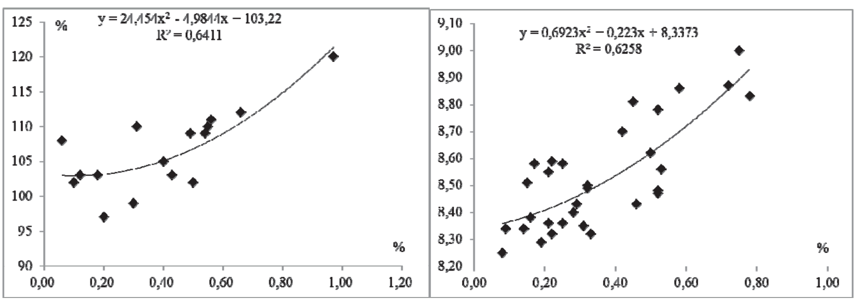
The geographic ranges of the distribution of soils with high content of organics not always coincide with areas of bedding of the fine-dispersed soils that connected with the influence on the intensity of the accumulation of the organic matter of productional processes.
The researches revealed a positive dependence between the accumulation of the organic carbon in soils and indicators of the intensity of primary producing of the organic matter (satiation of the superficial water with oxygen, pH-value, the content of the phytopigments).



a) b)

Fig. 1. The closest correlation in links with the organic carbon (%) – the percentage of the pelitic fraction (%) (a), organic carbon (%) – percentage of the aleuric fraction (%) (b)

The closest link between the level of accumulation of the organic carbon in soils and satiation of the superficial water with oxygen was revealed in June of 2011 ($r = +0,74$, $n = 13$, $p < 0,05$) (Fig. 2). The maximum coefficient of the correlation (+ 0,78) in connection with organic carbon in soils – pH of the coating surface of water was recorded in August of 1994 г. ($n = 31$, $p < 0,05$).



a) b)

Fig. 2.The closest correlation in links with organic carbon (%) – the saturation of surface waters with oxygen (%) (a), organic carbon (%) – pH (b)

The concentration of phytopigments is an indicator of the intensity of the primary production of the Sea. The correlation coefficients between the concentrations of phytopigments and concentration of organic matter in soils are presented in the Table 1.

The positive correlational dependence between concentrations with organic carbon in soils and phytopigments argues of influence of the intensity of the primary production to the concentration of soils with the organic material. Most notable is the impact of chlorophyll "a", presented in all photosynthetic organisms, and also carotenoids, whose contents are mediated through trophic relationships of benthic biocenosis.
Thus, the studies have shown that the level of accumulation of organic matter in soils of the Northern Caspian sea is in direct positive correlation between the percentage of pelitic and aleuric fractions of sediment, as well as on indicators of level of development of production processes (oxygen in the surface layer of water, pH, the concentration of phytopigments). The highest intensity of accumulation of organic material typical of fine-dispersed soils occurring in areas with high levels of new formation of the organics.

Table 1

The correlation coefficients between the level of accumulation of organic carbon and the concentration of phytopigments.

	005 I	008 II	008 X	009 II	009 X	009	010 II	011 II	011 III
a»	0,63	0,79	0,53	0,46	*	0,50	0,50		0,79
b»					0,47		0,79		0,62
c»				0,40		0,47	0,56	0,52	0,65
еофитин	0,89	0,73	0,48				0,70		0,79
ароти-		0,79	0,54				0,58		0,84
abc		0,77		0,47		0,51	0,55		0,83

* − - the lack of statistically significant relations

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Comparison of Composted Tobacco Waste and Farmyard Manure As Organic Amendments: Influence on The Yield and Nutrient Content of Lettuce

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Keywords: lettuce, manure, nutrients, tobacco waste, yield,

Introduction

Increase of population and the industrial development produced an enormous amount of organic residues that generate great environmental problems nowadays. Potential solution is better use of organic residues resulting from human activities, such as sewage sludge, manure and mankind own organic residues, such as tobacco waste in agricultural soil. Because it allows recycling, lessening the pollution problems, as well as the improvement of the physical conditions, chemistries and biotic of the soils (Brito et al. 2007). Benefits of organic wastes and compost amendments to soil have been reported by many researchers (Darwish et al. 1995; Delibacak et al. 2009).

Since farmyard manure (FM) is not found in sufficient amounts in farms, other organic materials can be used instead of manure to improve soil properties and plant nutrients in soil. Tobacco solid waste is classified as an agroindustrial waste. Direct use of tobacco waste could create an unfavorable soil environment; however, composting tobacco waste could accelerate the breakdown of nicotine and result in the production of a less toxic and more useful organic amendment (Adediran et al. 2004).

In the present study, composted tobacco waste (CTW) combined with FM at different ratios was applied to soil, and the influence of these amendments on the yield and nutrient content of butter head lettuce (*Lactuca sativa* L.) were investigated.

Materials and Methods

Experimental site and field experiment

The experiment was conducted in 18 parcels in a randomized block design with three replications at the Agriculture Faculty's Research Farm of Ege University in Menemen plain, Izmir, Turkey (38°58′35.51″-38°58′36.03″N; 27°03′84.56″-27°03′89.81″E). The investigated soil is characterized by loam texture with slightly alkaline reaction and classified as a Typic Xerofluvent (Soil Survey Staff 2006). Some physical and chemical properties and macronutrients and micronutrients in the experimental soil are given in Table 1. General properties of the organic materials (CTW and FM) are given in Table 2. The treatments were (1) control, (2) 12.5 t ha^{-1} FM + 37.5 t ha^{-1} CTW, (3) 25 t ha^{-1} FM + 25 t ha^{-1} CTW, (4) 50 t ha^{-1} FM, (5) 50 t ha^{-1} CTW, and (6) 37.5 t ha^{-1} FM + 12.5 t ha^{-1} CTW. Both materials were applied to the soil after composting. At the beginning of the experiment, 50 t ha^{-1} materials were applied to the soil because lettuce plants need 50-100 kg N ha^{-1} (IFA 1992). Lettuce seedlings were planted by hands.

Soil and plant analyses and statistical analysis

Soil texture (Bouyoucos, 1962), gravimetric water content of moist FM and CTW (Jury et al., 1991), total salt, organic matter, $CaCO_3$, pH, total N, P, K, Ca, Mg, Na concentrations of CTW and FM samples (Page et al., 1982). Total salt, OM concentration, $CaCO_3$, pH and total N (Page et al., 1982), available P (Olsen et al., 1954), available Ca, Mg, K and Na of experimental soil were analyzed (Kacar 1994). Total N, P, K, Ca, Mg, Na, Fe, Mn, Zn and Cu concentrations of butter head lettuce samples were all determined according to Page et al. (1982). Analysis of variance was performed using the Statistical Package for the Social Sciences, version SPSS 17.0. (SPSS 17.0 2008).

Table 1. Some physical and chemical properties of the experimental soil

Parameter	Value	Parameter	Value
Soil texture	Loam	[1]P	8.88
Sand (%)	44.26	[1]K	447.2
Silt (%)	44.13	[1]Ca	2752
Clay (%)	11.61	[1]Mg	529.4
pH	7.52	[1]Na	217.9
Total salt (%)	0.085	[1]Fe	7.11
$CaCO_3$ (%)	5.38	[1]Cu	1.45
OM (%)	2.53	[1]Mn	6.85
Total N (%)	0.129	[1]Zn	1.36

[1]Available (mg kg^{-1}) OM: Organic matter

Table 2. Some properties of composted tobacco waste (CTW) and farmyard manure (FM)

Parameter	CTW	FM	Parameter	CTW	FM
pH	9.17	8.70	[1]P (%)	0.49	0.58
EC (dS m^{-1})	40	38.5	[1]K (%)	2.688	3.072
Org. C (%)	37.87	39	[1]Ca (%)	1.287	1.521
OM (%)	65.3	67.2	[1]Mg (%)	0.655	0.615
C/N	17.37	16.5	[1]Na (%)	0.255	0.281
$CaCO_3$ (%)	2.43	2.09	[1]Fe (mg kg^{-1})	2166	1570
60°C WC (%)	7.19	5.50	[1]Cu (mg kg^{-1})	29	84
105°C WC (%)	29.79	25.13	[1]Mn (mg kg^{-1})	68	236
Total N (%)	2.18	2.35	[1]Zn (mg kg^{-1})	134	112

[1]Total, WC: Water content, OM: Organic matter

Results and Discussion

Influence of CTW and FM applications on grown lettuce yield in soil are given in Table 3.

Table 3. Influence of composted tobacco waste (CTW) and farmyard manure (FM) applications on the lettuce yield

Treatments	Lettuce yield (t ha^{-1})		
	First vegetation	Second vegetation	Total yield
Control	50.7 b	31.0 c	81.7 b
25% FM+75% CTW	60.8 a	38.0 ab	98.8 a
50% FM+50% CTW	59.9 a	37.7 ab	97.6 a
100%FM	60.9 a	37.4 ab	98.4 a
100% CTW	62.7 a	39.9 a	102.7 a
75% FM+25% CTW	60.1 a	36.0 b	96.2 a

Means for CTW and FM rates applied in soil in the same vegetation followed by the different letters are significantly different (Duncan; $P \leq 0.05$)

Table 4. Influence of composted tobacco waste (CTW) and farmyard manure (FM) applications on nutrient content of lettuce leaves

Applications	1st vegetation	2nd vegetation	1st vegetation	2nd vegetation	1st vegetation	2nd vegetation
	N (%)		P (%)		K (%)	
Control	2.35 c	2.74 b	0.57 b	0.61 b	7.42 ab	4.60 a
25% FM+75% CTW	3.08 a	3.18 a	0.73 a	0.71 a	7.86 a	4.98 a
50% FM+50% CTW	3.01 ab	2.98 ab	0.68 a	0.72 a	7.93 a	5.07 a
100%FM	2.89 ab	3.38 a	0.71 a	0.73 a	7.97 a	5.35 a
100% CTW	3.01 ab	3.08 ab	0.66 a	0.70 a	7.67 ab	4.91 a
75% FM+25% CTW	2.62 b	3.22 a	0.68 a	0.73 a	7.90 a	5.19 a
	Ca (mg kg^{-1})		Mg (mg kg^{-1})		Fe (mg kg^{-1})	
Control	7049 d	5506 e	2102 b	1318 c	145.8 c	82.6 c
25% FM+75% CTW	7550 c	6433 cd	2187 ab	1585 ab	192.4 ab	106.2 ab
50% FM+50% CTW	7906 b	6506 bc	2353 a	1452 abc	183.3 b	101.2 ab
100%FM	8125 a	6836 a	2183 ab	1418 bc	178.5 b	92.6 bc
100% CTW	7932 ab	6320 d	2300 ab	1652 a	207.2 a	112.9 a
75% FM+25% CTW	7963 ab	6676 ab	2228 ab	1452 abc	182.0 b	97.2 abc
	Cu (mg kg^{-1})		Zn (mg kg^{-1})		Mn (mg kg^{-1})	
Control	10.4 d	12.6 c	16.0 c	26.6 d	33.1 b	24.5 b
25% FM+75% CTW	18.1 bc	18.9 b	21.3 ab	35.3 a	38.5 a	26.7 ab
50% FM+50% CTW	18.9 abc	21.3 a	21.2 ab	32.3 abc	38.4 a	26.8 ab
100%FM	19.8 a	21.0 a	18.3 bc	30.3 c	39.8 a	27.2 a
100% CTW	18.0 c	19.1 b	24.2 a	33.6 ab	39.2 a	25.3 ab
75% FM+25% CTW	19.6 ab	20.3 ab	19.2 b	30.6 bc	39.1 a	26.4 ab

Means for CTW and FM rates applied in soil in the same vegetation followed by the different letters are significantly different (Duncan; $P \leq 0.05$)

Lettuce yield decreased in 2nd vegetation period due to negative effect of cold winter season. The highest total yield of lettuce in both vegetation periods was determined in

100% CTW application. Gunes et al. (2014), reported that application of biochar and poultry manure increased lettuce yield. Influence of CTW and FM applications on nutrient content of lettuce were given in the Table 4.

N and P content of the lettuce samples showed an increase in both vegetation periods statistically with CTW and FM applications. Maximum K content was determined 100% FM application (7.97%). Tepecik et al. (2014), found that N contents varied between 2.11 % and 2.70 % in the conventionally grown basil and between 2.21 % and 2.39 % in the organically grown basil. Gunes et al. (2014), determined that phosphorus and K concentration of the lettuce leaves significantly increased by poultry manure and biochar treatments. The effect of 100% FM application on Ca content of lettuce samples showed the highest increase in both vegetations. The highest Mg quantity in the first vegetation lettuce samples was determined in 50%CTW+50%FM application. On the other hand, the highest Mg quantity in second vegetation lettuce samples was in 100% CTW application. Maximum Fe quantity of lettuce samples in both vegetations was determined in 100% CTW aplication. When Cu contents of the lettuce samples were examined, the maximum value in the first vegetation was obtained in 100% FM application. The maximum Zn content of the first vegetation lettuce samples was determined in the 100% CTW application. As for the second vegetation lettuce samples, the maximum Zn value was determined in the 25%FM+75%CTW application. Maximum Mn content of first and second vegetation samples was determined in 100 %FM application. Demir et al. (2003) reported that average Mg, Na, Fe, Cu, Mn and Zn content of lettuce were determined as mg kg^{-1} 2321, 1007, 172.39, 12.51, 61.99 and 45.33, respectively, after appliying different organic fertilizers.

The quantitites of nutritional elements in the lettuce samples apart from N, P, Cu, Zn and Mn were determined as much higher in the first vegetation products than the second vegetation products. This case is also the same with lettuce yield. The reason behind this can be attributed to the fact that the second vegetation lettuce production happened in winter and metabolic activities showed a decrease because of the decrease of the temperatures.

Conclusion

CTW and FM applications raised the lettuce yield and N, P, K Ca, Mg, Na, Fe, Zn and Mn contents of the lettuce. According to the results obtained, it can be said that CTW can be used in agricultural fields just like FM. Especially the 25%+75% CTW and 100% CTW applications showed more important effects. These results indicate that CTW can function as an alternate organic additive (soil improver) so as to enhance the amount of organic matter in the soils of Aegean Region that has the Mediterranean climate and contain low amount of organic matter. It is useful to apply tobacco wastes on soil by composting them because of their high content of nicotine. For the applications without composting, it is suggested to wait for at least a month for sowing-planting process after the application. Some other studies that will reveal the positive, long-term affects of CTW should also be carried out so as to protect and enhance the soil quality.

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Pore space investigations by morphometric and X-ray microtomography methods

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Key words: soil microstructural, x-ray microtomography, soil swelling and shrinkage.

Introduction

Pore space of soils is the most important property of soils because3 all the processes in soil-biosphere system are connected with the pore space characteristics. Characterization of the internal structure of the soil can be obtained by morphometric methods. The main method of morphometric study of the soil, until recently, was the analysis of soil thin sections and chips by use the optical and electron microscopes. Unfortunately, these methods are not acceptable to the analysis of the swelling and shrinkage of soil. There are two main methodological limitations: 1) - micromorphometric analysis of wet samples requires special procedures of dehydration of the soil without disturbing its structure; 2) - the traditional microscopic techniques do not allow us to study the three-dimensional structure of the sample without its destruction. All these shortcomings can be successfully overcame with the help of X-ray microtomography [2]. Most natural and anthropogenically transformed soils are constantly influenced by precipitation, insolation, and changing temperatures. Swelling and shrinkage processes of the soil mass are the responses to these effects. Soil swelling results in solid's volume increase caused by moistening of inorganic and organic colloids. Shrinkage is a compression of the soil, which is characterized by linear and volumetric deformations caused by changes in soil water content and other factors. The analysis of these phenomena for different types of soils is of great theoretical and practical importance. Typically, soil deformation during swelling and shrinkage evaluated by the change of soil density and pore volumes.
The purpose of this work was to study structural changes of the loamy soil during the swelling and shrinking as a result of wetting and drying in the laboratory. Accordingly, it required: 1. Assess the visual morphological differences in the pore space of different genetic soil horizons on the 3-D tomographic image (qualitative analysis). 2. To investigate the geometry of the pore space of the soil layers on tomographic slices, and a quantitative characterization of pore shape and size. 3. To analyze the changes in the pore space of 2-D tomograms for the three variants of the experiment: at original water content, complete capillary saturation and subsequent draining of soil samples.

Materials and Methods

The object of investigation is soddy-podzolic soil on the cover loess under complex spruce 100 years of age in the village Darino Moscow oblast of the Russian Federation. Coordinates of the site are 37.82138 E, 56.09823 N. Under the terms of the formation, morphological, physical and chemical properties of this soil is a typical representative of the natural soil cover modern southern taiga landscapes of European Russia.

In the field of horizons AEL, EL, BEL, BT1 and BT2, differing in chemical composition and particle size characteristics were selected undisturbed soil samples in a vertical cylindrical shape cores with 4 cm diameter and 3 cm heights. Cores were collected in a transparent plastic container, permeable for X-rays. In performed laboratory humidification cores were saturated from bottom and the subsequently dried to air-dry state. All stages of the experience, including field humidity, moisture and dryness, accompanied with X-ray microtmography analysis of the internal structure of the samples.

X-ray microtomography is a non-destructive method of computer visualization and analysis of the internal structure of the samples using X-rays. Based on hundreds of projections collected at different angles by rotating the object, the computer reconstructs a set of virtual object cross-sections spaced at 1 pixel that allows cross-section in any direction without loss of resolution. The operator can view the cross section of the cross-section study section at any angle, to obtain numerical morphometric characteristics of two-dimensional and three-dimensional images of the internal microstructure throughout the facility, or in a separate selection, to create realistic three-dimensional model of the microstructure of the object, to carry out the virtual movement within the object of study. In this study, samples were analyzed by X-ray computed microtomography on SkyScan-1172. Scanning was performed with a beam energy of 100 keV and a resolution of 9 microns per pixel. This permit does not allow the study of thin and ultrathin soil pores, but allows you to analyze large-sized samples are sufficient to characterize the aggregate structure of soil horizons.The resulting X-ray stacks of slices of soil treated in free software ImageJ and SkyScan company software. For three-dimensional imaging of the pore space, all images in the stack was separated into two phases - solids and porous space.

Segmentation was performed by selection of a single threshold value using the pixel intensity histogram. According to the obtained tomograms were performed 3-D reconstruction of the monoliths, followed by visual assessment of the morphological differences in the three-dimensional image of the pore space. For a quantitative analysis of the shape of the pore space explored 2D tomographic image of the soil in the horizontal sections. Total has been studied more than 400 slices. With the help of Adobe Photoshop CS3 (Adobe) in the images was performed gamma correction, cropping, noise reduction, binarization and others. Segmented images obtained morphometric characteristics then using software ImagePro Plus 6.0 (Media Cybernetics, USA). Final data processing was performed in Microsoft Excel, where the quantitative calculation of the number of pores, total porosity visible in the MRI scanner, the pore size distribution and shape. Characterization of pore shape conducted largest generalized factor F = (4πS / P2 + D / L) / 2, where S - area of the pores, P - perimeter of the pores, D - cross and L - longitudinal dimensions of the pores in the image [3].

Results and discussion

Visual analysis of microtomography images showed that the humus-eluvial horizon profile is characterized by loose constitution and great content isometric rugged package has lumpy aggregates . In the eluvial horizon has EL type heterogeneous structure, there are areas with a lamellar structure and biogenic lumpy microzones. In the soil mass is present since many small isolated bubble shape. In the lower horizons content increases due to presence of cracks and thin nutrient channels. Specific structure has a transitional horizon BEL, presented compacted soil mass with abundant bubble pores and separate by heavy strokes of modern roots. Quantitative analysis showed that the total pore volume, apparent tomograms significantly below the total porosity determined by conventional calculation-gravimetric method [4]. The maximum value of the total pore area on separate slices do not exceed 17-18% and averaged 6.4% of the area of the field of view. This is due to the relatively low resolution tomographic survey, in which the mass of thin and ultrathin soil remain beyond the scanning resolution. The most visible in the scans have porosity horizons AEL and BT2, and the lowest - eluvial-illuvial horizon BEL. A similar, but more pronounced differentiation is observed and the number of long horizontal sections. Detailed morphometric analysis showed that scans all horizons studied numerically dominated by pore diameter 75-1000 mm (thin macropores classification Brewer [1]). Macropores larger than 1 mm in the majority of samples were detected. The exception is transitional horizon BEL, containing large-sized bubbles and root passages (Fig. 4, Table 3 and 4). The study confirmed the presence of cracks in the horizon BT1 (over 12%) and very high levels of long rounded shape on the horizon BEL (50%).
Processes moisture-draining have ambiguous effect on the pore space in different horizons. In horizons AEL and BT1 humidification is " tightened" the soil mass, a significant portion of the pore space disappears. In the horizon BT2 " tightened" soil expressed the greatest degree, and after draining the pore space do not restore the previous level. BEL changes in pore volumes on swelling-shrinkage less noticeable, which is associated with less clay particle size distribution and abundance of rounded closed pores which do not participate in the capillary saturation.
Besides pore volume upon swelling and shrinkage changes the shape of the pore space of the soil. The greatest transformation has revealed in the horizon BT1. This horizon is accompanied by a decrease in the amount of moisture treschinovidnyh and rugged elongated pores and then drying - increasing fracture rates beyond the initial native state (tab. 4). Similar changes as aand trends were noted in the BT2 horizon.

Conclusions

Differences in the structure of the soil mass matrix and the pore space in the genetic horizons of forest soddy-podzolic soil were shown experimentally. It was found that in most horizons, including elluvial humus horizon AEL, moisture-draining processes lead to more or less pronounced decrease in the pore volume visible on images. The greatest decrease in porosity is manifested in horizons with a heavy grain size and high content of fine macropores (horizon BT2). In addition to reducing the volume of pores in these horizons marked caused by swelling and shrinkage of soil dynamics of fracture. In horizons with less clay composition and containing large-sized isolated rounded pores (BEL), a marked influence processes moisture-draining soil at the mass were found.

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Impact of the anthropogenic deposits on properties of the urban soils

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Key words: anthropogenic additives, urban soils, anthropogenic soils

Introduction

Mixing or surface deposition of different materials into/on soils is one of the typical mechanisms of urban soils genesis. The effects of such deposition on soil properties were analysed on the example of Zielona Gora city, located in the western part of Poland. These artificial deposits are introduced into the soil for various reasons - both as a fertilizer and impurities as well.
As a result of the introduction to soil or surface deposition of organic materials, are formed Hortisols or anthropogenic soils enriched with humus. Their properties are typical for the good arable soils, with high TOC content (2.6-5.2%), sorption capacity to cations (CEC> 20 cmol (+)·kg^{-1}, V> 70%), high water retention (33.9-62.0%), a slightly acidic or neutral pH (6.01-7.69) and low salinity (0.03-0.39·mS cm^{-1}).
An important aspect of the described considerations is the placement of wastes in the soil profile. The organic matter in the most cases is applied as a monolayer on the surface of the soil, often previously truncated. Nevertheless, there are exceptions to this rule, where organic layers are observed in the lower parts of the soil profile. The municipal waste deposits are usually observed below the organic/humic horizon, in the upper fragments of the mineral part of the soil profile. The profiles of urban soils states also often the presence of monolayers of such waste. The construction waste are most frequently present in large quantities in the middle and lower parts of the soil profile. In the topsoil the presence of lower quantities, in the smaller particle sizes was occurred.
The anthropogenic deposits in urban soils occur in correlation with the form of land use. The scale of their presence and morphological composition also depend on the time of forming the soil, which results from different waste management conducted in different years in urban areas.

Materials and Methods

The research site is located in Zielona Gora, the western part of Poland (51°56’07”N, 15°30’13”E). The research was carried out in the town and in the administrative commune of Zielona Gora. Particular locations were selected in areas illustrating particular stages of human impact on the natural environment – 105 soil profiles at a depth of 150 cm (samples from each of the morphological layers or genetic horizons)

+ 32 bulk surface samples (an area of approximately 20 m^2 each, samples from humus horizons). In total, 562 samples were analysed (GREINERT 2003). Sorption properties were determined by the Kappen method, pH in 0.01M $CaCl_2$ – by the potentiometric method, TOC content using a Shimadzu analyser, particle size distribution – using hydrometer method.
The second part of experiment has been connected with the technogenic materials analysis. It was sampled the rubble and waste material from different locations in the city. For the analyses the raw rubble material from the construction sites was taken as well as long-term deposed in the soil. The materials were initially prepared by sieving, separation, drying and crushing.

Results and Discussion

The source of waste materials in urban soils are mainly activities involving the construction of buildings and other elements of technical infrastructure. Waste materials can be deposited not only in the place of their manufacture - there are known examples of this type of material for leveling the land, not only in the areas of housing, services, but mainly in industrial areas [Greinert et.al 2013, Fruzińska 2010]. The presence of considerable quantities of brick debris, slag and municipal wastes is a typical morphological feature of soils observed in urban areas, including Zielona Gora (Greinert 2013, Greinert et al. 2013). With regard to the development of urban soils, a considerable amount of their additional components is their bedrock.
It was confirmed by many researchers that admixtures of building materials is common in urban soil (Pouyat et al. (2007) and Pickett and Cadenasso (2009), Greinert 2015).
In Zielona Gora area various type of soils have been found, including Technosols constructed from materials of natural and technogenic origin. Most of the geological materials building the soil profile locality are medium and coarse sands of glacial and alluvial origin, gravels and in some areas, silts and clays within glaciotectonically disturbed moraine structures (Wróbel 1989, Gontaszewska, Krainski 2007). The range of bulk density of technosoils was from 1.55-2.70 $g \cdot cm^{-3}$ in soils constructed from technogenic materials and 1.82-2.64 $g \cdot cm^{-3}$ in soils constructed from natural materials. Large variability in physical properties is an effect of heterogeneous morphology of the urban soils. As a result of rubble deposition the soil properties have been changed, as evidenced by their alkalinisation (pH 3.9-8.2 vs. 3.9-7.6 in the other soil types within the city), sorption complex saturation with calcium (> 73% vs. >58%).
The smallest impact on the total porosity had natural materials without carbonates and mixed materials without carbonates. Cation exchange capacity ranged from 0.9 to 30.9 % in technosols of different carbonates content. The lowest BS for technosols was found in materials without carbonates (both natural and mixed). In all technosols the BS was close to the limit of 100 %. At the same technolsols formed of materials containing carbonate showed lower values than BS of technosols formed of materials containing carbonates. A similar pattern was observed for pH. The lowest soil reaction was found in technosols constructed from natural materials without carbonates. Many of this soils had the alkaline reaction, however the pH range from 3.9 to 8.2 (tab. 1).

An important issue is the fact of crumbling admixed materials as a result of typical land use (mechanical forces) or under the influence of weather conditions, which can cause increased surface leaching of metals into the soil solution [El Khalil et al. 2008 Lehmann and Stahr 2007].
The biggest differences in the content of skeletal parts were found in the contemporary building areas (tab. 2). Built-up areas from the XIX up to the middle of XX century showed similar content of skeletal parts. The highest content of skeleton was found in the urban areas build-up in present time. In the land of area built-up in the late 50's of XX century was found very low of carbon. The soil reaction is similar in the area of XIX and XX centuries building and contemporary buildings. Slightly lower was found in the area built-up in present time.

Table 1

Basic properties of urban soils discovered in Zielona Góra urban area

Urban soils	Bulk density	Solid particle density	Total porosity	Capillary water capacity	CEC	BS	pH in 0.01M $CaCl_2$
	$g \cdot cm^{-3}$		%		$cmol \cdot kg^{-1}_{d.m.}$	%	
Initial soils	2.49-2.66	1.49-1.58	34.5-43.5	6.9-24.8	2.7-24.8	65.4-99.9	6.30-7.60 3.90-4.46[1]
Rigosols	2.11-2.64	1.48-1.74	33.6-50.8	13.2-28.9	3.3-13.2	85.7-91.7	6.0-6.9
Treposols	1.98-2.68	1.28-1.60	29.8-42.7	12.6-26.1	2.8-25.1	58.8-100	4.0-7.3
Hortisols	1.65-1.74[2] 2.41-2.54	0.48-0.74[2] 1.40-1.58	33.9-62.0	19.5-38.8	2.0-21.6	75.8-95.9	6.2-6.9
Ekranosols	-	-	-	-	2.4-17.3	81.9-99.0	6.9-7.4
Technosols constructed from:							
natural materials without carbonates	1.82-2.64	1.48-1.78	30.5-45.5	17.4-27.2	1.6-25.5	32.2-98.8	3.9-7.4
mixed materials with carbonates	1.85-2.74	0.99-1.70	28.5-63.1	15.4-27.9	2.3-26.3	78.4-99.3	6.4-7.8
mixed materials without carbonates	1.97-2.70	1.13-1.74	33.2-41.9	12.6-22.7	1.9-21.8	40.7-99.7	5.2-7.3
technogenic materials with carbonates	1.55-2.70	0.43-1.70	42.2-70.0	16.2-24.1	0.9-25.0	73.1-100	6.6-8.2
technogenic materials without carbonates	1.65-2.61	1.12-1.71	30.2-61.0	15.0-21.7	2.4-30.9	63.3-100	5.4-7.3

[1] - in a new quarter of the city; post-forest land
[2] - in organic horizon

Table 2

Basic properties of Technosols in Zielona Góra urban area according to the age of building

Age of building	Skeleton (parts > 2 mm)	Parts < 0.02mm	Parts < 0.002mm	TC	pH 0.01M $CaCl_2$
	%				
XIX/XXth Century	11.8-51.1	1-25	0-6	0.39-3.26	3.9-7.5
50-60. of XXth C.	6.9-39.5	1-11	0-8	0.32-1.68	3.8-7.0
Contemporary	0.4-79.9	0-19	0-9	0.07-4.59	3.8-7.5
Extensive	0.0-58.7	0-31	0-15	0.46-4.95	3.2-5.1

Conclusions

- Waste materials affect the properties of urban soils. Technosols constructed from waste materials containing carbonates have different properties than technosols without carbonates.
- Technosols from Zielona Gora vary comparing the content of soil skeleton, carbon and soil reaction. Considerable importance was found also in the built-up age and the purpose of each building types.
- The presence of technogenic materials is the factor that differentiates urban soils the most. The variability in that regard is both of qualitative and quantitative nature. An admixture of different wastes in soil as a consequence of building activities is a typical, widespread situation.

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Construction debris as the anthropogenic bedrock of Technosols

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Key words: urban soils, Technosols, rubble, wastes

Introduction

The nature of urban surfaces is complex, because of the soil genesis, and different influences on the soil (GREINERT 2003, 2013, PICKETT AND CADENASSO 2009). Special attention should be paid to the uniqueness of the spatial and vertical distribution of soil parent-rocks and a high share of technogenic materials within. Their properties and degree of differentiation, and in many cases, their ease of decomposition, strongly influence the state of urban soils (MOREL ET AL. 2005, PICKETT AND CADENASSO 2009, HUOT ET AL. 2013). The presence of technogenic materials also strongly influences the potential direction of the migration of water and elements dissolved in the soil profile. Urban Soils Working Group of the German Soil Science Society pointed out the types of technogenic materials acting as parent-rocks for urban soils (BURGHARDT 1995, 1996): construction debris, slag, dust, rock material, lignite, coal, municipal waste and sludge. Wastes change the morphology and properties of soils, dominate the soil-forming processes and the soil evolution route. While studying the soil cover of the city of Essen, MEUSER (1996) noted technogenic materials, mostly rubble, in 70% of sites. BLUME AND RUNGE (1978) noted 56% brick parts in Rendzina from rubble in Berlin. NEHLS ET AL. (2013) reported that fine soil fractions of the urban soils of Berlin contained 3 to 5% of bricks, while the coarse fractions contained up to 50%. Technogenic materials present in most urban soils produce lots of pollution, which results from the composition of substrates used for their production and the manufacturing technology (HILLER AND MEUSER 1998). According to HILLER AND MEUSER (1998), industrial dusts are characterised by the EC 0.7-4.0 $mS \cdot cm^{-1}$, dusts from coal heating plants 0.9-6.0 $mS \cdot cm^{-1}$ and from lignite heating plants 2.4-3.1 $mS \cdot cm^{-1}$. High values of the EC index were noted in ash from the burning of municipal wastes – 10.5-20.2 $mS \cdot cm^{-1}$. Different bedrock materials of Technosols and admixture to them are containing elements potentially harmful for the environment. Presence of them can be combined with the directly technogenic materials addition (MOREL ET AL. 2005, EL KHALIL ET AL. 2008, GREINERT 2013, GREINERT ET AL. 2013), indirectly with the superficial deposition of dusts, and as a consequence of the aging of the components of utilities (PALM AND ÖSTLUND 1996). Construction rubble contains Cd, Pb, Zn and Cu (BLUME 1989). The presence of big amounts of Cr, Cu, Hg, Ni, Pb and Zn is connected with the different slages, ashes and dusts deposition to soil.

Materials and Methods

Zielona Gora is a medium-sized town inhabited by about 110 thousand residents and located in the western part of Poland (51°56'07"N, 15°30'13"E). From the geological and geomorphological perspective, Zielona Góra is located in the Middle-Odra-Land, on two geomorphological landforms: the Zielona Góra Moraine Belt (max. height 221 m a.s.l.) and the Chynów-Płoty Basin (about 80 m a.s.l.). Most of the geological materials building the soil profile of the Zielona Góra locality are medium and coarse sands of glacial and alluvial origin, gravels and in some areas, silts and clays within glaciotectonically disturbed moraine structures (WRÓBEL 1989, GONTASZEWSKA, KRAINSKI 2007). The role of sands is particularly large in the municipality of Zielona Góra – significantly higher than within the rest of the region. Besides natural materials, the described area is rich in artificial deposits connected with human activities, mainly related to house and road building. Locally, there are also deposits of industrial and municipal wastes, especially in the areas of former open-pits, excavations and subsidences. A phenomenon typical of the city is the prevalence of slag as an admixture in the soil profiles. This is due to the widespread use of this material through most of the twentieth century as a terrain filling material, for the road surface or the substructure. The research was carried out in the town and in the administrative commune of Zielona Gora. Particular locations were selected in areas illustrating particular stages of human impact on the natural environment – 105 soil profiles at a depth of 150 cm (samples from each of the morphological layers or genetic horizons) + 32 bulk surface samples (an area of approximately 20 m^2 each, samples from humus horizons). In total, 562 samples were analysed (GREINERT 2003). Sorption properties (hydrolytic acidity – HA and total exchangeable bases – TEB) were determined by the Kappen method, pH in H_2O, 1M KCl and 0.01 M $CaCl_2$ – by the potentiometric method; total Ca, K and Na content in aqua regia extract using flame photometry and the TOC content using a Shimadzu analyser. The content of heavy metals in the soil samples was determined by atomic absorption FAAS. Extracts in aqua regia (the mixture of concentrated acids $HCl:HNO_3$ in the proportion of 3:1) were prepared according to ISO 11466 (1995), extracts in 0.1M HCl – the fraction potentially available to plants according to Baker and Amacher (1982). Extracts in 0.1M HCl were prepared and analysed both for the soils and anthropogenic materials. Electrical conductivity (EC) of soil-water extract 1:2 was determined by conductometric method.

The second part of experiment has been connected with the technogenic materials analysis. It was sampled the rubble and waste material from different locations in the city. For the analyses the raw rubble material from the construction sites was taken as well as long-term deposed in the soil. The materials were initially prepared by sieving, separation, drying and crushing.

Results and discussion

The presence of considerable quantities of brick debris, slag and municipal wastes is a typical morphological feature of soils observed in urban areas, including Zielona Gora (Fig. 1). With regard to the development of urban soils, a considerable amount of their additional components is their bedrock. In general, admixtures of building materials were found in over 40% of the soil layers in Zielona Góra. This is a typical feature described in the literature by i.a. POUYAT ET AL. (2007) and PICKETT AND CADENASSO (2009). Glass and plastic waste was found in 3.3% of the soil layers and horizons. The presence of slag in the described soils is worth mentioning. This results from the fact that in the past, boiler rooms and heating stations discharged the waste in an uncontrolled manner, and alleys and roads were hardened with this material.

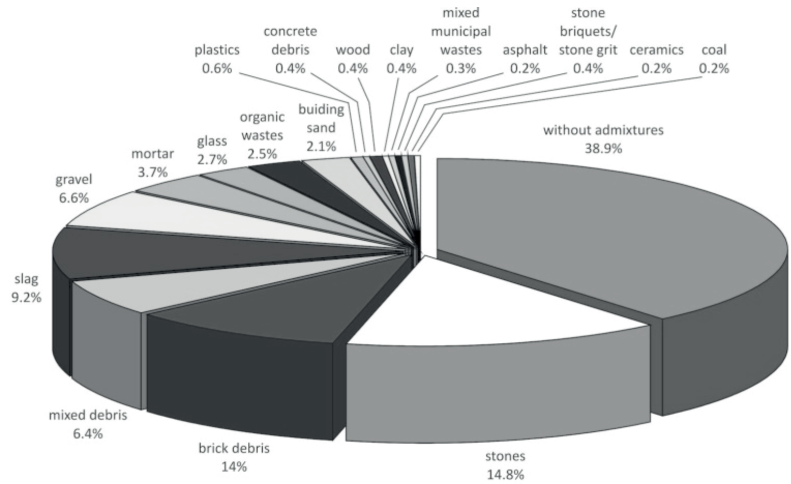

Fig. 1. Frequency of occurrence of admixtures in the soils of Zielona Gora urban area

In the course of investigation within the city of Zielona Gora, located in the western part of Poland, the different rubble materials were tested, the raw ones (after the present demolition works) and long-term deposited in soils. There were established the basic properties of rubble and soil lying under rubble deposit or containing debris additives. It was found a large variability of rubble properties, expressed in pH-H_2O 7.5-11.8, EC 0.63-4.49 $mS \cdot cm^{-1}$, $CaCO_3$ content 2.2-4.0%. This is mainly connected with the presence of mortar and plaster fragments, as well as fine parts of the cement and lime construction elements. It was obtained the image of a small load of heavy metals in the rubble in the potential bioavailable form: $Cd_{0,1M\ HCl}$ 0.12-0.18 $mg \cdot kg^{-1}$, $Cu_{0,1M\ HCl}$ 1.0-56.7 $mg \cdot kg^{-1}$, $Ni_{0,1M\ HCl}$ 1.3-17.8 $mg \cdot kg^{-1}$, $Pb_{0,1M\ HCl}$ 1.7-21.5 $mg \cdot kg^{-1}$, $Zn_{0,1M\ HCl}$ 2.4-125 $mg \cdot kg^{-1}$. This is an important element of reflection on the environmental importance of rubble admixtures to soil of the urban areas. The characteristic volatility of rubble reaction is connected not only with the properties of the construction material, but also the amount and type of construction adhesive present in the rubble. This is reflected in the results of the calcium carbonate content in the analysed Technosols (0.8-3.8%). As a result of rubble deposition the soil properties have been changed, as evidenced by their alkalinisation (pH 6.44-8.22 vs. 3.52-4.91 in the native soil typical for the city surroundings), sorption complex saturation with calcium (> 95% vs. 32-61%), increased salinity (0.39-2.50 $mS \cdot cm^{-1}$ vs. 0.03-0.20 $mS \cdot cm^{-1}$) and the increase in content of heavy metals.

Despite the relatively small heavy metal content in the analysed rubble, the heavy metal content in the reported Technosols was: $Cd_{og.}$ 0.2-1.0 $mg \cdot kg^{-1}$, $Cu_{og.}$ 7.9-26.8

mg·kg^{-1}, $Ni_{og.}$ 4.7-38.4 mg·kg^{-1}, $Pb_{og.}$ 12.4-59.2 mg·kg^{-1}, $Zn_{og.}$ 19.2-190 mg·kg^{-1}. The potentially available heavy metals form in them was: 29.5% Cd, 37.2% Cu, 20.9% Ni, 61.8% Pb and Zn 33.3% of the total content.

Table 1

Basic properties of technogenic materials, gathered on the soil surface in Zielona Góra urban area

Material	pH in H_2O	EC [mS·cm^{-1}]	$CaCO_3$ [%]	Fe	Cd	Pb	Zn	Cu	Ni
				0.1M HCl extracted content [mg·kg^{-1}]					
neat plaster	11.0	0.63	2.22	88.0	0.18	2.8	25.9	3.7	6.0
aerated concrete	8.3	0.85	2.17	n.d.	0.17	1.7	2.4	1.0	5.0
roof tile	8.1	2.27	2.27	306	0.16	n.d.	33.6	8.3	2.0
clinker brick (factory chimney)	7.8	1.14	2.26	3750	0.15	n.d.	41.1	16.7	1.3
asbestos-cement roof plank	11.8	4.49	2.18	n.d.	0.18	4.6	3.2	5.7	4.3
slag I	8.7	1.30	2.25	4150	0.12	18.5	92.0	35.8	16.3
slag II	7.5	0.70	2.26	5410	0.13	21.5	125	56.7	17.8
slag III	9.9	0.80	2.26	4960	0.13	n.d.	11.7	8.0	8.0

Table 2

Heavy metal content and availability in Technosols in Zielona Góra urban area

Element	Subtotal content in dry mass; mg·kg^{-1}	HM availability (the ratio HM-0.1M HCl/HM-aqua regia), %	
		Topsoil	Subsoil
Cd	0.2–2.7 (av. 0.4)	29.5%	27.7%
Cu	4.6–192 (av. 24.8)	37.2%	39.2%
Ni	1.2–46.8 (av. 11.1)	20.9%	20.3%
Pb	3–241 (av. 39.5)	61.8%	51.6%
Zn	9–510 (av. 80)	33.3%	27.4%

Conclusions

- All of the investigated building wastes contain a large quantities of binding and covering materials (based on lime), lifting pH and equalizing the carbonates content.
- Asbestos-cement roof plank and roof tiles are characterised by the relative high EC values; the other materials were characterized by the lower EC values.
- It was found that the analysed materials did not contain large quantities of heavy metals, but they were potentially movable and hence bioavailable.

This is an important aspect of the discussion about the environmental importance of technogenic materials in the soils of SUITMA's.

- The presence of technogenic materials is the factor that differentiates urban soils the most. The variability in that regard is both of qualitative and quantitative nature. An admixture of different wastes in soil as a consequence of building activities is a typical, widespread situation.

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Changes of certain properties of chernozems in Northern Kazakhstan under the influence of long-term tillage

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Keywords: chernozem, subzones, genetic horizons, soil physics, humus.

Introduction

In the traditional farming system, the soil is prepared for sowing tillage in order to create an optimal addition of the soil, favorable water regime, air and food regimes and anti-clogging fields.

Numerous scientific studies and practical experience have led to the development and implementation of a variety of resource-saving technologies instead of traditional one. The minimum and zero tillage is belong to techniques on farming conservation.

Research aim: to explore current state of fertility of natural and cultivated soils in subzone of southern and ordinary chernozems of Northern Kazakhstan, identify changes in main soil indicators and provide comparative description of these subzones.

The research objects include southern normal heavy loamy and ordinary normal heavy-loamy chernozems in Northern Kazakhstan.

For collecting objective data on current state of black soils the following indicators have been obtained: morphology of soil horizons, humus condition, presence of carbonates, water-physical properties [1].

Materials and methods

Field sites or grounds included a pair of sections. The soils of such pairs being in comparable terrain conditions are genetically linked. One section is located in the areas of economic use (arable land), and another - on conditionally virgin territory, which signs are used as standard signs. All three sites are located in close proximity to each other (the coordinates on YPS).

Climate of the subzone of southern and ordinary chernozems of Northern Kazakhstan does not always provide favorable conditions for growth and development of crops. Low quantity of precipitation and uneven character with high evaporation hinders plant normal development.

Deep location of ground water and lack of capillary moisture inflow from lower horizons to the soil root layer in dry conditions leads to the fact that plants are developing mainly due to atmospheric precipitation. That is why the increase in soil moisture reserves is a decisive condition for obtaining high and stable yields [2].

Soil tillage significantly changes the value of plow horizon density. After plowing, soil density is in the range 1.0-1.10 g/cm^3 (Table 1). However, the density is not constant. Wetting and drying, freezing and thawing, soil till and many other factors determine the dynamic state of soil compaction. In general, changes of soil density do not exceed the optimum range.

Table 1

Average indices of soil parameters during growing season

Cm Depth of sampling, cm	Average % humidity	Average soil density, g/cm3	General hole capacity or or porosity,%	Total moisture capacity, %	Moisture reserves by layers, mm
Ordinary chernozem (virgin)					
0 -10	20,58	1,00	65,5	74,5	17,89
10 -20	18,86	0,96	62,5	67,5	18,81
20 -30	16,77	1,13	56,5	49,5	18,80
30 – 40	16,09	1,13	56,0	49,0	17,99
40 – 50	10,92	1,27	51,0	40,0	13,78
1	2	3	4	5	6
Ordinary chernozem (arable land)					
0 -10	15,60	1,03	60	57,5	16,08
10 -20	19,16	1,09	58	53,5	20,42
20 -30	20,47	1,11	57,5	52,0	22,40
30 - 40	16,90	1,13	56,0	50,0	18,98
40 - 50	11,62	1,24	52,5	41,5	14,35
Southern chernozem (virgin land)					
0 -10	14,93	0,77	65,5	86,5	11,43
10 -20	11,50	1,12	56,5	50,0	12,88
20 -30	10,07	1,20	54,0	49,5	12,02
30 - 40	9,51	1,31	50,5	44,0	12,46
40 - 50	9,86	1,31	49,5	43,5	12,87
Southern chernozem (arable land)					
0 -10	9,44	1,09	58	52,5	10,23
10 -20	12,72	1,15	56	49,0	15,64
20 -30	15,03	1,23	52	42,0	18,41
30 - 40	14,48	1,22	53	43,0	17,54
40 - 50	12,51	1,24	52	42,0	15,20

The morphological structure of tilled chernozems does not differ from virgin soils. They have the same formulated profile, with the same set of genetic horizons as virgin soils. However, unlike the last ones, the cultivated soils are characterized by the presence of arable layer, which was formed under the influence of tillage in the process of transformation of genetic horizons A and top of the horizon B_1. Horizons B_2, BC and C have preserved with some changes.

Our research results showed that optimal density of arable soil layer ranges between 1.02-1.19 g/cm^3 [3].

Humus horizon capacity of plowed soils is higher than that of virgin soils. On average, it is 69 cm, ranging from 55 cm to 87 cm.

Long-term tillage results in decrease of humus content. Its amount in the arable horizon varies from 3.5 to 4.7 %.

Conclusion

As a result of long-term use of chernozems in Northern Kazakhstan, these soils in two sub-zones have lost 26 % of humus- from the layer 0-20 cm. In arable soils the water-physical properties are deteriorating and destruction of macrostructure, and increase of quantity of micro-aggregates have been observed, density of subarable soil horizons increases. In the long-term tillage the content of water-stable aggregates which are larger than 1 mm has reduced 5-7 times.

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The Influence of Gleyzation on the Chemical Composition of the Lysimetric Water and the Physicochemical Properties of the Parent Rocks under Stagnant-Percolative and Stagnant Water Regimes (Model Experiment)

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Key words: acidification, iron removal, gleying, anaerobiosis, drainage.

Introduction

Gleyzation has significant influence on soil properties establishment. Three simple conditions are necessary and sufficient for its origin: common anaerobic heterotrophic microflora, presence of readily available for fermentation organic matter and permanent or temporal waterlogging. The gley formation develops on acid, neutral and leached carbonate-free soils and soil-forming rocks in the presence of the foregoing necessary conditions. It could manifest itself under two drastically different water regimes: (1) stagnant-percolative and (2) stagnant. In the first case significant negative influence on soil happens by means of transformation physical, chemical, physicochemical properties of soils. Redox potential sharply drops down that generates intense removal of bivalent and trivalent metal ions. All that factors causes significant decreases of soil fertility. In the second case gleying development doesn't produce remarkable negative changes of soil properties.

Gleyzation is responsible for origin such important soil-forming processes as podsolisation [3], formation of chernozem-like podzolic soils, podbels, solods and so on [4, 5].

Fundamental researches of gley formation under model experiment conditions have been implemented using relatively limited amount of soil-forming rocks [1, 2, 6]. Dynamic and specific of gley formation on many kinds of parent rocks is insufficiently investigated up to date.

Materials & Methods

The objects of studies were three heavy parent rocks with contrasting properties and genesis:

River light clay alluvium (Ramenskaya floodplain of the Moskva River). Acidity is 6.8; it does not boil from HCl; the content of physical clay is 51%.

Loess-like light clay (Vladimirskoye high plain).The reaction is subacid (pH 6.2); it does not boil from HCl; the content of physical clay is 52%.

Lacustrine heavy loam carbonate alluvium (Barabinskaya depression). The reaction is alkalescent (pH 7.7); it boils from contact with HCl; the content of physical clay is 41%. Subterranean chloride–sulfate waters have participated in the formation of these soils that is reason of chloride-sulfate salinization and development of sulfate reduction process.

For the model experiment, a massive sample of the parent rocks was dried until the air dry state and run through a sieve with 3 mm meshes. Samples of 1.7 kg were taken from it and placed into a plastic container on a base of washed off the iron quartz sand. To create anaerobic conditions and initiate gleyzation in the studied medium, a 1% liquid sucrose was added. In the experiment variant with a stagnant-percolative regime, lysimetric waters were discharged once every ten days. The sample was dried for three days and filled with the 1% sucrose solution again. Before the discharge of lysimetric waters and the repeat filling with solution, the reduction-oxidation potential of the solid phase was measured. In the control variant, samples were filled with distilled water without sucrose. In both variants, lysimetric waters were analyzed once every two weeks.

Results and Discussion

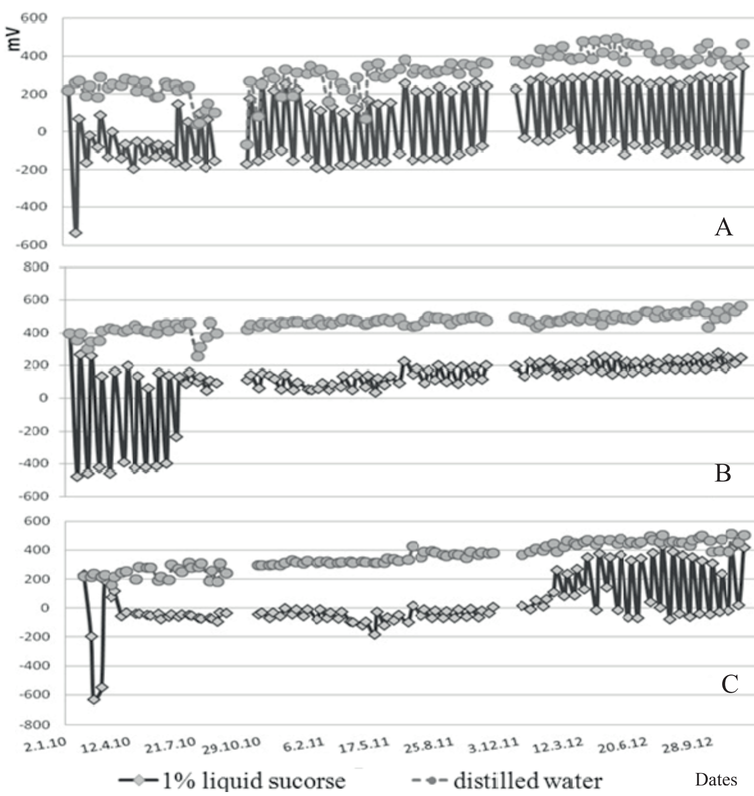

Fig. 1. Red-ox potential dynamic of the soil-forming rocks under stagnant-percolative water regime: A - river alluvium; B - loess-like clay; C - lacustrine carbonate alluvium

Red-ox potential dynamic. Fluctuations of red-ox potential between aeration and waterlogging periods were inherent in every parent rock sample with liquid sucrose addition. Nevertheless for every type of parent rock the fluctuations were specific during the whole experiment (fig. 1). This fact could be explained by specificity of mineral composition, differences in water resistance of soil structure and aggregate stability under the influence of gleying. It is remarkable that deepest slump of red-ox potential has been observed during one-two decade since experiment start. Red-ox potential of control variants basically didn't fall under 200 mV. It points out the absence of gley formation here.

Changes of lysimetric water acidity. Initiation gleyzation generated by addition of the organic matter capable of anaerobic fermentation lead to significant acidification of lysimetric waters respectively to control variant (up to 3 – 4 pH points). Lacustrine carbonate alluvium sustained its initial acidity for 40 discharges. Presumably after leaching of carbonate there was sharp increase of lysimetric waters acidity up to the carbonate-free parent rocks level.

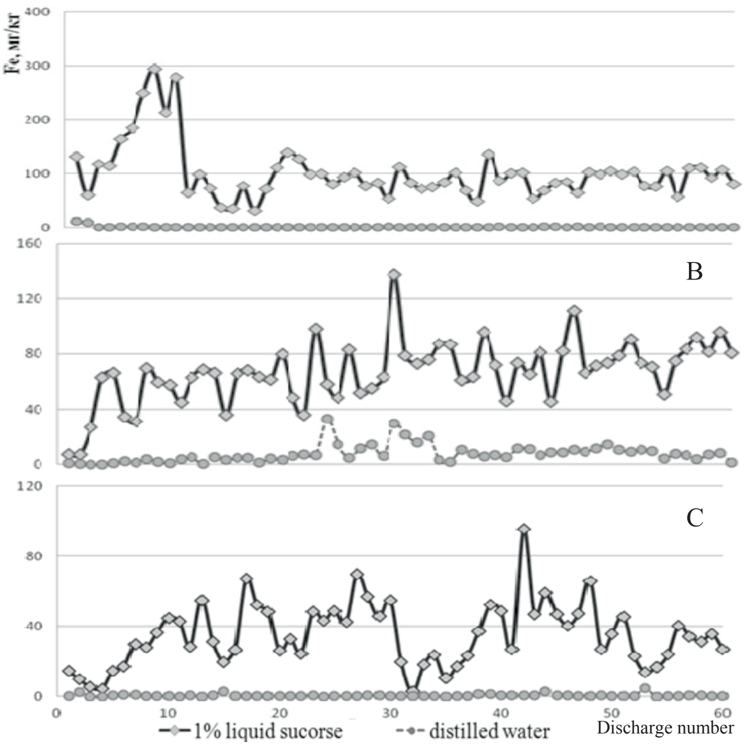

Fig. 2. Iron removal dynamic from the soil-forming rocks under stagnant-percolative water regime: A – river alluvium; B – loess-like clay; C – lacustrine carbonate alluvium

Removal of iron. Under stagnant-percolative water regime, gleyzation caused significant removal of iron from soil-forming rocks with lysimetric waters. Dynamic of iron removal is specific for every soil-forming rock (fig. 2) that can be related with differences in its genesis, mineralogical, physical and chemical properties. Total iron removal increases in the raw: *River light clay alluvium* (6.1 g/kg) > *Loess-like light clay* (3.9 g/kg) > *Lacustrine heavy loam carbonate alluvium* (2.1 g/kg). Presumably it is explained corresponding differences in content of Fe_2O_3 within bulk chemical composition the initial parent rocks (11,17%, 8.74% and 5,02% respectively).

The influence on physicochemical properties of the soil-forming rocks. Under stagnant-percolation water regime gleying caused drastic transformation acid-base properties and content of exchangeable bases except Lacustrine heavy loam carbonate alluvium. The deepest changes occur in carbonate-free acid and neutral soil-forming rocks. There was sharp drop actual and exchangeable pH. The strongest slump has taken place in top layers of the carbonate-free rocks (Table 1). Also there

Table 1. Physicochemical properties of the parent rocks

Parent rock	Water regime	Depth, mm	pH H_2O	pH KCl	Hydrolitic acidity	Mobile Al^{3+} by	Mobile H^{3+} by	Base saturation, %
					mmol (+)/100 g of soil			
River light clay alluvium	Stagnant-percolative, 1% liquid	0 – 3	4.61	3.07	-	7,82	0,18	-
		3 - 30	4.53	3.13	10,05	4,08	0,17	70,71
		30 - 40	4.86	3.30	5,14	3,33	0,42	84,79
	Stagnant, 1% liquid sucrose	0 – 3	6.89	6.11	-	0,25	0,01	-
		3 - 30	6.54	5.58	2,46	0,05	0,01	95,46
		30 - 40	6.85	5.73	2,02	0,03	0,06	96,17
	Control, distilled water	0 – 3	7.09	6.55	-	0,25	0,01	-
		3 - 30	7.34	6.19	1,56	0,02	0,03	97,54
		30 - 40	7.20	6.55	1,67	0,01	0,03	97,42
	Initial parent rock		7.59	6.91	0,68	0,00	0,08	98,93
Loess-like light clay	Stagnant-percolative, 1% liquid	0 – 3	4.26	3.33	-	4,79	1,46	-
		3 - 30	4.17	3.63	14,50	6,00	1,33	42,73
		30 - 40	4.37	3.38	10,50	7,56	2,15	52,23
	Stagnant, 1% liquid sucrose	0 – 3	6.55	5.45	-	0,25	0,02	-
		3 - 30	6.22	5.05	1,86	0,05	0,01	95,03
		30 - 40	6.19	4.66	3,40	0,09	0,01	90,04
	Control, distilled water	0 – 3	6.21	4.49	-	0,26	0,01	-
		3 - 30	6.27	5.12	1,43	0,07	0,01	95,55
		30 - 40	6.61	4.51	1,99	0,07	0,01	94,45
	Initial parent rock		6.30	4.58	3,05	0,12	0,01	92,15
Lacustrine heavy loam carbonate alluvium	Stagnant-percolative, 1% liquid	0 – 3	4.70	3.46	-	1,72	0,03	-
		3 - 30	6.33	4.61	2,07	0,24	0,01	88,93
		30 - 40	8.22	8.35	0,30	0,05	0,01	98,56
	Stagnant, 1% liquid sucrose	0 – 3	8.48	8.22	-	0,25	0,01	-
		3 - 30	8.78	8.25	<0,23	0,01	0,07	99,10
		30 - 40	8.92	8.72	<0,23	0,01	0,03	99,16
	Control, distilled water	0 – 3	8.72	8.24	-	0,01	0,25	-
		3 - 30	8.82	7.88	<0,23	0,01	0,07	99,20
		30 - 40	8.86	8.15	<0,23	0,01	0,06	99,18
	Initial parent rock		8.88	8.21	<0,23	0,06	0,01	99,09

was significant increase of hydrolytic acidity; content of mobile Al^{3+} и H^{+} by Sokolov significantly increased. It is revealed that base saturation level sharply decreased because of leaching out considerable masses of exchangeable Mg^{2+} and Ca^{2+}. For lacustrine heavy loam carbonate alluvium changes of physicochemical properties were either less remarkable or absent (for bottom layer). It should also be states that under stagnant water regime, gleyzation didn't cause considerable changes of physicochemical properties both the carbonate-free soil-forming rocks and the carbonate rocks.

Conclusion

Gleyzation causes significant acidification and iron saturation of lysimetric water running through the soil-forming rocks body. Under stagnant-percolative water regime gleying can lead to drastic transformation of physicochemical characteristics of parent rocks. The most intensive changes occur in acid and neutral carbonate-free parent rocks. It manifests in significant acidification, decrease of base saturation and forming of the eluvial-illuvial features. Stagnant water regimes and presence of carbonate reduce influence of gleying on soil-forming rocks and lisymetric waters.

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Investigation of Heat Conductivity Equation in Soil Using Similarity Theory

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Key words: Soil temperature, heat conductivity equation, similarity theory.

Introduction

Heat conductivity theory has been developed by engineers and earth scientists in last two centuries (Kurylyk et al., 2014) and it has been applied in agronomy as well as in other sciences (Mellander et al., 2007; Kahimba et al., 2009; Ekberli and Sarılar, 2015). Application of heat transfer model in agronomy, climatology and civil engineering etc. depends on experimental determination of heat conductivity and heat diffusivity coefficient (Nikiforova et al., 2013) or detail determination theoretically (Usowicz et al., 2006). There are a few studies about effects of agricultural practices on heat transfer in soil and approaches by numerical evaluations. These studies reflect the conventional approaches of measuring or analyzing long term mean soil heat properties for different soil types and climate conditions (Tikhonravova, 2007). The objective of this study was to investigate solution of one dimensional heat conductivity equation and application of mathematical model to predict soil temperature.

Material and Method

Heat flow $q=-\lambda\frac{\partial t}{\partial \tau}$ through soil depth can be expressed with Fourier equation (where, q - heat flow intensity which is velocity of heat flow from unit area, $\text{Joule/m}^2\cdot\text{s}$; λ - heat conductivity, $\text{Joule/m}\cdot\text{s}\cdot\text{K}$; τ (K or $^{\circ}$C) - temperature; $\tau(s)$ - time; $x(\text{cm})$ -length or soil depth).

Generally, heat transfer process in objects is expressed with heat conductivity equation obtained using heat flow equation $t_\tau(x,\tau)=at_{xx}(x,\tau)$. Heat conductivity equation in this study was used as a material of the model obtained to predict heat distribution along soil profile. Analytical solution method of heat conductivity equation was used to obtain this model.

Results and Discussion

Investigation of One Dimensional Heat Conductivity Equation in Case of Instant Heating and Cooling of Soil Surface

When investigating the solution of one dimensional heat conductivity equation for instant change of temperature at the boundary $(y=0)$ of semi infinite media $(y>0)$, temperature of all semi infinite media is t_0 at time $\tau=0$, temperature at the surface ($y=0$) of the semi infinite media is t_y at time $\tau>0$. In case of $t_y>t_0$ condition, heat flow occurs through inside the semi infinite media and temperature increases. If $t_0>t_y$, temperature of the media decreases and it becomes cold.

To determine the temperature distribution at $t_0>t_y$ condition, $\frac{\partial t}{\partial \tau}=a\frac{\partial^2 t}{\partial x^2}\ (0\le \mathrm{x}<\infty,\ \mathrm{t}>\text{-}\infty)$ (1) equation should be solved for the boundary conditions given below:

$$\begin{aligned} &t=t_0,\quad if\ \ \tau=0,\ y>0\\ &t=t_y,\quad if\ \ \tau>0,\ y=0\\ &t\to t_0,\ \ if\ \ \tau>0,\ y\to\infty \end{aligned} \tag{2}$$

The problem of (1), (2) can be solved using dimension analyses and similarity theory. Physical parameters having dimension are combined together using similarity theory and are converted to one dimensionless parameter. Buckingham π theory is used to determine number of dimensionless variables. When a physical equation including $N\ge 2$ number of dimensional variables, which are formed $K\ge 1$ number of basic dimensions (mass, length, time etc.) is converted to dimensionless form, the number of dimensionless variables becomes results $N-K$ (Sedov, 1967; Moiseev, 2004).

To solve (1), (2) problem, dimensionless temperature function is added as a rrelative variable according to similarity theory:

$$\theta=\frac{t-t_0}{t_y-t_0} \tag{3}$$

θ, is dimensionless temperature function, supplies $t(x,\tau)$ function:

$$\frac{\partial\theta}{\partial\tau}=a\frac{\partial^2\theta}{\partial y^2} \tag{4}$$

With respect to (2) boundary conditions and (3) statement, boundary conditions become simpler:

$$\begin{aligned} &\theta(y,0)=0,\\ &\theta(0,\tau)=1,\\ &\theta(\infty,\tau)=0. \end{aligned} \tag{5}$$

Except y coordinate, the length for heat diffusion is expressed as $\sqrt{a\tau}$ with the length dimension, the value of θ is determined with similarity theory. θ dimensionless function has $N=3$ (length-L, time-T, heat diffusion-$\frac{L^2}{T}$) variables, $K=2$ variables (length-L, time-τ) are expressed with basic dimensions within N variables. According to π theory, θ dimensionless function formed with the combination of variables expressed with basic dimensions depends on the number of $N-K=1$ dimensionless variables.

In this case, according to dimension method, the expression of $y^{\alpha}\tau^{\beta}a^{\gamma}$ has zero dimension, the equation given below is supported: $y^{\alpha}\tau^{\beta}a^{\gamma} = L^0T^0$

When the force of dimensionless variable is also dimensionless, α, β and γ numbers are not limited and any variable can be equal to ± 1 . If $\alpha = 1$,

$$y\tau^{\beta}a^{\gamma} = LT^{\beta}\left(\frac{L^2}{T}\right)^{\gamma} = L^{1+2\gamma}T^{\beta-\gamma} = L^0T^0 \Rightarrow \begin{cases} 1+2\gamma = 0 \\ \beta - \gamma = 0 \end{cases} \Rightarrow \beta = -\frac{1}{2}, \alpha = -\frac{1}{2} \ ,$$

One dimensionless combination of y, τ, a variables become as $y\tau^{\beta}a^{\gamma} = y\tau^{-\frac{1}{2}}a^{-\frac{1}{2}} = \frac{y}{\sqrt{a\tau}}$.

Therefore, $\eta = \frac{y}{2\sqrt{a\tau}}$ (6) and $\theta = f\left(\frac{y}{2\sqrt{a\tau}}\right) = f(\eta)$, according to dimension analyses, θ dimensionless function is not depend on y and τ variables, but it is just depend on η dimensionless variable. To express of Equation (4) and (5) boundary conditions with η variable, partial differential of τ and y variables should be expressed with partial differential of η . In this case, Equation (4) becomes:

$$-\eta\frac{d\theta}{d\eta} = \frac{1}{2}\frac{d^2\theta}{d\eta^2} \tag{7}$$

In (6) statement, $y = 0$ is suitable $\eta = 0$ value, $\tau = 0$ and $y = \infty$ are suitable for $\eta = \infty$ value, therefore (5) boundary conditions are written as:

$$\begin{aligned} &\theta(\infty) = 0, \\ &\theta(0) = 1. \end{aligned} \tag{8}$$

If $\varphi = \frac{d\theta}{d\eta}$ transformation is done, Equation (7) becomes: $-\eta\varphi = \frac{1}{2}\frac{d\varphi}{d\eta}$ or

$$-\eta d\eta = \frac{1}{2}\frac{d\varphi}{\varphi} \tag{9}$$

The solution of Equation (9) is found as $\theta = 1 - \frac{2}{\sqrt{\pi}}\int_0^{\eta} e^{-\eta^2}d\eta$ (10)

According to initial parameters of (a, τ, y), the statement of (10) can be written as:

$$\frac{t - t_0}{t_y - t_0} = erfc\left(\frac{y}{2\sqrt{a\tau}}\right) \tag{11}$$

(Where, $erfc(\eta) = 1 - \frac{2}{\sqrt{\pi}}\int_0^{\eta} e^{-u^2}du$ is complementary error function). The rate of $\frac{a\tau}{y^2}$ is heat conductivity, Fourier number (dimensionless time) is y coordinate:

$$F_{o_y} = \frac{a\tau}{y^2}.$$

In this case, solution of (11) becomes $\frac{t-t_0}{t_y-t_0}=erfc\left(\frac{1}{2\sqrt{F_{oy}}}\right)$ or

$$\frac{t_y-t}{t_y-t_0}=erf\left(\frac{1}{2\sqrt{F_{oy}}}\right) \quad (12)$$

This solution can be summarized with an example for homogenous sandy soil profile having 15°C surface soil temperature. If during the $\tau=5\,\text{hours}$, surface soil temperature is $t_y=t(0,\tau)=15^{\circ}C$; mean temperature along the y axis or soil depth is $t_0=10^{\circ}C$; heat diffusion coefficient is $a=8.35\cdot10^{-6}\,\text{m}^2\text{s}^{-1}$, soil temperatures along the 50 cm soil depth can be estimated using the statements of (12) and (11) (Luikov, 1967), which is shown in Fig. 1 1.

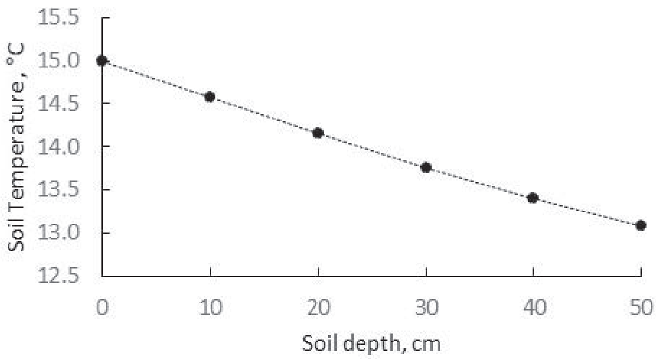

Fig.1. Estimation of surface soil temperature changes along a soil profile.

Conclusion

In this study, solution of one dimensional heat conductivity equation using the similarity theory was done, and this solution was applied to predict surface temperature change along a homogenous soil profile. This mathematical solutions can be used to predict cooling or heating procedure in homogenous soil depths or homogenous porous materials.

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Determination of Microbial Biomass C and Organic C Contents in Different Sizes of Natural Soil Aggregates

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Key words: Microbial biomass, macroaggregate, microaggregate, organic carbon

Introduction

Soil is one of the most important components of ecosystem in terms of forming the source of life. Necessity of use in a sustainable manner of soils occurs considering of role in human nutrition and ecological balance. If we look in terms of geomorphological, the structural properties of the soils must be improved and protected due to the presence of a significant part of our country soils on sloping lands. For this reason, aggregation and stable aggregates in soils are important. Aggregate formation in soils; while effective on soil properties such as aeration and water retention capacity of soils, the movement of water and air in the soil, root growth and distribution and the activity of microbial communities, aggregate stability is one of the important physical properties of soil also it is effective in terms of prevention of soil erosion (Tate, 1995).
Soil is an environment physical, chemical and biological processes occured continuously and also soil is a living system contains in micro and macro organisms. Soil microorganisms constitute about one quarter of all living biomass on earth and are responsible for significant nutrient transformations involving both macro and micro nutrients (Alexander, 1977) and therefore influencing nutrient availability and ultimately soil health and quality. For this reason, soil properties related to the microbial and faunal activity in soil. The importance of microorganisms in ecosystem functioning has led to an increased interest in determining soil microbial biomass (Azam et al., 2003). The soil microbial biomass is the active component of the soil organic pool, which is responsible for organic matter decomposition affecting soil nutrient content and, consequently, primary productivity in most biogeochemical processes in agricultural ecosystems (Franzluebbers et al., 1999). Therefore, measuring microbial biomass is a valuable tool for understanding and predicting long-term effects on changes associated soil conditions (Sharma et al., 2004).
The protection and enhancement of the physical structure is extremely important for the sustainable use of soils in agricultural areas. Generally, structural degradations in soils occur due to a decrease in soil organic matter in intensively tillage soils (Grandy et al., 2002). Tillage is effective both on microbial biomass carbon and mineralisable C. Tillage may lead to decrease in aggregation and the amount of organic matter causing decomposition of organic C quickly in the soil (Beare et al. 1994). Structural

condition of the soil degrades, losses its granular structure and aggregate formation is prevented with significant decrease of organic matter in continuous cultivation areas. As a result of this degradation occurring in soil structure, properties related with structure is affected negatively. As a consequence of these, decreases occurs in yield and quality. Therefore distributions and stability measurements of soil aggregates are considered as a quality indicator of soils (Six et al., 2000).

The aim of this study is to determine contents of organic C and microbial biomass C in different sized of natural soil aggregates with the sampling taken from surface horizons of soil profiles opened at six different locations in Kuşkonağı Basin located within the boundaries of Samsun Province.

Materials and Methods

Study area contains Kuşkonağı Watershed boundaries in Havza district of Samsun Province and it contains soil profiles opened at six different locations in this area. Kuşkonağı Watershed is located in 4548-4544 north and 718-724 (utm-km) east longitude. The study area generally has a rugged topography and slightly sloped areas located in both over the hill on the plains and bottom land occur a large part of the study area. Such as wheat, sunflower and corn products are among mainly grown products in terms of agricultural activities in the area. Also the average annual temperature 14.2 and average rainfall 680.0 mm in the region.

Natural aggregates of samples taken from the surface horizons of the study area was determined with dry sieving method as reported by Tisdall and Oades (1982). For this purpose, < 0.250 mm, 0.425 mm, 1.00 mm, 1.40 mm, 2.00 mm, 4.75 mm, 6.30 mm size sieves were stacked in automatic sieve shaker and 1000 g of the soil was sieved for 2 minutes. As a result of sieving natural aggregates obtained in eight size classes. These are, i) > 6300 µm, ii) 6300-4750 µm, iii) 4750-2000 µm, iv) 2000-1400 µm, v) 1400-1000 µm, vi) 1000-425 µm, vii) 425-250 µm ve viii) < 250 µm. Then, each fraction was weighed and samples was stored in the refrigerator at +4 ºC until analysis to determine microbial biomass C and organic C contents.

Microbial biomass C (Cmic) contents of soil and aggregate samples were determined according to the method of SIR (Substrate Induced Respiration) as reported by Anderson and Domsch (1978). For this purpose, certain amounts of glucose were added on soil samples and biomass C was calculated with equation 40.04 mg CO_2 g^{-1} + 0.37 from the amount of CO_2 produced at the end of a certain time and the results expressed as mg CO_2-C 24 h^{-1} g^{-1} in drysoil. Also, organic C (Corg) contents of each natural aggregates of samples taken from the surface soils were determined by Walkley-Black method (Rowell, 1996).

Results and Discussion

According to the results obtained, microbiological properties of natural soil aggregates taken from the surface horizons didn't show a homogeneous distribution. In the soils of study area, generally microbiological properties of macroaggregates were found at low levels. A more intensive medium occured in terms of microbiological properties getting the size of macroaggregate smaller. Also it was determined that microaggregates (<0.250 mm) involved more microbiological properties than macroaggregates in many soils (Table 1). As seen in Table 1 the highest Cmic value was determined in 0.250-0.425 mm aggregate size of profile 5. In addition to the highest Corg values showed differences in different aggregates sizes. Similarly, Aşkın and Kızılkaya (2006) were found that generally microbial biomass C content was higher in microaggregates (<0.250 mm) and microbial biomass C in soil aggregates decreased as aggregates size increased in their study carried out to determine changes of microbial biomass C and organic C along the slope in pasture.

Table 1

Cmic and Corg values of natural aggregates of the surface soils

Biological Property	Aggregate size (mm)	Profile Number					
		1	2	3	4	5	6
		Typic Haploxerept	Typic Calcixerept	Lithic Xertorthent	Vertic Xerofluvent	Typic Calcixerert	Chromic Haploxerert
Cmic (mg CO_2-C $24h^{-1}g^{-1}$)	<0.250	3.33	3.01	1.72	1.95	4.07	3.19
	0.250-0.425	3.91	3.07	1.58	1.34	7.85	5.81
	0.425-1.00	2.82	2.86	1.44	1.38	4.30	5.38
	1.00-1.4	2.29	2.70	1.08	1.42	5.72	5.25
	1.4-2.00	2.37	2.31	1.03	1.38	2.46	2.89
	2.00-4.75	2.01	2.50	1.04	1.32	2.64	2.80
	4.75-6.3	2.69	2.44	1.04	1.51	2.40	2.83
	>6.3	1.95	2.19	1.53	1.15	1.90	2.73
Corg (%)	<0.250	1.88	1.10	0.40	0.77	1.36	1.35
	0.250-0.425	1.81	0.91	0.44	0.52	1.34	0.67
	0.425-1.00	1.90	1.02	0.33	0.51	0.59	0.59
	1.00-1.4	1.78	1.32	0.29	0.69	0.49	0.55
	1.4-2.00	1.90	1.64	0.21	0.71	0.59	0.38
	2.00-4.75	1.80	1.60	0.19	0.66	0.68	1.51
	4.75-6.3	1.81	1.51	0.38	0.62	0.53	1.89
	>6.3	1.78	1.53	0.23	0.49	0.36	0.63

Cmic: Microbial biomass carbon, Corg: Organic carbon

Textural structure of soils, organic matters added to the soils, surface areas of solid soil particles have an impact on the number of microorganisms in the soil, their biomass and activities. Chemical equilibriums such as adsorption and desorption of nutrients occurs more intensely in the soils have a large surface area. As a result of this, microorganisms benefit more from these nutrients. Consequently, microbiological properties of soils have large surface area are greater. Similarly, surface areas of microaggregates are more than macroaggregates. As being in the soil because of effects of similar properties microaggregates are estimated to contain more microbiological properties than macroaggregates. Therefore generally microbiological properties such as microbial biomass C were found at higher levels in the smaller diameter of aggregates. At the end of the study it was found that changes in biological properties showed differences depending on the type of soil.

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Agroecological practices that prevent degradation of the landscape and promote the restoration of tropical soils

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Keywords: environment, peasant production, microbial diversity

Introduction

Agroecology is emerging today as the fundamental science to guide the conversion of conventional production systems to more diversified and self-sufficient systems. For this agroecology uses ecological principles that favor natural processes and biological interactions that optimize synergies so that agricultural biodiversity is able to subsidize itself key processes such as the accumulation of organic matter, soil fertility, biotic mechanisms regulating pests and crop productivity processes are crucial condition for the sustainability of agro-ecosystems. Most of these processes are optimized by specific interactions emerging from spatial and temporal combination of crops, animals and trees, supplemented by organic soil management (Altieri, 2014).
Unfortunately, many of our tropical soils are losing their fertility and health properties, this crisis is largely due to conventional farming practices that have been used for many years, some of these practices are: application of chemical fertilizers, monoculture, intensive tillage, land degradation through soil erosion, compaction, decline in organic matter and biodiversity associated with it, salinization, depletion of groundwater, deforestation and desertification; and pest outbreaks because of widespread monoculture, genetic uniformity, elimination of natural enemies and pesticide resistance developed by insects, weeds and crop diseases (Sánchez, et., al 2012).
One way to start or where it should focus efforts on substituting chemical inputs to agriculture agro origin given that these transitional periods can be long, and to be given the time needed to restore soil life, his structure and organic matter as well as recover the beneficial fauna. The medium-term goal is to reduce the use of chemicals, and therefore dependence on costly inputs to farmers, to the extent that the agro-ecological system you gain the ability to self-sponsor your needs for fertility and pest and disease. The process of agricultural conversion, time and space must be prudent to go allowing the introduction of agro-ecological systems gradually, thus to avoid risks associated with the production, the demoralization farmer (for wanting immediate results) and finally to social acceptance and consent benefits. According to the above, it is necessary to know how the research and experience in this field have led to progress in the implementation of sustainable alternative systems, in the first part of the research question arises; What are the ecological practices that contribute to soil remediation and promote the conversion of peasant production systems?.

Materials & Methods

The Sumapaz region or province is located south of the department of Cundinamarca is composed of 10 municipalities The current landscape of the high mountains and the Paramo of Sumapaz stems from the intense glacial activity occurred during cold periods of the Pleistocene.

Sampling points

From single organic market in the region could start creating a database of farm production. Thus a survey containing social, environmental, economic and technological indicators to diagnose this type of design productions. They have been registering 65 producers to date, so while the characterization and classification of all the properties was made, We began with a pilot that housed 12 farms with different production times. Four organic farms (A), 4 animal farms in transition (B) and 4 non-animal farms in transition (C).

Evaluation of chemical soil variables

Chemical fertilizers variables were: carbon / nitrogen (C / N), cation exchange capacity (CEC), organic matter (OM), organic carbon (OC), micronutrients (Ca, Mg, Na, Fe, Mn, Cu, Zn, S, B, Si) and macronutrients (N, P, K). The samples were sent to the soil laboratory at the University of Tolima.

Microbiological characterization

For identification of microorganisms in 90 days, the composting process, macroscopic and microscopic techniques were applied in the Laboratory of Microbiology of the Universidad de Cundinamarca, taking into account Colombian Technical Standard (NTC 4491-2) on microbiological procedures, for each substrate be treated with descriptive statistics with the application of the procedure MEANS of SAS version 9.3.

Results & Discussion

Overall organic farms (A) presented the best results of soil chemical and microbiological indicators, this may be due to the types of practices found in these farms, as elaborated composting agricultural waste and animal excreta, rotate and diversify crops, do not use any chemical input, they used to cover the soil, preventing erosion. Farms with animal agriculture in transition (B) have floors in recovery, as these farms implemented the gradual replacement of chemical fertilizers and pesticides 4 years, since the organic matter and some trace still no optimal value of fertilization, but there is an excess of phosphorus that can be caused to even fertilized with chemicals. The agriculture farms in transition without the incorporation of animals (C) had significantly lower chemical and microbiological parameters values, this may be because the ground not paid with compost manure as they have, buy commercial poultry indicating excess nitrogen in soil (Tables I, II and III).

The concept of agroecological soil management is a comprehensive overview of production, where protection and improvement practices are used in order to maintain or improve soil fertility and prevent deterioration. In this regard (Sutton, et al., 2012), mention that it is removing the high-input agriculture and replace strategies that mimic natural ecological processes. Diacono, (2010) believe that agroecological management of soils should also be integrated ancestral knowledge and traditional cultural practices, in consideration of the social, historical, ethnic and religious aspects linked to the land and care. In the case of very disturbed soils. Rashid, et al., (2010), recommend handling imitate natural succession, this is a scheme of managed succession, natural successional stages are mimicked by introducing plants, animals, agricultural inputs and practices that promote development of interactions and connections between the components of the agroecosystem. A soil can get a crop of high performance with minimal negative impacts on the environment. Organic matter influences almost all major properties contributing to soil quality. Thus, it is crucial to understand and highlight the key importance of crop management and soil to maintain and increase organic matter content, with the aim of developing good soils and thus tending to sustainable handling (Lahmar, et al., 2012).

Table I

Chemical parameters results for soil samples

Different letters indicate significant differences P <0.05

PARAMETERS	UNIT	A	B	C
O.M.	%	48,65 a	33,77 b	31,67 c
O.C.	%	21,84 a	19,59 b	10,11 c
Organic Nitrogen	%	3,88 a	2,69 bc	1,73 c
Total Nitrogen	%	2,89 a	1,86 c	1,39 c
C.E.C.	Meq. 100g	27,24 b	32,34 a	28,62 c
Calcium	%	1,19 a	1,74 b	2,02 a
Magnesium	%	0,045 a	0,065 a	0,124 a
Potassium	%	1,91 a	1,97 a	1,97 a
Sodium	Mg/Kg	465 a	388 b	299 c
Iron	Mg/Kg	198 a	181 c	249 a
Zinc	Mg/Kg	112	ND	ND
Manganese	Mg/Kg	288 a	22,8 b	ND
Copper	Mg/Kg	0,584 a	0,655 a	0,584 b
Phosphrous	%	6,84 b	7,03 a	4,44 c
Sulfur	%	0,368 b	0,32 b	0,268 b
Boron	Mg/Kg	93,98 a	83,99 c	85,2 c

Organic matter is the heart of soil and agro-ecological practices must be provided to keep your balance. Singh, et al., (2011), reported that the first objective of a good crop management and soil should be to create the conditions for a highly diverse community of soil organisms. Soil biodiversity is an important part of the health and stability of the agroecosystem. The microbial populations are influenced by crop management and waste. Soil management and crop may affect the population dynamics of soil organisms. The introduction of animals to agricultural systems and complex rotations with different crops, large amounts of waste of different types of crops, fertilizers, cover crops and reduced tillage are practices that help increase a population biologically diverse soil organisms. The various effects of organic matter can be grouped under the influences on the physical, chemical, nutritional and biological soil properities (Kalinina, 2009).

Table II

Abundance and diversity of bacteria found in sample soils

Bacteria													
Farms	*A*	*B*	*En*	*Es*	*Mi*	*Mo*	*Nb*	*Ns*	*Pa*	*Pr*	*Ps*	*Sc*	*Sm*
A	++	+	+	++	++	++	+++	++	+	++	+++	+++	++
B	-	++	++	++	+++	++	-	+	++	++	+	+++	++
C	++	+	++	++	-	+	+	-	+	+	-	-	+

(Absent –), (Mild +), (Moderate ++), (Heavy +++)
A=*Arthrobacter*; B=*Bacillus*; En=*Enterobacter*; Es=*Escherichia*; Mi=Micrococcus; Mo=*Morganella*; Nb=*Nitrobacter*; Ns=*Nitrosomonas*; Pa=*Paucimonas*; Pr=*Proteus*; Ps=*Pseudomonas*; Sc=*Staphylococcus*; Sm=*Streptomyces*

Table III

Abundance and diversity of fungi found in sample soils

Fungi																					
Farms	*Al*	*As*	*Ce*	*Cl*	*H*	*Ma*	*Mo*	*N*	*Pe*	*Ph*	*Pr*	*R*	*So*	*St*	*Si*	*Tv*	*Th*	*Td*	*Tc*	*V*	*Z*
A	-	++	+	++	+	-	+	+	+++	++	++	-	+	+++	+	+	-	+	-	++	+
B	-	+	-	+	+	++	+	-	++	+	+	+	+	+	-	+	+	+	-	+	+
C	+	+	+	-	-	-	-	-	+	-	-	-	-	++	+	-	-	+	++	-	-

(Absent –), (Mild +), (Moderate ++), (Heavy +++)
Al=*Alternaria*; As=*Aspergillus*; Ce=*Cephaliophora*; Cl=*Cladosporium*; H=*Humicola*; Ma=*Macrosporium*; Mo=*Moniliella*; N=*Nigrospora*; Pe=*Penicillum*; Ph=*Phoma*; Pr=*Preussia*; R=*Rhizopus*; So=*Sordaria*; St=*Staphylotrichum*; Si=*Sistotrema*; Tv=*Thielavia*; Th=*Thysanophora*; Td=*Trichoderma*; Tc=*Trichurus*; V=*Verticillium*; Z=*Zygorhynchus*

Jansa, et al., (2010), proposed to improve soil quality the following strategies: Better use of crops and other organic waste, The composting, Practice good rotations, Use Of cover crops, Integration Of animal farming systems, Use Compost, Guests Labranza, Erosion-Control, Better use of nutrient cycling. Altieri, (2014), mention that the strategies mentioned above require training, participation and continuous support to farmers, in order to raise awareness and show the benefits in the medium and long term that will result in the cost-benefit ratio. Lahmar, et al., (2012), indicate that chemical fertilizers can dramatically influence the balance of nutritional elements in plants, and is likely to overuse increase the nutritional imbalances, which in turn reduces resistance to insect pests, also indicate that organic fertilization practices promote increased soil organic matter and microbial activity and a gradual release of nutrients to the plant, theoretically allowing the plants to derive a more balanced nutrition, can also provide micronutrients sometimes absent from conventional farms, which rely primarily on artificial sources of N, P and K. Optimum fertilization, which provides a balance of elements, can stimulate resistance to insect attack.

Legros, et al., (2012), suggest that in the search for design alternatives that take advantage of the waste produced, to mitigate environmental pollution and recover productive soil conditions, by improving its structure, fertility and biological activity, composting has proven to be a viable and easy to use in both temperate and tropical regions alternative. Today a recent interest in developing basic and applied research to gain insight into the biological, biochemical, physical and environmental processes that accompany the production of compost. Agronomic fertilization practices refer to all those techniques to improve soil fertility in terms of physical, chemical and biological view. Among them, the supply of nutrients is through mineral sources (synthetic fertilizers) and organic fertilizers and manures, crop residues, compost and vermicompost, among others.
The integration of animals in farming systems has been reported, increasing interactions and synergisms of soil microbiota, through the application of organic fertilizers made from techniques such as composting. Processes for reclamation promote the incorporation of agro-ecological practices, it requires participatory methodologies and continuous support to the farming communities.

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Linking of microbial biomass and activity to organic matter biodegradability in Siberian permafrost-affected soils

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Key words: Permafrost, soil organic carbon, microbial biomass and activity, abundance of the 16S rRNA genes of bacteria

Introduction

Northern ecosystems are characterized by extreme climatic conditions and low productivity during the short growing seasons. Deep soil temperature regimes and partially water saturation of large areas give rise to low microbial activity and long turnover time for organic materials. As a result, accumulation of organic matter is favored in cold climate soils (Rodionow *et al.*, 2006). Knowledge of linking microbial community features and SOM quality as a substrate for decomposing organisms is necessary to predict the magnitude and the time-scale at which C will get mobilized in permafrost soils at climate change (Khvorostyanov *et al.*, 2008).

Materials and Methods

The main goal was to identify links between the microbial biomass and activity and organic matter composition in soils underling by continuous permafrost.
The study site is located in the homogeneous larch forests of the Central Evenkia (N 64°, E 100°). The investigated area is situated in the continuous permafrost zone, with a permafrost thickness up to 300 m and with the permafrost temperature of -3.5 °C. Soil cover is presented by Cryosols. Climate is highly continental with mean annual temperature of -8.9°C (mean temperature in January, -36 °C; mean temperature in July, +16 °C) and a mean annual precipitation of 370 mm.
Measurement of carbon and nitrogen contents in soil was done by an Elementar Vario EL III elemental analyzer, and stocks were calculated for different layers based on the bulk density and corrected for the rock content.
Labile organic matter was extracted using serial daily extractions of a soil sample by distilled water and 0.1N NaOH solution, without preliminary decalcifying. The content of stable soil organic matter was determined by a difference between the content of the total organic carbon and carbon of the labile organic matter.
Microbial biomass was assessed by rehydration method and using substrate-induced respiration (SIR). Basal (heterotrophic) soil respiration was estimated from CO_2 emission rate from soil samples incubated at 23ºC and 60% moisture content. Quantitative PCR was used for analysing abundance of the 16S rRNA genes of bacteria.

Results and Discussion

The total organic carbon stock in the active soil layer on the north-facing and south-facing slopes was 5.4 and 2.1 kg C m^{-2}, respectively, in spite of the thickness of the active layer on the south-facing slope, which was 1.3 times deeper thawed compared to the north-facing slope. The upper 0-20 cm soil layer of north-facing slope contained 2.3 times more carbon than soils on the south-facing slope. At both slopes, soil organic carbon concentrations decreased gradually with soil depth down to the permafrost table.

The main part of accumulation of soil organic matter stocks on both slopes was stable humus (C_{stab}). C_{stab} accumulation in the soil of the north-facing slope took place down to the permafrost table, while at the south-facing slope the accumulation occurred mostly within the top 0-30 cm of the mineral soil. Labile carbon (C_{lab}) had larger contents in soils of north-facing slope. We assume that higher moisture conditions of a north-facing slope favored the migration of dissolved organic matter to the lower part of the active layer, where it accumulated in both fractions, as labile and stable organic matter.

Basal respiration rate as well as heterotrophic microbial biomass within the active layer of soil profiles at both slopes decreased with depth and were strongly correlated with the organic carbon content. The number of bacterial 16S rRNA gene copies in the soil of the south-facing slope decreased down on a profile with sharp increase in close to the permafrost table, while the number of gene copies in the soil of the north-facing slope was rather evenly distributed within active layer profile, with a tendency to decrease close to the permafrost table. Possibly, such distinction is bound to various soil moisture and its flushing regime on slopes. Also the pattern of biomass of the heterotrophic microorganisms with soil depth was similar to that of the number of gene copies, indicating that the majority of the microorganisms in these soils were heterotrophs. However, the heterotrophic respiration in the deeper soil horizons was extremely low, thus showing that heterotrophic respiration is influenced by decreasing soil temperatures with depth.

Conclusion

The heterotrophic activity in the investigated permafrost soils is closely correlated to the labile fraction of soil organic matter while microbial biomass depends on total organic carbon content.

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Estimation of soil buffering to heavy metals in the impact zone of Pervouralsky-Revdinsky industrial hub, Sverdlovsk region, Russia

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Key words: degraded soils, ecological risk, pollution assessment, total index of pollution Zc

Introduction

Heavy metals (HM) contamination is one of the most dangerous and widespread type of environment pollution. Soils polluted with heavy metals have direct effects of toxicity to biota and indirect threats to human health from ground water and food chain contamination.
The historical development in the Urals of siderurgy and non-ferrous metallurgy factories with old technologies leads to significant environment pollution with gas and dust emissions. As result, the formation of local technogenic geochemical anomalies around metallurgical factories. Anomalies scales and its components in the Sverdlovsk and other regions are studied in detail now (Gusev, 2000; Semyachkov and Pochechun, 2007; Kozlov et al.,2009; Vasiliev and Chashchin, 2011). An important problem is that different levels of contamination with HM fall on different soils with different properties and, therefore, to identify the effect of singular pollution factor on soil properties, and even to compare properties of contaminated and pure, without pollution, soils is almost impossible.
Our objectives in this study to explore the complex influence on soils of the enterprises in Pervouralsky-Revdinsky industrial hub emissions and land using possibilities this territory

Materials & Methods

Pervouralsko-Revdinsky industrial hub covers an area between Pervouralsk and Revda towns (within 56º 54′ 19″ - 56º 48′00″ N; and within 59º 56′ 36″ - 59º 55′ 00″ E) .This territory is located near the Middle Urals watershed part; mainly coincide to Revdinsky - Ishim depression that contained between the Konovalovsk - Ufaley and Revdinsky ridges. The climate in the region is temperate continental, with an annual mean temperature of 1.9ºC and a mean annual rainfall 500 mm year-1. Dominant soils occurring in the research area are classified as Greyzems in the FAO System or Grey Forest Soils (zonal soils of the forest–steppe, in Russia).
The study area is confined to the impact zones of two major factories of Pervouralsky-Revdinsky industrial hub. The Middle Urals copper smelting plant (SUMZ) – environment polluter by copper, lead, zinc, cadmium and other HM together with oxides of sulphur and nitrogen, hydrogen fluoride. «Chrompick» - the plant for production chromium-containing materials, in which emissions chromium

compounds, are dominated. Sampling of surface soil carried out radially, considering mainstream wind rose within a distance of 0.5-3.5 km from the emission sources.
The concentrations of heavy metals in soils were determined by atomic absorption with flame atomization, using PE 5300VI spectrophotometers. The pH $_{KCl}$ was measured in a 1:2.5 soil/water ratio using pH meters Sartorius PB-11.The particle size distribution of the soils was determined by the Kachinsky pipette method. Organic carbon (OC) was determined using the acid–dichromate wet oxidation method of Tjurin. Soil humus, meaning by it the percent of soil OC multiplied by the factor of 1.724. Sesquioxides concentrations determined by the method as described by Rinkis et al.

Results and Discussion

Table 1

The level of soil contamination according to the distance from point pollution

Sampling district (distance from point pollution, km)	The content of heavy metals, (mg kg^{-1})						Zc	Technogeneous pollution degree of soils
	Cr	Pb	As	Cd	Ni	Zn		
SUMZ								
0,5	1000	300	300	0,2	150	5000	545,8	extremely threatening
1,0	400	70	100	0,2	60	900	263,3	extremely threatening
1,5	400	20	2	0,2	50	150	121,6	threatening
2,0	150	70	2	0,2	70	400	32,2	threatening
2,5	100	50	2	0,2	60	150	31,1	moderately threatening
3,0	180	70	2	0,2	90	200	37,6	threatening
3,5	700	50	2	0,2	60	180	34,9	threatening
«Chrompick»								
0,5	9990	100	2	0,2	100	150	134,4	extremely threatening
1,0	1500	40	2	0,2	180	150	28,8	moderately threatening
1,5	200	15	2	0,2	60	150	23,5	moderately threatening
2,0	400	40	2	0,2	180	150	28,8	moderately threatening
2,5	600	30	2	0,2	180	150	33,8	threatening
3,0	400	70	2	0,2	70	400	30,5	moderately threatening
3,5	300	60	2	0,2	90	150	27,7	moderately threatening
4,0	300	50	2	0,2	60	100	25,2	moderately threatening

Data for estimating the distribution of heavy metals according to the distance from point pollution (the SUMZ and the«Chrompick» plants) are given in Table 1. To estimate the soils chemical pollution level with heavy metals as the indicator of unfavorable effects on human health the summarized index of pollution (Zc) used. This index is equal to the sum of the chemical elements concentration coefficient.

The level of HM pollution in the studied soils varied widely and is linked to composition of industrial emissions and distance from point pollution. The greater heavy metal contents were in soils around the SUMZ plant, within 1.5 km, the pollutants degree was assessed as extremely threatening, index Zc ranged from 263.3 to 545.6. The main pollutants were copper, chromium, lead, arsenic. Total heavy metal contents multiple times exceeded the maximum allowable concentrations (MPC)- Cu by 50 times, Asc by 150 times, Cr by 10 times,Pb by 6 times. With distance from the pollution source the heavy metal content decreases somewhat, but still exceeds MPC by several times (Cu and Cr by 2-4 times, Pb by 1.5-2 times).

Soil pollution around the «Chrompick» was lower (extremely threatening contaminated soils are found only within 0.5 km zone). The contamination level characterized as moderately threatening, index Zc ranged from 23.5 to 30.5. The main pollutant is Cr; its content within 0.5 km zone was almost 100 times higher than MPC. Excess of maximum allowable concentrations indicated for Pb (3 times), and Cu (5 times). In soils, more remote from the enterprise, pollution is lower. Chromium content exceeded MPC by 3-6 times, lead by 1.5-2 times, copper 1.5-3 times.

Table 2

Estimation of buffering soil to heavy metals

Sampling district	Acidity of the soil		Humus		Physical clay (particles< 0.01 mm)		Sesquioxides		Grades summed up
	pH_{KCl}	grades	%	grades	%	grades	%	grades	
SUMZ									
0,5	3,9	2,5(15,0)	4,4	5,0	61,5	20,0	9,0	7,0	34,5(47,0)*
1,0	4,9	2,5(15,0)	3,7	3,5	67,6	20,0	8,1	7,0	33,0(45,5)
1,5	6,3	7,5(10,0)	3,3	3,5	62,6	20,0	7,0	7,0	38,0(40,5)
2,0	6,8	10,0(7,5)	3,4	3,5	59,2	15,0	8,5	7,0	35,5(33,0)
2,5	6,1	7,5(10,0)	4,2	5,0	59,5	15,0	6,5	7,0	32,0(39,5)
3,0	5,8	5(12,5)	2,3	3,5	57,5	15,0	7,0	7,0	34,5(37,0)
3,5	6,3	7,5(10,0)	4,0	5,0	46,4	15,0	7,1	7,0	37,0(34,5)
«Chrompick»									
0,5	6,9	10,0(7,5)	4,1	5,0	44,9	10,0	8,6	7,0	32,0(29,5)
1,0	6,8	10,0(7,5)	3,4	3,5	48,8	15,0	9,2	7,0	35,5(33,0)
1,5	5,9	5,0(12,5)	4,1	5,0	47,5	15,0	10,5	7,0	32,0(39,5)
2,0	5,0	2,5(15,0)	4,6	5,0	41,9	10,0	7,4	7,0	24,5(37,0)
2,5	6,5	7,5(10,0)	2,9	3,5	47,5	15,0	9,0	7,0	33,0(35,5)
3,0	5,8	5,0(12,5)	4,3	5,0	47,1	15,0	8,8	7,0	32,0(39,5)
3,5	6,5	7,5(10,0)	4,0	5,0	53,1	15,0	8,6	7,0	34,5(37,0)
4,0	6,8	10,0(7,5)	4,1	5,0	53,7	15,0	7,3	7,0	37,0(34,5)

* in the parentheses - grades for elements mobile in alkaline condition

For a detailed evaluation buffer capacity of soils to heavy metals used scale proposed by V. Iliyn (1995). The buffer capacity of soil in this study based on HM inactivating effect of humus, physical clay, sesquioxides, pH. It was found that the leading inactivation factors in automorphic soils are the fine particles and pH. Soil acidity has a particular significance in the buffering assessing, with increasing pH, the buffer in relation to the metals mobile in acidic conditions is increased, but to the metals mobile in alkaline is reduced. The degree of soil buffering is estimated by summing the scores of all indicators on the following grading scale «buffering degree / grades»: very low / 10; low / 10-20; average / 21-30; increased / 31-40; high / 41-50; very high / >50.

The particle size distribution of the soils and other properties are shown in Table 2. Textural classes were heavy loam and light clay. Significant content clay particles in the soil caused high content of sesquioxides (7-10%) - one of the main components of clay fractions. Despite the acidic nature, soils were weakly alkaline, it obviously is the result of periodic liming farm land from which samples were taken. pH of soils in immediate vicinity of the SUMZ – acidic, which we attribute to the influence of sulfuric acid enterprise emissions.

Studied soils are similar and were belonged to the group with high buffering. The proportion separate defining factors of this buffering varied and decreased in the following sequence: particle size distribution (30-60%), pH (5-50%), sesquioxides (15-25%), humus (10-20%).

According to the current level of pollution in the survey area, we have proposed restrictions on land use basic categories. It is recommended to minimize the use of land in the contaminated areas in agriculture, the introduction of special water and forest protection procedures, as well as recultivation methods of agricultural land (Gusev et al., 2014; Firsov, 2014; Firsov et al., 2015).

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Changes in physical properties of chernozem under the influence of steppe woodlands

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Key words: Soil physics, chernozems, forest shelterbelts, complicated soil cover, water resistance, the coefficient of permeability (CP)

Introduction

It is understood that the climate of the steppe zone is characterized by hot summers, long and warm autumns, cold winters with temperature fluctuations and short springs, with large temperature swings, low amount of annual rainfall with significant variation in different years, strong winds with low humidity and intense evaporation, which exceeds the annual precipitation. [2]

In studies of steppe regions, changes in climate and soil conditions in the territories covered by forest are noted everywhere [1,2,3,7,8]. And irrespective of the way of appearance, plants, which form the forest communities, possess significant capacity to transform the environment. Steppe soils are the first to be exposed to such restructuring [3]. The fastest and the most characteristic influence of forests reflected in the distribution of the moisture, content of organic and carbonate carbon [4, 9]. Phytoclimate of such plantings has distinctive special hydrothermal conditions, for example, steadier temperature conditions, higher humidity and weaker wind flows, compared to phytoclimate open steppe [3,5]. These mesoclimatic conditions and surface condition of chernozems, by all means, should reflect their basic properties. The purpose of this work - to study basic physical properties under woodlands.

Materials and Methods

The study was conducted in Saratov and Kursk regions.

In the Saratov region, near the town of Kalininsk, 3 cuts were laid: in the typical chernozems under a natural woodland ("master") (51 ° 27'12,8 "N, 44 ° 27'24,2" E), under the forest belt (forest belt Kalininsk - Penza) (51 ° 27'27,19 "N, 44 ° 26'43,58" E), on arable land (51 ° 27'28 "N, 44 ° 26'40,8" E). The sections were laid according to the principle of gradual increase in the influence of forest vegetation. Therefore, in natural woodland the age of trees exceeds 100 years, the planting of forest shelterbelts Kalininsk-Penza is dated back to 1959 and the last section on the arable land was used as a comparison of modern use of topsoil.

On the territory of Kursk Scientific Research Institute of agro-industry we laid 2 sections in similar conditions to that of the previous area, excluding natural forest. The first section was in the forest belt (directing West-East) (51 ° 37'18,63 "N, 36 ° 15'42,07" E), this planting is dated 1962, and the second section is located on the

territory of long-term field experiment with crop rotations under the chernozems zone, on rotation of fallow land (51 ° 37'49.9 "N, 36 ° 16'12.9" E).
Density of soil and moisture permeability coefficient was determined using classical methods in the field conditions[10].
Coefficient of filtering (CF) estimation was conducted by tubes method with a constant pressure in a 3-fold repetition. The obtained data was approximated in Statistica 10 according to the Horton equation qw = qf + (q0 - qf) * Exp (-k * t), where qw - infiltration rate, which changes during the experiment (cm / hour), qf, q0 - the rate of imbibition at the start and end (filtration) time points, t - time (h), k - factor (k> 0), h-1 [10].
Estimation of water-stable aggregates was conducted by Andrianov modified method.
To describe the decaying process the data was approximated by the equation y = n1 * (1 - exp ((- n2) * t)), where y - the total number of units of disintegrated at the time t, n1 - a measure of instability of the aggregates in water, n2 - is the rate of destruction. Both parameters n1 and n2 represent instability and disintegration of aggregates in water: n1 - their total disintegration, n2 - fast decay. Therefore, we can offer generalized index of destruction aggregates (GIDA) in water

$$N = n1 \cdot n2$$

This composition represents the process of aggregates decay in water, and it will be increasing with the number of disintegrated aggregates and the rate of the decay in water. Aggregates are considered absolutely stable in water when N = 0 [11].

Results and Discussion

Chernozem typical in Saratov region are characterized by differences in the density of the surface horizons (arable land - 1.06 g / cm3, a forest belt - 0.93 g / cm3, forest - 0.55 g / cm3) , which are caused, mainly, presence of active biota, developed root system, high humidity and lack of agricultural processing.
In gradation with similar to density changes are observed CF (classification Kaczynskii): filtration in the forest and in the forest belt - "too high" (3249 and 1515 cm / day) on arable land - "the best" (92 cm / day).
The data which obtained by the method of water-stable aggregates Andrianova indicate about extremely high water stability of aggregates in the territories covered by forest vegetation. Aggregates of humus horizon (5-3 and 7-5 mm) of the forest and the forest belt didn't respond to the destruction over 2-day (GIDA = 0). The aggregates of the same diameter and the same period of time, which taken from an arable land, are destroyed of the amount of 50% of the total (GIDA = 18.8 and 22.4 from the surface A horizon, GIDA = 0.08 and 0.15 from the middle of the A horizon for aggregates a diameter of 5-3 mm and 7-5, respectively).
In the Kursk region in the forest belt the density of the soil gradually increases with depth (from 0.86g/cm3 from the surface up to 1.13g/cm3 to the BC horizon). On arable land observed a similar situation, but average of absolute density index is increases (1.02 g/cm3 from the surface to 1.20g/cm3 to the horizon BC). And, as noted throughout the literature and observed in our case, in the second section at a depth of 17 cm allocated compaction horizon with a density of 1.20g/cm3, which called "underploughing layer" .
CF brighter show the influence of forest vegetation on previously plowed soil. So, on the surface of the humus horizon of soil under forest belt filtration is the "best" (780

cm / day), and while under the arable land - "unsatisfactory" (37 cm / d) (classification Kaczynskii).
Water-stability of aggregates change similary. For GIDA lowest values indicate the highest stability to destruction. GIDA surface horizon of chernozems under arable land is quite high (91 and 98 for aggregates of 5-3 and 7-5 mm in diameter, respectively). Also, can observe the effects of the presence of compaction layers , for example, increased water-stability compared with the bulk of the arable layer (21 and 40 aggregates 5-3 and 7-5 mm in diameter, respectively). Influence of forest vegetation within forest plantations by several orders improves water-stability of aggregates (0.07 and 0.58 for aggregates 5-3 and 7-5 mm in diameter, respectively).

Conclusion

Based on this data, we can say with certainty about the positive effect of the presence of forest vegetation on previously degraded agricultural soil.
It is reflected in a significant decrease in density throughout the profile, and liquidation of compaction effects on the border of the plow penetration. Changes in plant composition community lead to a logical restructuring of elements cycle in the environment and can influence soil properties, such as water stability of aggregates, by introducing new organic compounds with litter. The increase of water stability by several points compared to previous level is attributed to quality change in the material composition of organic matter. As it is shown earlier, there is predominance of hydrophobic elements in the soil’s organic matter under forest vegetation and predominance of hydrophilic elements under arable land [4, 5].
As a result, the values of the CF on the surface horizon under the canopy of the forest vegetation and without it differ by more than one scale point and by several scales in the classification. Well structured chernozem of forest belts with high water stability aggregates has more favorable filtration properties compared to little-structured and compaction chernozem of arable land. However, it is worth noting that, density and water-stability of aggregates of compaction layer ("underploughing layer") differ from general bulk of humus horizon, but these features are not actually reflected in CF.

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Effect of different amendments on the behavior of the culture of faba beans in a saline soil in Algeria

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Introduction

In Algeria, the bean *Vicia faba* L. is the most important crop among the large-seeded legumes in area level, which was estimated at about 37668 ha in 2013, and at the level of production with about 42380 tons (Faostat , 2015). Its cultivation is practiced mainly in coastal and interior plains and in the Saharan areas. In Algeria, the bean is mainly used for human consumption as fresh pods or as dry grains. In case of high output, the excess dry grains may be incorporated into animal feed (Maatougui 1996)
The global area occupied by faba bean is about 2,5 million hectares producing 4,564 million tons in 2012 (FAOSTAT, 2015), African production is of 1.50 million tons over an area of 0,96 million hectares, Algeria produced only 40507 tons on an area of 36835 ha in2012 (FAOSTAT, 2015).
In Algeria the culture of faba bean is subject to a number of abiotic stresses (cold, frost, heat and salinity) and biotic, which limit its production, development and extension. The experimental work focuses on the behavior of a variety of bean in a highly saline soil amended with 3 types of treatment we used gypsum, humic acid, manure and treatment with a nitrogen fertilizer.

Materials and Methods

Site Description. This study was carried out during winter season of 2014. The site is located in the experimental station of Hmadna at the National Institute of Agronomic Research of Algeria, which is located at latitude 35 ° 54 'N and longitude of 0° 47 'E with an altitude of 48m.
The study area is characterized by a semi-arid to arid climate trend where irrigation is essential for crops. The soil of the experimental area is a loamy clay texture having pH values ranges between 7-8 of 7.97, EC of 1,98 (dS/m).
An experiment was conducted at the experimental station of Hmadna, Algeria, to study the “Effect of different amendments on the behavior of the culture of faba beans in a saline soil” during 2014/2015. The experiment was carried out in randomized complete block design having three replications. A plot size of 1200m², distance from plant to plant was 50 cm while row to row distance was 50 cm. All the agronomic practices were applied when needed. Applied at time of sowing. LUZ DE OTONO variety was sown on 25th November 2014. Three treatments were applied at sowing.
The first treatment includes gypsum mixture (7,5t ha^{-1}), humic acid 2,25 t $ha^{-1}$and manure 45 m^3ha^{-1}, 2nd treatment contains gypsum (6 t/ha), and manure 37,5 m^3ha^{-1}.
The 3rd treatment contains mineral fertilizer NPK (15-15-15) 750 kg ha^{-1}

Each plot was divided into their sub-block which represents a repetition. Some performance parameters were calculated as plant height, number of pods per plant, number of seeds per pod, weight of 100 grains and grain yield.

Statistical Analyses

Data were subjected to the analysis of variance test (ANOVA) with mean separation at 5 %, levels of significance averages of various repetitions were calculated and analyzed by the software of statistics (STATBOX 6.0.4.) and the device used is the unifactorial total randomization by the test of Newman and Keuls (P 0,05 and P 0,01).

Results and discussion

Plant height

The average plant heights of faba bean seedling were calculated during all season in all treatments. The results show the highest plants ranged at 51.16 cm, 41.83 and 32 cm in the treatment 01, 02 and 03 respectively. The first treatment which is based on gypsum, manure and humic acid shows the higher average of plant height. Statistical analysis of data showed highly significant differences among all treatments examined for.

The number of pods per plant

The number of pods per plant was calculated for all the treatments and repetitions. Statistical analyzes of each test show a significant difference between the pod no.plant^{-1}.

Data of Table (01) show that all treatments had direct effect on faba bean net yield. Using gypsum manure and humic acid in faba bean plants significantly improved pods no.plant-1 while 100-seed weight (113.93g, 126.6g and 116.1g increase respectively with no significant difference among treatments). On the other hand, application of treatments to faba bean plants have no significant effect on number of seeds pod^{-1}. El-Ghamry et al. 2009 show that using humic acid improves pod no. plant -1, unless the number of seeds plant^{-1} did not increase significantly.

Table 1

Effect of treatments on yield parameters in faba bean

	Plant height	Pod per plant	Grains per pod	100 grains weight (g)	Grain yield (gr/m²)
Treatment 01	51,16 a	19,44ab	4,733	113,93	510,3 a
Treatment 02	41,83 b	21,77 a	4,733	116,1	406,63 b
Treatment 03	32 c	13,55b	5,333	126,6	284,4 c
Test F (Signification)	18,224**	4,057 *	1,421 NS	1,867 NS	18,45**
CV	13,20%	34,57%	10,20%	7,22%	11,39%

NS : non significant ; * , ** Significant at the 0.05 and 0.01 probability levels, respectively a,b,c : homogeneous group (Numbers with the same letter are not significant different at P < 0.05).

Pod per plant

Analysis of the data indicated that pod plant^{-1} was significantly affected by manure gypsum and fertilizer treatment, and also by the interaction between gypsum mixture and manure. Maximum number of pods plant-1 (21,77) was recorded with application of gypsum and manure while lower number of pods (13,55) was observed with application of fertilizer. Similarly higher number of pods plant-1 (19,44) was noted when applying NPK fertilizer.

Hundred Grains Weight (g). Hundred grains weight (g) was not significantly affected by any of treatments Maximum hundred grains weight (113, 116 and 126 g) was recorded withapplication of treatments which are statically similar with each other and there is no significant difference.

Grain Yield (g m^{-2}). The gypsum mixture+ manure and humicacidehad significantly affected grain yield g m^{-2} However, Higher grain yield (510,3 g m^{-2} was recorded when applying the three component of fertilization which is statistically different with the use of gypsum+manure or NPK fertilizer, minimum grain yield (284,4 g m^{-2}) were recorded with application of NPK. Grain yield of 406.63 g m^{-2} were noted with application of gypsum +manure without Humic acid. The graph (Fig. 1 1) showed that a steep increase was observed in grain yield when applying humic acid with manure and gypsum unless the use of NPK fertilizer records the lowest rate. The ability of Humic acid to release the nutrient slowly due to the decomposition of residue for a longer time could be the possible explanation for improved grain yield due Humic Acid application (Dev & Bhardwaj, 1995) and sharif et al. (2002) who reported that humic acid alone can increase the grain yield by 21-25% with nutrients accumulation.

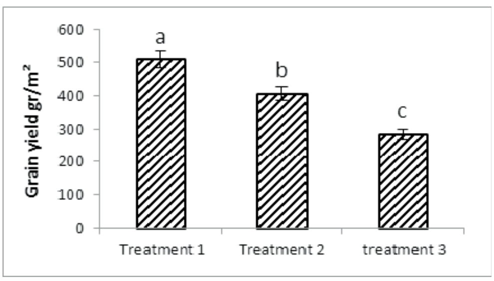

Fig. 1. Grain yield (g /m²) as affected by treatments

Conclusion

From the results and discussion mentioned it is concluded that the yield and yield components of *vicia faba* were maximum when applying a gypsum mixture + manure and Humic Acid, so it is recommended for higher grain yield and higher crop growth.

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Causes of desertification in the Shirvan region of Azerbaijan

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Keywords: desertification, soil, plant cover, prudoctivity

Now in Azerbaijan spent researches for prevention of negative results of desertification and antropogenous factors on soils and plant cover. Influence of anthropogenic factors as a natural factors in the formation of desertification are undeniable.

Desertification is a process which leads to unavoidable modifications in direction of aridization of soil-vegetation cover and reduction of biologic productivity in arid zones, which may turn the territory into desert under extreme conditions. There are not still precise criterias about desertification and its indication (by diagnosis). All over the world 3,3 billion hectare (80%) of the agrigultural soils in arid terriotries have udergone desertification asa result of ecological degradation of the lands. 21% of the irrigated lands, 77% of the dry lands and 82% of the pastures have undergone average desertification. The main problems of desertification may be water erosion, deflation and degradation of vegetation.

In Azerbaijan Republic the square of the populated arid territories is 5,2 thousand hectares (60%). The main part of the arid territories is located in intensive irrigated Kur-Araz lowland, Shirvan, Mil, Mughan plains. Desertification and landscape degradation processes occur mainly here. One of the important problems of Azerbaijan nature is tendecy to landscape degradation and desertification. In these regions desertification goes in direction of reduction of biological productivity of the soil-vegetation cover, reduction of the biologic potential under influence of the natural and anthropogenic factors, full degradation of the lands under extreme circumtances. Research of desertification, revalation of its creation reasons, its prevention or weakening being the actual mater is the main problem of each country and of Azerbaijan as well [1].

The main object of the research are degraded, steppe, useless, deserted natural ecosystems and agrolandscapes. As scientific-research works conducted by us are multiprofile,morphologic, systematic, floristic, geobotanical, bioecological, industrial, mathematical, monitoring, agrotechnical, phenological, expeditionary, semiportable, stationary, vegetation resources, comparison and other methods were used [2;3].

During implementation of the researches the various methodology [4;5;6;7-10] were used. Under studying of degradation process of the soil-vegetation cover used the methods of the geographic comparison. As a standard there were taken the soils exposed to erosion and deflation, at the same time destroyed and polluted soils and the areas where vegetation was not destroyed (natural, reserve regime and etc.). [11-12;13].

The purpose of the research is study of the main indicators of desertification in this territory and their development parameters, modern condition, criterias and by this way definition of ways of prevention of desertification. One of the main indicators measures for sollution of the put problems is condition of vegetation, its structure, vegetation regime, development and other factors in total senotic reflection for concrete area of Shirvan plains. Research (monitoring) of ecological modifications in the arid territories exposed to desertification, definition of intensity of desertification in some areas are the main problems put forward. For sollution of the problem firstly natural and anthropogenic factors of desertification should be defined, at the same time they should be ecologically based, modern condition of desertification in different ecosystems should be forecasted and diagnosed [13].

Since ancient times the large pasture fields of Shirvan zone have been used as winter pastures. In this territory the square of winter pastures reduced from 3 mln hectares to 1 mln hectares. In winter months in the pastures of the territory about 100 thousands of cattle of the republic and of neighbouring countries pastures. In submontane territories the productivity reduced in 2-3 times, and this indicates that fertility of soil in these territories is falling with the lapse of time. At present in Azerbaijan 240 thousands hectares of 635 thousands hectares of summer pastures are under occupation. 43,8% of 350 thousands hectares of lands area covering 20 districts has incurred erosion, and 14,2% of them has faced more severe erosion danger. In 2010 year according to region information major portion of 704 thousands of cattle are kept here. That is why the soils were trampled down and erosion process increased manyfold. One of the most major factors caused worsening of winter pastures are salinization of soil, strengthening of repeated salinization process. Thereby, natural vegetation exposed to various degree of fluctuation under high anthropogenic tension and especially deepened degradation of desert phytocenosehaving local character.

Natural vegetation of the researched territories differs by its great variety [13]. This variety is reflected not only in modern natural-historical situation, growing anthropogenic tension of the people, but also in the past long and complex evolution process and formation of changing geological periods. Geological structure of the territory of Azerbaijan was exposed to many modifications, in the end of the Sarmat period. After drawing out of the waters part of the territory stepped into continental phase. In Pont era of Sarmat period sea slowly went away, Eastern Caucasus connected with mountain slopes of Iran and as a result it started migration of xerophyte elements from there into the territory. In the Trio period against the background of the Ancient Mediterranean Sea flora there formed "Kolkhid" and "Hirkan" floristic centersnot depending from each other. During Sarmat era 3 main flora province existed on the Caucasus. Two of the being mesohile province formed as "Kolkhid" and "Hirkan" floras, and the third formed as xerophyte flora. In the end of Pont era on the places released from the sea there were created conditions for formation of xerophyte type of flora, to be more exact, desert and semidesert vegetation, but from the beginning of the fourth period – for formation of the steppe flora. In the territory *Pinus eldarica* Medw., *Ficuscarica* L. and etc. referres to the third period xerothermic relicts and etc. The species existing in trio period of Caucasus flora formed surrounded by Southwest Asia, Mediterranean Sea, Eastern Asia elements and species migrated from the north.

On the basis of the monitoring research and office laboratory-analytic works criterias, internal danger of desertification, modern xerophytic biotypes, project cover, fertility in arid territories and etc. in compiling areas can be determined. Reserach results of the flora of natural ecosystems, vegetation existing in the territory, new floristic and phytoserology features, regularities of desertification process gives opportunity for implementation of the new modern technological, agrotechnical, engineering-technical works in compliance with changed situation. And this in turn will provide proper, effective and continually usage of soil and vegetation cover on the basis of restoration of the destroyed ecological balance.

Degradation of soil and vegetation in arid and very dry territories are strongly influenced not only as complex influence of ecological factors, but also by global modifications occurring of flora and vegetation. Desertification in the territory historically happened as a result of formation of arid and continental climate condition, steppification of existing vegetation types, depletion of grass cover, reduction of productivity, worsening of botanic structure, gradually collapse of the fertile soil layer. Shirvan plain where there is the most intensive development of desertification process, is the territory of large spread of saline-steppe (Shirvan desert -Picture) soils. In these ecosystems aridity index is 4, radiation balance is 45-47 kilocal/sm^2, heat energy spent for evaporation is 15-17 kilocal/sm^2, sun radiation is 127-130 kilocal/sm^2, continentality degree is 45% and surface evaporation is 4 times more than rate of precipitations. 87% of 45 defined factors of desertification relate to uneffective use of natural resources by peopleand just 13% relates to natural events.

Desertification process in the territory has been studied on the scientific bases and the main indications causing desertification, their development parameters, modern condition, factors have been identified and the ways of their prevention have been defined. Direction of spreading, intensity and areals of the ecological modifications intensifying desertification process have been determined.

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Physical properties of soil - the most important part of agrophysics

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Key words: soil physical properties, long-term field experiment, penetration resistance.

Introduction

The application of fertilizer and manure also affects many soil properties - in particular, relatively stable (conservative) physical properties such as aggregate size distribution and specific surface (Rachman and others 2003, Dutartre and others 1993). Depending on the particular farming practices, soil properties and climatic conditions, these changes may be clearly manifest; in other cases, they cannot be diagnosed by traditional methods. For instance, several studies have shown that the long-term application of fertilizers exerts a negligible effect on soil texture and bulk density (Munkholm and others 2006). Many physical properties of soils are quite stable; their minor changes cannot be properly estimated by the routine methods so it is important to develop methods that will allow unambiguous judgments about changes in the physical properties of soils under the impact agricultural management. To this end, we have studied a wide range of the physical properties of a soddy-podzolic soil and their changes under the impact of mineral fertilizers, lime and manure.

Materials and Methods

Field studies were undertaken on plots of the long-term experiment of the Timiryazev Agricultural Academy, established by Prof. AG Doyarenko in 1912. The site slopes at 1^{o} towards the northwest within the southern part of Klin–Dmitrov Ridge; the soil is light loamy soddy medium podzolic[1]. The area of 1.5 hectares is divided into two parts with six rectangular fields in each. In the first part, continuous crops of winter rye, potatoes, barley, clover, flax, and bare fallow are cultivated; in the second part, a rotation of bare fallow–winter rye–potatoes–oats (barley) with clover–clover–flax is followed. Each field within the part under continuous crops is split into eleven plots of $100m^2$ on which different variants of fertilization have been applied: unfertilized control (two plots), N, P, K, NP, NK, PK, NPK, manure, and NPK + manure. Since the fall of 1949, half of each plot ($50m^2$) has been limed once every 6 years (Kiryushin and Safonov 2002).

Samples were taken from 0–10, 10–20, 20–30, and 30–40cm layers from the continuously cropped plots under the control, lime, NPK, and NPK + manure treatments auger. Bulk density was determined on samples taken by a cylindrical (Pol'skii) auger.

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[1] Albeluvisol in the World reference base for soil resources 2006

Particle size distribution was determined in two stages. First, ground soil was sieved through 1mm and 0.25mm screens to separate coarse soil particles (> 0.25mm). Then particle size distribution in the fraction <0.25mm was determined on a FRITSCH Analysette22 laser difractometer after ultrasonic pre-treatment. Thus, we obtained data on the content of coarse fractions (> 0.25mm) and the particle size distribution for finer fractions. This procedure was necessary because the large coarse fraction in the bulk soil hampered the measurement of particle size distribution curves for the finer fractions (Shein and others 2006).

The soil specific surface was determined by desorption equilibrium above saturated salt solutions: 3–5g soil samples were wetted and stored for two weeks in desiccators above water to reach quasi-equilibrium saturation, then placed in desiccators with saturated salt solutions ensuring relative vapour pressures of 0.15, 0.332, 0.55, 0.86 and 0.98. The desorption of water from the samples continued for about three months until equilibrium state, then the samples were dried at 105°C and their water content was determined. The specific surface was calculated according to the BET method (Shein 2005).

Aggregate size distribution in the upper horizons (0–10 and 10–20cm) was determined by dry sieving using a Retsch device (Retsch 2005).

Organic carbon was determined with an AH7529 auto-analyzer at 900–1000°C in a flow of oxygen.

Wetting heat (*WH* cal/g) was determined using an OX12K calorimeter.

The strength of dry aggregates of size 3–5 and 5–7mm was determined in 20 replicates using a cone penetrometer developed by PA Rebinder:

$$P_m = 1.108 \cdot \frac{F}{h^2}, \quad (2)$$

where F is the load, kg; h is the depth of the cone penetration, cm; and 1.108 is the coefficient for the cone of 30°. The penetration resistance (P_m), measured in kg/cm^2, was determined at various water contents.

Results and discussion

Comparative analysis of these physical and chemical properties of the upper soil layers from different variants of the experiment shows relatively small differences between major physical characteristics of the soil solid phase. The spatial heterogeneity in the distribution of the studied indices within the particular soil profiles and between them is considerable. It may be supposed that a somewhat coarser soil texture in the control and an increased content of clay particles in the variant with NPK and manure application are related to the initial heterogeneity in the soil properties rather than to the different agricultural loads on the soils; the degree of changes in the soil physical properties under the impact of different agricultural loads is relatively small. Only the variant with NPK and manure application differs significantly from other variants in having a higher content of the finest particles and, hence, higher water retention capacity at the plastic and liquid limits.

Relatively small differences between the major physical properties of soils under different variants of the experiment prompted a search for other differentiating properties. In particular, the strength of soil aggregates and penetration resistance were studied at different water contents. These characteristics are indicative of the strength of inter-particle bonds. The strength of air-dry aggregates in the variants with lime and with NPK and manure is higher than that in the control and NPK variants for both studied depths (0–10 and 10–20 cm) and for both aggregate diameter groups (3–5 and 5–7 mm). As for the NPK + manure variant, an increase in the physical strength of the aggregates may be explained by the addition of organic substances that favour the development of coagulation bonds. In the case of soil drying, such bonds may be transformed into stronger mixed and cementing bond which increase the dry stability of soil aggregates (Bouajila and Gallali 2008). Thus, the addition of manure not only increased the soil organic matter content but, also, improved the strength of soil aggregates.

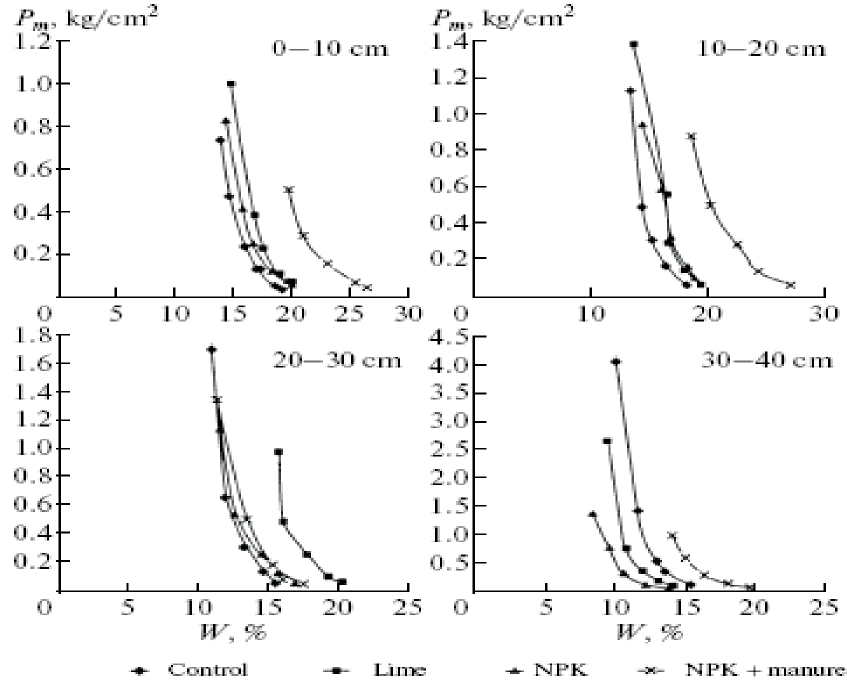

Fig. 1. Penetration resistance (P_m, kg/cm^2) dependent on water content (W,% of dry soil mass) in different experimental variants

Interesting results were also obtained from penetration resistance (P_m) tests at different soil water contents (W) from the liquid limit to the plastic limit. The soil is subjected to compression stress and shear stress, and the dilatant properties characterizing interaction between the soil particles are clearly manifest (Fig. 1 1). The P_m–W curves for the variant NPK + manure are shifted to the right, *i.e.,* at a given soil water content, the soil resistance to penetration in this variant is higher than in other variants due to the formation of coagulation bonds between the particles; the limed variant is also characterized by an increased penetration resistance, which is seen from the steep slope of the P_m–W curves. In all variants, the strength of soil structure (soil resistance to penetration) increases sharply within a relatively narrow range of the soil water contents, which is typical of the soils with a substantial content of coarse particles. As seen from Fig. 1, with a decrease in the relative degree of soil moistening, the soil penetration resistance increases most significantly in the variant with lime application; the least increase is observed in the variant with NPK and manure application which, in this case, may be explained by the lubricant action of hydrophilic organic matter.

Conclusions

1. Determination of the physical properties (particle size distribution, bulk density, specific surface, aggregate size distribution, wetting heat) of soddy-podzolic soils in the long-term field experiment involving applications of lime, NPK, and NPK + manure revealed that the different treatments produced only a minor effect on the main physical properties. Only the soil of the plot with NPK+ manure application was characterized by a somewhat higher content of the finest particles and a higher water retention capacity.
2. Physico-mechanical properties (the strength of soil aggregates and the dependence of penetration resistance on the soil water content) were more sensitive and revealed statistically reliable changes under the impact of different treatment systems. These soil properties characterize inter-particle bonds and their changes in dependence on the degree of soil moistening, i.e. the rheological behaviour of the soils.

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Effect of Organic Matter on TDR Calibration and Measurements of Soil Moisture Content

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Key words: TDR, pedotransfer equations, calibration, organic matter, volumetric water content.

Introduction

Time domain reflectometer (TDR) as a tool for monitoring in situ volumetric water content has been used in various researches such as; natural resource management, environmental monitoring, precision agriculture practices and irrigation scheduling. In agricultural practices, the soil moisture content (θ) is very important to start and to stop irrigation for optimize water use and produce a good quality crop (Hanson et al., 2004) and also important for environmental quality by reducing chemical percolation and nutrient loss in the soil (Leib et al., 2002). Many advanced instruments and methods used to monitor and measure soil moisture in irrigation management techniques vary with respect to their accuracy, labor intensity, cost and simplicity of use (Ley et al., 1994). The basic principle of measuring soil moisture content with TDR method is base of the change dielectric constant 'ε' depend on soil moisture content. The propagation speed of an electromagnetic wave in a vacuum is similar to the light speed (c) ($3x10^8$m s^{-1}). The speed (v) of electromagnetic wave between the rods can be expressed by ε with standing for the dielectric constant of the medium, $v = \frac{c}{\sqrt{\varepsilon}}$. When the speed ($v$) propagation of the electromagnetic wave is written as $v = \frac{2L}{t}$ depend on the wave's travelled distance ($2L$) at a travel time (t), the dielectric constant ε of a medium from measurements of the propagation speed of an electromagnetic wave is shown as (Fellner-Feldegg, 1969) $\varepsilon = (ct/2L)^2$. It is known that beside the considerable amount of water, some other factors affecting the TDR measurements are the clay content, the mineralogy of soil, and the organic matter content, surface area and bulk density of soil (Regalado et al. 2003; Weitz et al. 1997; Tomer et al. 1999; Topp et al. 1988; Roth et al. 1992). Jones et al. (2002) reported that clay and organic matter bind substantial amounts of water, such that measured bulk dielectric constant is reduced and the relationship with total water content requires individual calibration in TDR measurements. The objective of this study was to determine effects of organic matter content on time domain reflectometer (TDR) calibration and errors in volumetric water content measurements in soils having different level of organic matter content.

Material and Methods

This study was conducted in the field of Agricultural Faculty in Ondokuz Mayıs University. The rates of 0, 3, 6, 9 % of rice husk compost were applied to 0-20 cm depth of sandy clay loam soil with three replications. Compost used as organic matter source in the study had 38.32 C/N ratio including 21.14% organic C and 0.55% total N. Some soil characteristics were determined as follows; particle size distribution by hydrometer method (Demiralay, 1993), soil reaction (pH) in 1:1 (w:v) soil water suspension by pH meter; electrical conductivity ($EC_{25°C}$) in the same soil suspension by EC meter; soil organic matter (OM) content was determined by modified Walkley–Black method (Kacar, 1994). Soil properties of the experimental field can be summarized as; the textural class is sandy clay loam (50.10% sand, 26.53% silt, 23.37 % clay); it is slightly alkaline in pH (7.64) and non-saline (1.22 dS m^{-1}) (Soil Survey Staff., 1993). Bulk densities (BD) were determined on undisturbed soil samples (Demiralay, 1993). Relative saturation (RS) values were calculated by the equation; RS = θ / F where, θ is volumetric water content of soil at field condition, F is the total porosity. Volumetric water content (θ) and total porosity (F) were estimated from the equations; θ = gravimetric water content (W) x BD (g cm^{-3}) / water density (g cm^{-3}), and F = [1 – (BD (g cm^{-3})/2.65 (soil particle density, g cm^{-3}))]. Soil moisture contents for each plot were measured using Field Scout TDR 300 soil moisture meter. Direct and indirect effects of soil properties on TDR measurements were determined with path analysis (Wright 1968) using TARIST (1994) program. Correlations among the TDR readings and soil properties and the pedotransfer (PTF) equation to predict the volumetric water content (θ_E) were obtained with the Minitab 13.2 program. The Root Mean Square Error (RMSE) values were computed for testing the accuracy.

Results and Discussion

Descriptive statistical results for TDR measurements and some soil properties and correlation matrix among them are given in Table 2 and 3. While compost application increased soil OM content from 1.09% to 6.29%, BD values decreased from 1.22 g cm^{-3} to 0.589 g cm^{-3} and F values increased from 61.50% to 77.80%. Soil OM contents gave a significant positive correlation with F (0.703**) and a negative correlation with BD (0.703**).

While the volumetric water contents (θ) in the field measured gravimetrically changed between 18.30% and 36.50%, volumetric water content determined using TDR measurements (θ_{TDR}) changed between 38.00% and 72.00% (Table 1). SOM content gave a significant negative correlation with θ_{TDR} (-0.580**). TDR measurements (θ_{TDR}) had significant positive correlations with BD (0.617**) and (0.596**) relative saturation (RS) values. Tomer et al. (1999) reported that bulk density variations cause significant changes in dielectric constant and soils with a bulk density lower than 1 g cm^{-3} require particular calibrations in the TDR measurements which are strongly dependent on the bulk density of the material. If the BD is significantly high (>1.7 g cm^{-3}) the TDR signal tends to overvalue soil moisture and if the BD is relatively small, (<1.0 g cm^{-3}), the water content is undervalued. This can be related to soil mass increase and air volume decrease because the soil matrix has a higher dielectric constant than that of air (Dirksen and Dasberg, 1993; Ponizovsky et al., 1999).

Table 1

Descriptive statistics for soil properties

	Min.	Max.	Mean	Std.Dev.
TDR	0.38	0.72	0.56	0.098
W	0.31	0.42	0.35	0.027
θ	0.18	0.36	0.27	0.044
θ_E	0.2	0.32	0.27	0.035
BD, g cm^{-3}	0.59	1.02	0.79	0.144
F	0.61	0.78	0.7	0.054
RS	0.23	0.59	0.39	0.094
OM, %	1.09	6.29	3.87	1.529

According to the path analyses given in Table 3, the direct effects of soil properties on TDR readings were ordered as follows; BD (61.78%) > SOM (42.20%) > θ (23.34%) > gravimetric soil moisture content (W) (8.34%). The highest indirect effect values of SOM, θ and W on TDR readings were determined with BD. To calibrate the TDR measurements (θ_{TDR}), a second order pedotransfer (multiple regression) equation was obtained using TDR and BD values to predict volumetric water content (θ_E) as follow;

$$\theta_E = 0.013 + 0.571\ TDR - 0.014\ BD - 0.37\ TDR^2 + 0.103\ BD^2$$

Table 2

Correlation matrix among the soil properties

	θ	θ_E	W	BD	F	RS	OM
TDR	0.59**	0.84**	-0.18	0.62**	-0.62**	0.60**	-0.58**
θ		0.89**	-0.02	0.91**	-0.92**	0.99**	-0.75**
θ_E			-0.34	0.94**	-0.94**	0.91**	-0.73**
W				-0.42*	0.42*	-0.17	-0.07
BD					-1.00**	0.96**	-0.70**
F						-0.96**	0.70**
RS							-0.74**

Comparison of volumetric water content (θ) with TDR measured θ and estimated θ at different relative saturations are given in Fig.1. Measured θ values showed a higher regression with θ_E estimated by the pedotransfer function (0.842**) than θ_{TDR} (0.598**) values (Fig. 2). Regression coefficient (2.48) between θ and θ_{TDR} was higher than that (0.79) between θ and θ_E. It is known that if a regression coefficient becomes close to 1, accuracy of the regression increases. Root mean square error (RMSE) (0.244) and relative error (88.06%) between θ and θ_{TDR} were higher than

RMSE (0.023) and relative error (8.81%) between θ and θ_E values. Serrarens et al. (2000) determined that soil-probe contact and soil compaction were critical to the accuracy of the TDR. In this study increasing soil OM content decreased BD and increased F values. Therefore, volumetric water contents and also TDR measurements significantly decreased with increasing soil OM contents in sandy clay loam soil (Table 2).

Table 3

Direct and indirect effects of the soil properties on TDR measurements

	Direct effect, %	Indirect effects, %			
		BD	OM	W	θ
BD	61.78	-	15.63	1.25	21.34
OM	42.2	38.46	-	0.78	18.55
W	8.34	71.94	18.28	-	1.44
θ	23.34	56.6	19.99	0.07	-

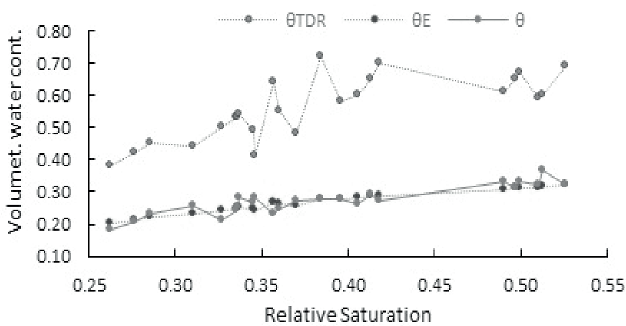

Fig.1. Comparison of volumetric water content (θ) with TDR θ and estimated θ at different relative saturations

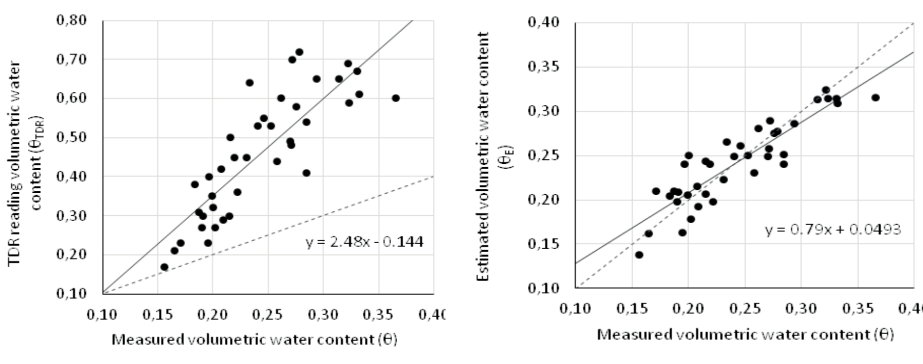

Fig. 2. Regressions of measured volumetric water content (θ) with TDR reading (θ_{TDR}) and estimated (θ_E)

Conclusion

Estimated volumetric water content values (θ_E) using TDR readings in the second order pedotransfer equation decreased RMSE and relative errors in volumetric water content measurements of soils. Increasing soil OM content caused significant decreases in volumetric water content and TDR measurements due to decreasing relative saturation significantly. If a field study is organized with different soil OM contents, TDR measurements for volumetric water contents in the same soil textural class should be calibrated according to bulk density values to get more accurate results.

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Composting potential of paper mill waste with town waste

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Keywords: Paper mill waste, town waste, composting, physical and chemical properties.

Introduction

Paper mill waste (PMW) is generated as by-products of paper production. The disposal of this material might cause environmental problems. It is known that paper mill waste is usually composted by mixing with other organic wastes such as animal manures or sewage sludge placing in windrows, and allowing to decompose for three to five weeks with frequent turning of the windrows (Campbell et al. 1991; Chong and Cline, 1991; Cline and Chong, 1991).

Paper mill sludge has been used to reclaim land (Bellamy et al. 1990; Pridham and Cline 1988) and as a soil amendment for agricultural and forest areas (Cline and Chong 1991; Henry 1991; Logan and Esmaeilzadeh 1985). It is known that polysaccharides and $CaCO_3$ as the main constituents of the paper sludge and it could be used to immobilize heavy metals in soil (Beyer et al., 1997; Wang et al., 2001). Xhio et al. (2010) found that paper sludge has a potential for remediation of soil contaminated with Pb. On the other hand, Evanylo and Daniels (1996) reported that freshly dewatered paper mill sludge caused phytotoxicity in emerging corn plants when incorporated into soil immediately before planting.

Composting is a biological decomposition pocedure of raw materials including the physical breakdown and biochemical transformation of complex organic molecules of dead material into simpler organic and inorganic molecules (Juma 1998, Kızılkaya2015).

The objective of this study was to investigate the potential of composting paper mill waste (PMW) with town waste (TW), and to determine physical and chemical properties of the compost material.

Material and Methods

This study was carried out in the greenhouse of Soil Science & Plant Nutrition Department in Agricultural Faculty of Ondokuz Mayıs University, Samsun-Turkey. Crude materials of paper mill waste (PMW) and town waste (TW) having less than 4 mm size were mixed with a rate of 2:1 (PMW:TW) and composted at the 60% moisture level of total water holding capacity for 65 days under greenhouse conditions. To decrease the C:N ratio of PMW (85.84), TW having lower C:N ratio (22.16) was used as another compost material and also 1.8% of urea having 46% N was mixed with raw materials before composting. Fresh forest soil (0.5 kg) and manure (1 kg) were mixed within 10 L tap water and filtered. This filtration was also

mixed with compost materials to initiate and increase the microbial digestion of raw materials. During the composting, the raw materials were mixed very well and moisture and temperature of the compost were monitored every day.
At the end of composting procedure, sub samples were taken from different part of the compost. pH and electrical conductivity (EC) were determined by shaking 10 g of compost material in 100 ml of distilled water (1/10, w/v) for 30 min, and then measuring with digital pH and EC meters. Total nitrogen (N) in composst was estimated by digestion and subsequent measurement with the Kjeldahl method. Total carbon (C) content was determined with the dry ashing procedure. The C/N ratio was calculated by dividing the percentage of organic carbon by the percentage of total nitrogen (Jones 2001). Macro ad micro element contents of compost were determined according to Kacar and Inal (2008). Total water holding capacities of PMW, TW and compost materials were measured according to (Labuschagne and Eicker, 1995)

Results and Discussion

Changes in pH, electrical conductivity (EC) and water holding capacity (WHC) of raw materials that occurred in the heap during the decomposition period are shown in Table 1. The starting pH value of PMW was 7.80. After 65 days of decomposition, the pH increased to 7.85. Similar increase in pH values in the composted hazelnut husk was determined by Kızılkaya et al. (2015) and attributed to the production of ammonia. When ammonia reacts with H_2O to form NH_4^+ and free OH^-, the pH increases (Alexander 1977). Also, pH value of raw TW used as the composting material was higher than that of PMW. Electrical conductivity of raw PMW (0.86 dS/m) increased to 1.05 dS/m at the compost product. Water holding capacity (WHC) (225.0%) in the mixture of raw materials at the beginning of composting also increased to 311.0% in the end compost product.

Table 1

. Effect of composting on pH, EC and water holding capacity.

	pH (1:10)	EC (1:10)	WHC, %
PMW	7.80	0.86	243.6
TW	7.97	2.91	140.0
COMPOST	7.85	1.05	311.0

While the ash content increased from 50% in PMW to 59% in the compost product, OM and OC contents decreased from 50% and 29% in PMW to 41% to 24% in the compost, respectively (Fig. 1). The C/N ratio in the initial 65 days of decomposition was 85 in PMW and 22 in TW (Fig. 1). Tiquia et al. (2000) reported that higher C:N may be harmful and might cause damage to plants. C:N ratio reduced to 35 in the end compost product. Gregory et al. (2013) reported that paper mill sludge normally has a moderate to high C:N ratio, which often requires supplemental N to facilitate complete composting. Therefore PMW before composting procedure was enriched with supplemental nitrogen using urea (46% N). The basic macro nutrients, N, P and K increased from 0.34%, 0.11% and 0.03% in PMW to 0.68%, 0.13% and 0.16% in the end compost product, respectively (Fig. 1 2). According to the PMW, increases of

N, P and K contents were 100%, 13% and 431% in the end compost product, respectively. TW material had higher N, P and K contents than PMW. Therefore, enriching with urea and mixing TW with PMW increased N, P and K contents in the end compost product.

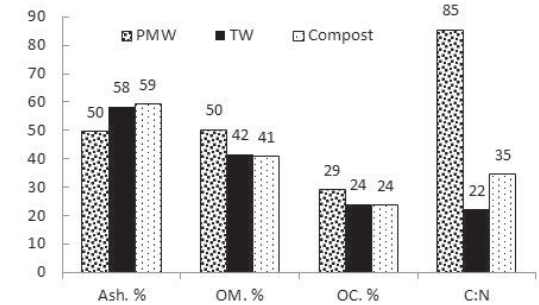

Fig. 1. Changes in some chemical properties of raw materials after composting

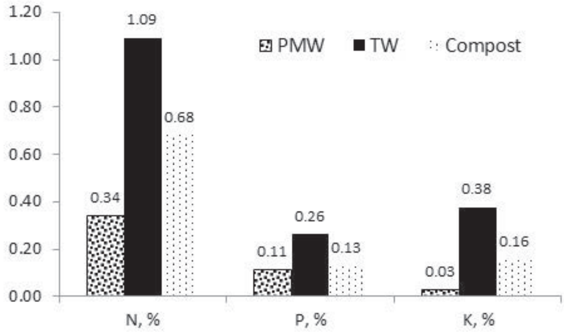

Fig. 2. Changes in N, P and K contents of raw materials after composting

Table 2

. Effect of composting on some macro and micro nutrient contents of raw materials.

	Ca, %	Mg, %	Na, %	Fe, %	Cu, ppm	Mn, ppm	Zn, ppm
PMW	14.83	0.165	0.204	0.033	24.22	102.90	95.88
TW	6.87	0.212	0.422	0.200	49.63	191.23	187.73
COMPOST	10.05	0.129	0.138	0.144	36.12	84.20	109.27

Some macro and micro nutrient contents of PMW, TW and the compost product are given in Table 2. Kızılkaya et al. (2015) reported that the structure of the initial organic materials differs from that of the decomposed materials in terms of C/N ratio and other related chemical properties. In this study, while the Ca, Mg, Na and Mn contents in the compost product decreased 32%, 22%, 33% and 18% according to that in PMW respectively, Fe, Cu and Zn contents in the compost increased 332%, 43% and 14% according to that in PMW respectively.

Conclusion

Decomposition of raw PMW during the composting with TW and enriching with urea improved some physical and biological properties of the end compost product. According to the content of raw PMW, pH, EC values, N, P, K, Fe, Cu and Zn contents increased while C:N ratio, OC, Ca, Mg, Na and Mn contents decreased in the end compost product. The compost product can best be employed as a soil amendment or supplemental nutrient source for plant growth media.

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Evaluation of van Genuchten model parameters for two land-use types

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Key words: Land-use, soil hydraulic properties, van Genuchten equation

Introduction

Understanding the relation between water storage capacity and land-use change is important in determining the flow properties of water in soil. Several researchers have demonstrated that land-use type has an important effect on the soil hydraulic characteristics (Bormann and Klassen, 2008). The characteristic of soil water retention is affected by soil organic carbon (SOC) content and porosity, which are significantly influenced by land-use type (Zhou et al., 2008). The determination of soil water properties required as input data for simulation models is time consuming and relatively costly (Wösten et al., 1995). To estimate the land-use effects on soil water retention, the van Genuchten model (Van Genuchten, 1980) may be applied. Schwartz et al. (2000) showed that the simultaneous fit of the Mualem-van Genuchten equation (van Genuchten, 1980) to water retention data resulted in a good fit for different land-uses. Sonneveld et al. (2003) also used the Mualem-van Genuchten equation for fitting θh data for the retention curves in different land-uses. Several researchers have correlated van Genuchten parameters with soil organic matter, bulk density (BD), and soil particle size distribution (Sonneveld et al., 2003), and many researchers have estimated the water retention curve using soil texture, bulk density, and porosity (Nemes et al., 2004). Estimation of the van Genuchten parameters, α and n, using the RETC program can be used to develop models to estimate these parameters using basic soil properties (Kutlu and Ersahin, 2008). The objective of this work was to compare the van Genuchten model parameters (α, n, and θr) obtained in cultivated and rangeland, in the some soils of the Taleghan watershed.

Materials and Methods

This study was conducted on some soils of the Taleghan watershed in Iran, which was covered by rangeland and dryland farming. The site (36° 08' 58"N and 50°43'12"E) had an elevation of 1453 m with homogeneous soils. The core method was used to measure soil bulk density (Blake and Hartge, 1986). θ(h) was determined at various potentials (0 kPa, -33 kPa, -50 kPa, -100 kPa, -500 kPa, -1000 kPa, and -1500 kPa) by a pressure chamber apparatus (Klute, 1986). The θ(h) data were fit to the van Genuchten equation to derive retention curves and parameters (α, n, and θr) for two land-use types using the RETC (retention curve) optimization computer code. The van Genuchten model is defined as follows:

$$\theta(h) = \theta_r + \frac{\theta_s - \theta_r}{(1 + |\alpha h|^n)^m} \qquad \theta_{(h)} = \theta_s \qquad h \geq 0 \qquad (1)$$

Where $\theta_{(h)}$ ($cm^3\ cm^{-3}$) is the volumetric water content (for h < 0); θ_r ($cm^3\ cm^{-3}$) is the residual water content; θ_s ($cm^3\ cm^{-3}$) is the saturated water content; m is 1 - (1/n) with $n > 1$; and α (cm^{-1}) and n are empirical parameters determining the shape of the curve.

Result and Discussion

Table 1 presents several soil properties for depths of 0 cm - 15 cm and 15 cm - 30 cm corresponding to two land-use types. Significant differences in the BD were observed between dryland farming and rangeland at both depths.

Table 1

General soil properties for the two selected land-use types

Land use	**Depth (cm)**	**Soil Particle Size Distribution (%)**			
		sand	**Silt**	**Clay**	**BD***
Rangeland	0 - 15	24.6	46.5	28.9	1.19 [c]
	15 - 30	24.7	43.1	32.2	1.21 [bc]
Dryland farming	0 - 15	31.6	39.1	29.2	1.34 [b]
	15 - 30	29.4	38.1	32.5	1.53 [a]

The values of BD that share the same letters (a - d) are not significantly different at $p < 0.05$. * Bulk Density

Table 2

Estimated mean values of van Genuchten parameters.

Land use	Depth: 0 – 15 *cm*				Depth: 15 – 30 *cm*			
	n	α	θ_r	θ_s	n	α	θ_r	θ_s
Dryland farming	1.5817	0.0106	0.1754	0.4874	1.5056	0.0129	0.1691	0.4724
SSE	**0.09738**	**0.00226**	**0.00852**	**0.0039**	**0.0762**	**0.0026**	**0.0084**	**0.0029**
Rangeland	1.3443	0.0206	0.1387	0.5523	1.7780	0.0096	0.1861	0.5314
SSE	**0.14127**	**0.01230**	**0.04467**	**0.00737**	**0.08794**	**0.00139**	**0.00419**	**0.00331**

n: Empirical parameter, α: Empirical parameter (cm^{-1}), θ_r: Residual water content (cm^3cm^{-3}), *SSE*: Sum of squared errors, θ_s: Soil saturated water content ($cm^3\ cm^{-3}$)

Previous studies on the effect of land-use have demonstrated clear changes in soil physical properties, such as soil porosity and BD, in relation to hydraulic properties (Bormann and Klassen, 2008; Haghighi et al., 2010), which agrees with the results obtained in the present study. Fitted parameter values obtained from the simultaneous fit of the θ_h data to Equation 1 are presented in Table 2. The fit of the van Genuchten model to water retention data resulted in a low *SSE* and high R^2. In the case of the Taleghan watershed soils, the van Genuchten model resulted in satisfactory estimates of water retention capacity except in saturated water content (θ_s). Similar results were obtained by Schwartz et al. (2000) who found that the θ_h data fit to the van Genuchten equation yields acceptable results (high R^2). Comparing the estimated θ_r, n, and α value with the van Genuchten equation did not show significant differences between the two land-use types (at $p < 0.05$). These parameters were not significantly different between the cultivated lands and rangelands. Θ_r is the water content at the lowest soil water potential (-1584.9 *kPa*) (Ndiaye et al., 2007). Thus, at this pressure head, the water is retained in soil micropores, which is not affected by land-use type. As reported by Ndiaye et al. (2007), the *n* parameter is influenced by soil texture, which is related to soil particle size distribution. Therefore, the *n* parameter is not influenced by land-use change. Because α and n are empirical parameters determining the shape of the water retention curve (Sonneveld et al., 2003), it was concluded that there was no significant differences between the retention curves of dryland farming and rangeland. This conclusion was apparently related to insignificant differences in water retention data at the considered pressure heads.

Conclusion

The fit of the van Genuchten model to the water retention data resulted in a low *SSE* and high R^2. This finding showed that the van Genuchten model was useful in describing soil water retention in clay loam soils in the studied area. Thus, use of this model should be considered as a valuable tool to gain more knowledge of hydraulic properties for various soil types.

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To Display Soil Texture Triangle and Soil Particle Size Distribution Using MATLAB

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Key words: MATLAB, programming, soil texture triangle

Introduction

Soil texture is one of the most important soil characteristics in crop production and soil and water management. The textural class of a soil is determined by the proportion of the three primary soil particles including sand, silt and clay. Soil water movement, soil water retention capacity, soil erodibility and aeration are influenced by soil texture. A soil texture triangle is usually used to determine the soil texture class. Despite reading the texture triangle is simple, to automate the soil texture reading is justified especially when a large number of soil samples exists for soil particle size analyses. There are increasing number of modern computer programs (Liebiens, 2001) to automate the look up task as the introduction of a program called Texture Auto Lookup by Christopher and Mokhtaruddin (1996). In general, 13 scheme files have been presented for the soil schemes including USDA (Soil Survey Division Staff, 1993), UK (Avery, 1980), Canada (Canada Department of Agriculture, 1974), International (Leeper and Uren, 1993), India (All India Soil and Land Use Survey Organization, 1971), International Society of Soil Science (Verheye and Ameryckx, 1984), Switzerland (Jäggli and Frei, 1977), Belgium (Sys, 1961), New Zealand (Gibbs, 1980), FAO (Verheye and Ameryckx, 1984), AISNE, France (Baize, 1993), Germany (Boden, 1994), and the Shepard's proposed scheme for sedimentologists (Shepard, 1954). This paper is presented to introduce a program in MATLAB that can look up a soil texture. In this paper, we have presented a computer program to automate the task of looking up the soil texture classes.

Materials and Methods

Program Description

The programming was done using MATLAB™ (The MathWorks Inc., USA). First step to solve the problem is to design a function which receives apex coordinates of an n-angular convex and determines whether a point with (x,y) coordinates is located inside the polygon or outside. Consider the below n-angular shape (Fig. 1). Each apex position of this polygon is clearly identified. Definitely, given an arbitrary point coordinates will determine whether the point is placed inside the polygon or not. To solve the problem, we used the following method. According to the Fig. 2, if the point places inside the convex polygon, total areas sum ($S_{total} = \sum_{i=1}^{m} S_i$) will be equal to overall polygon area.

According to the Fig. 3, if the point be placed outside the convex polygon, total areas sum ($S_{total} = \sum_{i=1}^{m} S_i$) will be greater than the overall polygon area. Therefore, expressed algorithm in the below program is used to determine whether a point is inside the polygon or not.

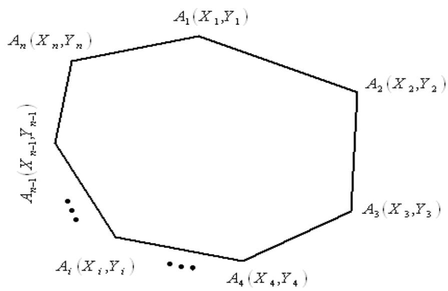

Fig. 1. Arbitrary n-angular convex

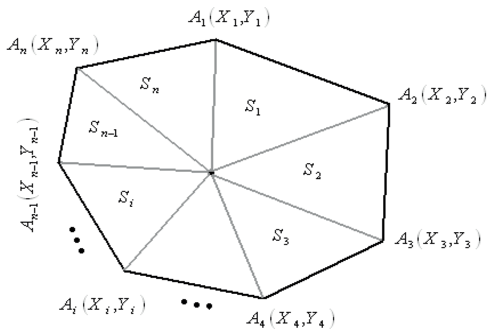

Fig. 2. Areas made using a point inside an n-angular shape

This function is called INOROUT, and receives polygon apex coordinates as X and Y vectors. X and Y are the considered point’s coordinate which the position has to be mentioned to solve the problem. To determine area, poly area command is used. Polygon area is saved according to the expressed command in second line in the A variable. Sum of made triangles’ areas ($S_{total} = \sum_{i=1}^{m} S_i$) is calculated using for loop in the written program.

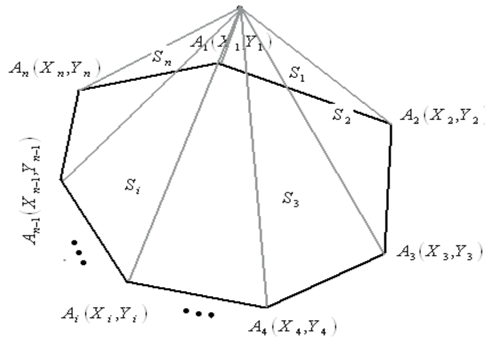

Fig. 3. Provided areas using a point outside an n-angular shape

Result and Discussion

In the below diagram (Fig. 4), all available polygons are convex shaped except sandy loam and silt loam parts. Therefore, if we have the considered soil's coordinates, we can determine soil type using the algorithm expressed in first step. Then in this step, first we define point coordinates related to available polygons in the above diagram.

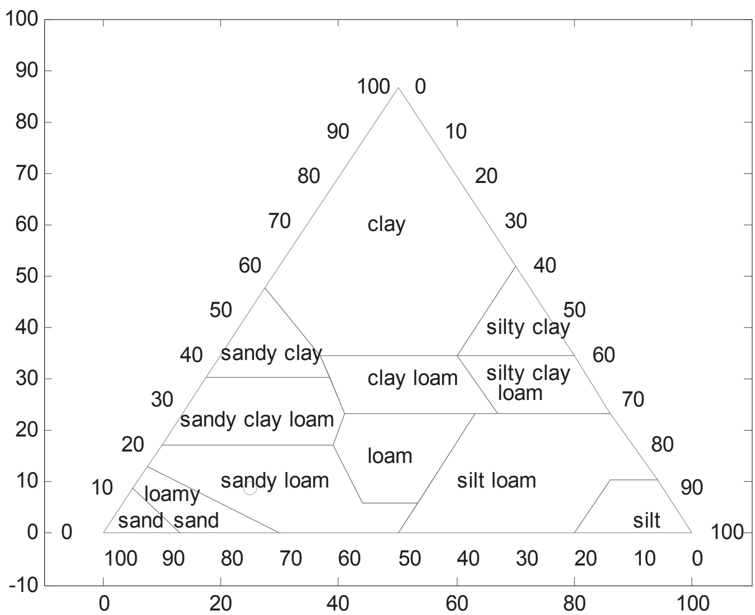

Fig. 4. Soil type diagram

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The Effect of Salinity And Sodicity Levels on Some Soil Microbiological Parameters

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Keyword: salinity, sodicity, soil respiration, microbial biomass C, dehydrogenase activity

Introduction

Today, in accordance with the principles of sustainable agriculture, especially in areas exposed to intensive agriculture, while people are getting the nutrients they need and enhancing soil fertility must think about the natural world and sustainability of natural resources. Therefore, taking advantage of the soil, ıt must be considered topics such as not only increase the amount of products, but also environmental health, soil health, soil erosion, desertification, economic sustainability, cultural and social rights the science basics. However, the excess will cause toxicity as lack of plant nutrients are also important. Anions such as HCO_3, CO_3, Cl connected to them and Na, Ca, Mg, K ions moved by rising ground water in the soil, erosion and irrigation water accumulate near the surface and the surface. This accumulation from long years causes salinity in soils. Soil salinity (desertification),it can also be man-made by reasons such as excessive fertilization, irrigation, lack of drainage as a natural process. The forms and amounts of plant nutrients in the soil and applied agricultural activities (irrigation, fertilization, tillage...) is very important from the agricultural point of view. Both agricultural point and in terms of sustainable land management, determination of soil physical, chemical and biological properties is extremely important. As it is well known, and therefore too much number of studies have been conducted (Houx III et al. 2011, Diaz F.J. 2011, Nayak A.K. et al. 2012, Messina M.G. et al. 1986, Abanda P.A. et al. 2011, Tirado-Corbala R. et al. 2013, Davis J.C. et al. 1994, Barsotti J.L. et al. 2013, Kızılkaya R. et al. 2007, Yakupoğlu T. et al. 2007, Hepşen Ş. et al. 2008). Soil biological properties is an indicator of soil microbial activity. The soil microbial activity is an important parameter in the soil properties assessment. İmproving physical and chemical properties of the soil is also increased microbial activity.

Material And Methods

The area that found intensive irrigated agriculture land in Suluova, 4 km^2 is divided into grid using Google Earth geepaths (Fig. 1) and 45 sampling grid is determined. 45 soil samples which can represent to region from (plants from the root zone (0-30 cm) and in accordance with the soil sampling methods) determined the coordinates with a GPS were taken. Samples analysis was maintained at the appropriate techniques and methods for analysis are prepared appropriately. Soil samples were pounded the air dry state and sieved from standard 2mm sieve for physical and chemical analysis. For biological analysis, soil samples sieved from 2 mm to stop microbial activity moved to the laboratory by placing the freezer and stored in the refrigerator. The analysis and the method used in the soil samples are given in Table 1. This study was supported by the Amasya University (BAP) Scientific Research Unit.

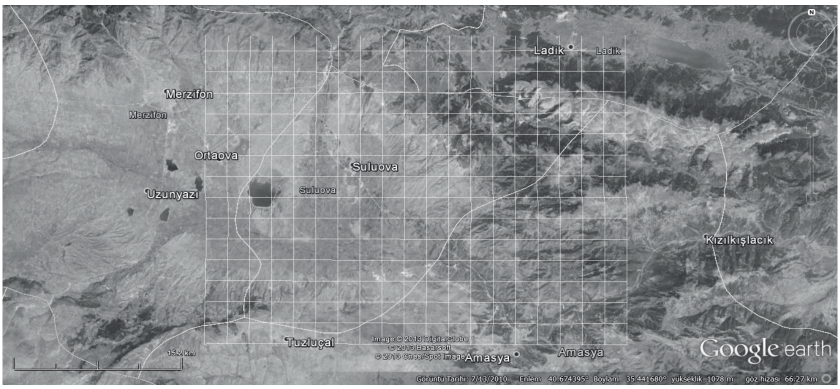

Fig. 1. Grids created for soil and water sampling of the irrigated land in Suluova

Table 1

Analysis and ıts methods used on soil samples

Analysis	Methods	Analysis	Methods
Soil physical and chemical properties		K, $mg.kg^{-1}$	Flame Fotometer
Soil texture	Bouyoucos Hydrometer	Na, $mg.kg^{-1}$	Flame Fotometer
pH	1:1 (W/V) soil:water	Ca, me/l	Titration
EC, dS m^{-1}	1:1 (W/V) soil:water	Mg, me/l	Titration
SOM, %	Walkey-Black	**Soil Biological Properties**	
CaCO3,%	Scheibler Calsimeter	Soil respiration, SR	Anderson (1982)
Total N, %	Kjeldahl	Microbial biomass C	Anderson and Domsch 1978
Av. P, $mg.kg^{-1}$	Bray-Kurtz	Dehydrogenase activity	Pepper and Ark. (1995)

Results And Discussion

PH, electrical conductivity (EC)% organic matter, N, P, K, exchangable Na, Ca, Mg content of soil samples was determined.The soil texture of all examples the soil is clayey textured class. pH of all the soil samples (8,07- 8,86 in range) is determined to alkaline reaction.Soil salinity degree were determined according to EC value (in the range of 0.001 to 0.005) of soil samples. K content were found to be low enough to be considered as well as the low Na values (1,225-2,111ppm). The content of soil organic matter in soil samples (0.267 to 1.721%) is very low. Similarly, the total N content (0.023 to 0.150%) is poorly and too low. The reason for the lower levels of the Plant available P content (1,286-2,581ppm) is due to the high pH values in the whole soil samples. Once the pH exceeds 7,5 the plant-available P form is fixed by Ca ions. Ca and Mg content of all soil samples (16.6 to 34: 1 to 20.8 mA / s) was determined as high levels. Although Na content is too low, the high pH value is due to their high Ca ions. In these soil samples, very high level Ca and $CaCO_3$ % content is a result of chemical fertilizer.

Table 2. Descriptive statistics of study soil

Variable	Min.	Max.	Mean	SD
MBC	4,2225	13,7295	8,19871	2,24963
SR	0,0055	0,012	0,00904	0,00149
DHA	1,60467	17,1983	9,62979	4,01597
Na,%	0,126	0,8	0,338	0,13173
SAR	0,012	0,061	0,02829	0,01022
CaCO3,%	5,49046	18,9433	11,9718	3,05423
SOM,%	0,26733	1,739	0,86477	0,37205

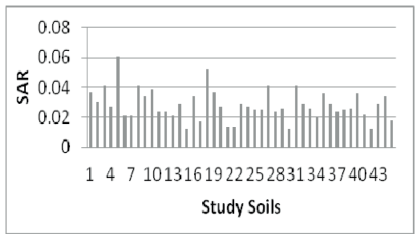

Fig. 2. Comparison of soils in terms of SAR

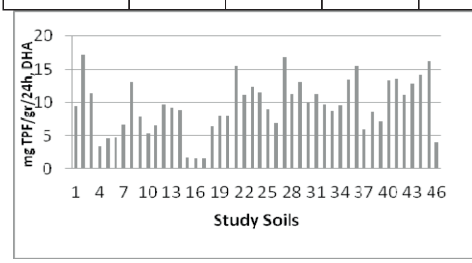

Fig. 3. Comparison of soils in terms of DHA

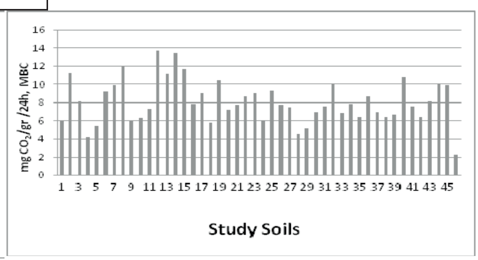

Fig. 4. Comparison of soils in terms of MBC

DHA analysis is frequently used an intracellular enzyme in the evaluation of the microbiological activity and shows the total amount of oxidative activity of soil microflora (Skujins 1973; Trevors, 1984). It has been revealed by many studies that stimulate microbial populations and enzyme activity having a positive impact to soil physical properties (aggregated on, such as the capacity for water retention) of organic waste and compost added to the soil (Satchell ve Martin, 1984; Alef ve Nannipieri, 1995; Amador ve ark., 1997; Tejada ve ark., 2009; Garcia ve ark., 1997).

But when very low organic matter and very high pH, higher microbial activity is due to chemical fertilization. Soil samples biological parameters determined to as soil respiration; 5,367-12,308 µg CO_2 /gr/24h, microbial biomass C; 4222-13415 µg CO_2 /gr/24h, DHA;1,605-17,198 µg TPF/gr/24h. Besides the yield increase intensive agriculture and chemical fertilizers is causing negative effects such as deterioration of aggregates, infiltration reduction, drop porosity. This stuation will cause to fall later of periodically increased microbial activity.

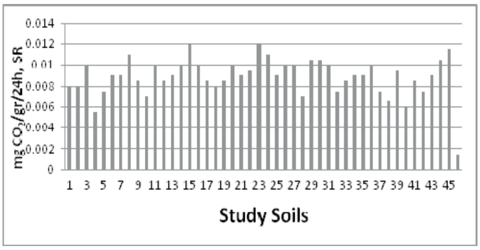

Fig.5. Comparison of soils in terms of SR values

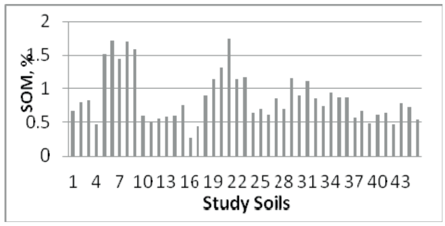

Fig. 6. Comparison of soils in terms of SOM

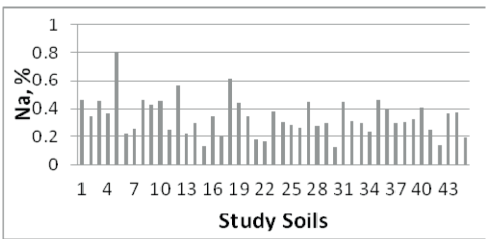

Fig. 7. Comparison of soils in terms of Na,% values

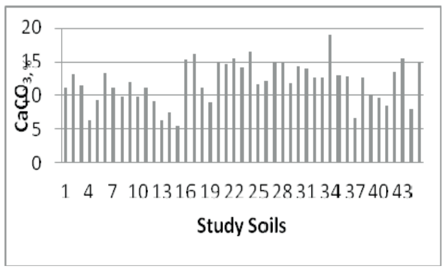

Fig. 8. Comparison of soils in terms of CaCO3,%

Acknowledgement

Organic matter content of almost all of the study area is poor. This condition causes over time soil physico-chemical and biological properties of a significant amount of corruption. The most basic way to fix this situation is to increase the organic matter content by adding organic matter to the soil. For this purpose, the organic wastes, obtained from numerous kind of plants and animal originated, are proposed to be used in agricultural lands. The amending effects of the cow manure on soil properties are well known and it is widely used because of the easiest one to reach among the other kind of organic wastes in our country. The importance of organic waste, composting applications and the improper fertilization seminars should be organized and the usage of them should be expanded. It should be encouraged for the region farmers to have knowledge about the soil properties of this region and their land soil.

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Bıologıcal characterıstıcs of kıwıfruıt orchard soıls ın Ordu/Turkey

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Key words: Kiwifruit orchard soils, soil enzyme activity, microbial biomass, soil respiration.

Introduction

Varieties of kiwifruit are grown today has been breeding in New Zealand in the 1930s. Trade of Kiwifruit has been the monopoly of this country until the 1970s. After this date, it has started to grow by Australia, Japan, South Africa, Chile, United States, and the Northern Mediterranean countries (Ferguson, 1990; Tarakçıoğlu ve Aşkın, 2005).
The studies carried out to specify about soil quality, and measure it to be taken in terms of productivity levels and plant nutrition. However, soil physical, chemical, biochemical, microbiological, mineralogical, must be dealt with issues related to geology and plant physiology (Schinner, 1986; Karaca et. All., 1998). Besides their activity as measured determining the biological properties of the soil microorganism counts it is important for soil health (Gök ve Onaç, 1995; Karaca et. al., 1998). Each culture soil, soil composition, and the amount of residues remaining in the product varies according to environmental conditions and soil arrangement methods, and are also affected by the level of seasonal conditions of an enzyme. Enzyme activity can be greatly affected by the kinds of plants in soil (Arcak et. al., 1994; Karaca et. al., 1998). Organic matter content, organic carbon, nitrogen, and soil properties such as soil pH significantly affects the biological properties of soil. (Karaca et al.,1998).
In this study 24 soil samples of kiwifruit garden were taken from Ordu/Turkey, and some of the physical, chemical and biological properties of the samples are determined. It has also performed statistical analysis to determine the multiple correlations.

Materials and Methods

This research has been implemented in Ordu province of Turkey. In September 2013, 24 soil samples were taken from kiwifruit orchard lands of Medreseönü Municipality and Efirli Village of Perşembe County of Ordu. Medreseönü Municipality's 14 villages and Efirli Village's 10 fields have kiwifruit orchard lands. Research materials of this 24 kiwifruit orchard lands constitute of the samples were taken from the region of 0-30 cm soil depth of kiwifruit orchard. The analyzes made in taken soil samples was carried out as paralleling. Samples have been transfered to the laboratory in ice bags and temperature of trays have been preserved as + 4 ◦C. Moist samples were sieved by 4 mm sieve. Sieved moist samples brought to the laboratory for biochemical analysis (CO_2-production, Microbial biomass-C and Dehydrogenase enzyme activity). Soil samples of sand, silt and clay fractions were determined by hydrometer method, organic matter was analyzed according to Walkley-Black wet digestion method, pH and electrical Conductivity saturation were determined mud by Jackson (1962) as indicated by lime was detected by Scheibler calsimeter.

Table 1

Physical, chemical, and biological properties of soil samples

Samples No	DHG Enzymes Act.	CO_2-Production	Microbial Biomass-C	% Total N	Org. matter	% CaCO3	pH	EC (mhos/cm)	Na (ppm)	K (ppm)	Ca+Mg (meq/lt)	Texture class
1	37,19	15	22,63	0,1	3,38	2,26	7,08	94,5	343,44	87,1	81,6	SL
2	4,91	16,07	13,9	0,06	1,81	0,91	6,81	23,8	175,24	50,9	70,4	SL
3	2,4	12,81	9,56	0,11	2,91	0,72	5,52	50,9	185,22	34,3	71,2	SL
4	36,97	12,87	8,28	0,15	2,92	0,52	6,54	107,3	649,2	157,82	48,6	SL
5	38,81	8,98	45,01	0,2	1,73	0,35	6,59	28,6	84,94	12,74	81	SL
6	54,04	15,22	19,29	0,23	1,92	2,09	7,66	125,7	465,5	118,94	63,2	SL
7	32,06	9,67	36,55	0,16	1,92	0,73	5,6	66,2	244,4	57,82	67,8	SCL
8	6,05	18,83	11,81	0,35	0,42	0,28	5,76	50,3	190,3	47,5	63,2	SL
9	15,71	20,64	12,15	0,09	3,41	0,53	6,49	50,01	116,22	15,7	58,6	SL
10	26,1	14,28	33,36	0,08	6,17	0,36	5,97	194,7	317,24	98,74	34,2	CL
11	16,58	12,33	7,33	0,15	3,15	0,88	6,97	107,6	21,1	4,1	43	L
12	0,55	13,51	17,71	0,05	3,43	0,64	6,28	5,56	545,4	388,3	64,4	SL
13	22,28	7,71	20,48	0,02	5,65	1	6,57	121,9	343,44	472,54	57,2	L
14	14,83	6,2	6,57	0,02	4,78	0,64	5,55	66,7	391,6	465,82	48,4	SL
15	21,42	7,7	8,81	0,1	4,19	0,73	7,13	80,4	200,64	64,9	67,4	SL
16	57,37	11,45	32,64	0,15	1,88	0,37	6,67	47,1	175,24	68,5	94	SL
17	38,65	5,77	18,05	0,04	3,42	0,26	7,56	39,5	39,44	18,7	23,6	SL
18	96,16	11,02	12,61	0,11	2,42	3,36	7,49	15,38	120,4	37,54	88,2	SCL
19	24,65	6,31	4,88	0,06	5,42	0,57	6,8	68,6	238,72	68,5	75	SL
20	20,91	5,84	20,57	0,17	3,23	3,63	7,55	84,6	255,94	83,3	44,2	SCL
21	67,65	9,3	29,03	0,21	4,39	3,68	7,62	166,6	596,22	171,5	87,4	SC
22	56,01	23,01	28,07	0,16	1,49	8,69	7,71	122,6	151,34	47,5	55	SC
23	46,38	8,86	16,72	0,17	5,02	0,36	7,48	93	233,1	57,82	44,2	SL
24	48,33	7,57	25,48	0,24	4,12	0,52	6,92	14,4	255,94	57,82	40,4	SL

DHG : Dehydrogenase enzyme actvity, EC: elektirical Conductivity , SL: Sandly Loam, SCL: Sandly Clay Loam, SC: Sandly Clay, SiL: Silt Loam, CL: Clay Loam, L: Loam,

The elements of K, Ca and Mg soil samples AAS was detected according to the nitrogen Kjeldahl method, CO_2-production 0.1 N KOH solution using and after 1 day incubation period at 27 ° C was determined by back-titrated with 0.1 N HCl (Isermeyer, 1952). Microbial biomass-C: the glucose supplied in moistened soil samples up to 55-60% of the water holding capacity of aerobic based on organisms glucose parsing the principles of 25 ° C was determined by measuring the CO_2-production after the 4-hour incubation (Anderson, 1982). Dehydrogenase Enzyme Activity: TTC (triphenyl tetrazolium chloride) solution is added to the soil samples were incubated 16 h at 25 ° C. then the formed TPF (triphenyl formazan) is determined by photometric measurement at 546 nm. (Thalmann, 1968). Soil sample analysis have been made in laboratories of Department of Soil Science and Plant Nutrition of Ordu University.

Results and Discussion

Physical, chemical and biological properties of the soil samples forming the research material are given at Table 1. Dehydrogenase enzyme activity results determined in soil samples were measured between 0.55 - 96.16 µg TPF/gr. According to a study it was determined that dehydrogenase enzyme activity in the Middle Black Sea Region soil 132.9-658.6 µg TPF/gr dry soil (Aşkın et.all.,2004). Dehydrogenase enzyme is a respiration enzyme. These enzymes by measuring the activity of various dehydrogenase enzymes provide information on the total amount and the majority of the soil. Both aerobic, anaerobic as well as living organisms that can reveal organic compounds in breath hydrogen levels and is an indicator organisms that can carry him to a hydrogen trapping agent (Çengel, 2004). In order to determine the effect on the soil characteristics of soil dehydrogenase activity obtained results of performed statistical analyses seen Table 2.

Kiwifruit orchard soil dehydrogenase enzyme activity % $CaCO_3$ in terms of value on the statistical significance at the level of 5% and a pH of 1% positive impact. According to the results of two different surveys carried out in the soil of the region of the level of significance of 5% in terms of statistics between the pH value of the alkaline phosphatase enzyme activity was determined positive correlation in Eastern Black Sea (Kızılkaya et. al., 1998 and Karaca et. al., 1998). CO_2-production amounts of research soil varies from 6.2 to 23.01 mg CO_2/ 100 gr dry soil. CO_2-production is one of the important indicators of soil quality. CO_2-production was found to be statistically significant negative relationship between the level of 5% organic matter. Because of soil samples were taken from different kiwifruit orchards, relation has determined negative. Research of soil microbial biomass-C values of 4.88 with 45.01 mg of biomass-C/100 gr dry soil ranged from value.

Kızılkaya et al. (2004), microbial biomass-C levels was found between 3.8 and 135.4 mg of 100 g CO_2-C and soil samples were in accord with these results. According to the results of statistical analysis, a negative correlation between the level of 1% organic matter % total nitrogen from the physical and chemical analysis, are at the level of 1% between pH and $CaCO_3$ % positive and a positive correlation between the EC and the 5% level of organic matter. Soils can be taken some elements (Na, K, Mg + Ca), organic matter, $CaCO_3$%, % Total - N values can be found within the borders of agricultural land. Because of the different kiwifruit orchards research soil and microbial biomass- C is scattered kiwifruit orchards were not detected a correlation between other values. This study has supported by Ordu University Scientific Research Projects AR-1314 fund.

Table 2. Correlations

		CO$_2$-Production	Mic. Biomass-C	% Total - N	Org.Mat.	% CaCO$_3$	pH	EC	Na	K	Ca_Mg
DHG	r	-0,085	0,351	0,25	-0,087	**0,449***	**0,608****	0,143	0,031	-0,228	0,290
	P	0,693	0,093	0,239	0,687	**0,028**	**0,002**	0,506	0,884	0,285	0,169
CO$_2$	r		0,010	0,241	**-0,502***	0,363	-0,063	0,108	-0,053	-0,243	0,123
	P		0,965	0,256	**0,013**	0,081	0,770	0,615	0,807	0,252	0,568
Microbial Biomass-C	r			0,269	-0,165	0,174	0,046	0,154	-0,026	-0,131	0,183
	P			0,204	0,440	0,417	0,831	0,473	0,906	0,543	0,393
% Total-N	r				**-0,531****	0,138	0,117	0,051	0,009	**-0,434***	0,115
	P				**0,008**	0,521	0,585	0,813	0,966	**0,034**	0,593
Org. Mat.	r					-0,238	-0,003	**0,406***	0,262	**0,422***	-0,339
	P					0,264	0,988	**0,049**	0,216	**0,040**	0,105
% CaCO3	r						**0,536****	0,303	0,027	-0,078	0,125
	P						**0,007**	0,150	0,901	0,718	0,559
pH	r							0,173	-0,062	-0,281	-0,013
	P							0,419	0,774	0,184	0,953
EC	r								0,378	0,124	-0,201
	P								0,069	0,564	0,347
Na	r									**0,605****	0,074
	P									**0,002**	0,730
K	r										-0,066
	P										0,761

DHG: Dehydrogenease enzymes activity * $p < 0.05$; ** $p < 0.01$

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Spatial Structure of Metagenome of Soil Microbiomes

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Key words: high-throughput pyrosequencing, 16 S rRNA, soil microbial community

Modern biology is currently coming to the new level of development which is characterized by transition from studying of biology of separate organisms to investigation of complex biological supra-organismal systems - various natural ecosystems. It resulted in the emergence of a number of the new scientific areas – omics (metagenomics, metatranskriptomics, metaproteomics, etc.). Material for studying is the biological material emitted directly from a natural ecosystem. If the material is the total DNA, we are dealing with metagenome - a complex of genetic material of the ecosystems investigated.
The most complex object for metagenomic research is soil. Soil is the largest source of genetic information. This is due to a presence of various phases - liquid, solid and gaseous, as well as the presence of the aggregate structure and vertical stratification of the soil profile with the formation of genetic horizons. Soil heterogeneity on macro- and microstructural level, in turn, leads to a specific structuring of its metagenome. The main objective is to understand the ecological and functional role of these structural units in the formation of soil metagenome as a complete ecosystem with qualitatively new properties.
At the first stage of metagenomic research – extraction of DNA, one could face the existence of various pools of DNA in the soil, the main are: DNA of living and resting forms of microorganisms, dead microbial cells, whose DNA supplements constantly the next pool of genetic information – extracellular DNA (eDNA). In soil there is a huge pool of extracellular DNA which can make up to 60% of all volume of DNA in the soil and, most likely, has a huge ecological value (Pietramellara et al. 2009). Extracellular DNA can remain in the soil for the long time due to the formation of stable complexes with clay minerals and an organo-mineral matrix of soils, and represents some kind of «a genetic print» of the previous stages of soil ecosystem functioning. It allows the use of term of some kind of "memory" to a soil metageome concept, by analogy with "soil memory", and represents a complex of steady properties of a soil metagenome as a result of its evolution as reaction to specific soil-forming processes. In turn, by analogy with the concept of «soils moment», it is possible to use also a «metagenome-moment» – a part of soil organisms which are actively functioning in an ecosystem at the present moment. The «metagenome moment» - «metagenome memory» system is very dynamic. Under the influence of ecological factors the genetic information from «metagenome-moment» can pass into the «metagenome memory» as a result of death of microbial cells and sorption of the released DNA on the soil organo-mineral matrix. In turn, the information of

«metagenome memory» can be realized by «metagenome moment» due to the transformation of bacteria by extracellular DNA. So, DNA in the soil is an adaptive structure which was created as the adaptation to the changing conditions in the soil (seasonal and climatic fluctuations, existence of nutritious substrates).

Another adaptive structure of microorganisms inhabiting soil is a soil aggregate. The process of aggregate formation is mediated by the closest interaction between a wealth of different microorganisms with mineral part of soil and soil organic matter. The result is a system with a specific structure which is characterized by stratification of nutrients and organic compounds as well as the specific structure of the pore space. Aggregate structure also contributes to the preservation of microbial enzymes - all of them are located within a specific compartment. Soil extracellular DNA seems to play an important role in the formation of the microbial community of soil aggregate because it is known to take part in the formation of microbial biofilms. Thus, aggregates are structural units of soil as well as of its metagenome, thus soil metagenome of the aggregate is a functional unit of the soil. The understanding of functioning of soil microbial community is thus possible only due to the analysis of separate aggregate fractions as they have adaptive value for microorganisms.

Until now little is known about the taxonomic structure of microbial communities inhabiting soil microenvironments. There are only few studies that characterized the taxonomic diversity of microbial communities in different aggregate fractions (Sessitsch et al. 2001 ; Davinic et al. 2012) and microorganisms living inside and on the surface of microaggregates (Mummey et al. 2006) using different molecular techniques. It was shown that microbial communities of micro- and macroaggregates, as well as the community on a surface and inside soil aggregates significantly differed from each other (Mummey et al., 2006; Davinic et al., 2012; Umer et al., 2014). Microaggregates were inhabited mainly by actinobacteria from *Rubrobacterales* order and by bacteria of *Chloroflexi* phylum. In microbial community of macroaggregates bacteria from phyla *Bacteroidetes, Proteobacteria, Verrucomicrobia* were prevailed. In microbiomes of an internal surface of microaggregates dominated actinobacteria of order either *Rubrobacteiales* order or from *Actinobacterideae* family. The external surface of aggregate was populated mainly by proteobacteria.

The study of microbiomes of various aggregate fractions of typical chernozem in conditions of various systems of land use was carried out (Ivanova et al., 2015). Fractions of microaggregates (< 0.25 mm) and macroaggregates – 2-5 mm and the > 7 mm sizes were used for the analysis. It was shown that, depending on fraction, bacterial and archaean biomass differed significantly (the quantity of a procaryotic component decreased from microaggregates to macroaggregates). In spite of the system of land use was the strongest determinant of the structure of microbial community, the size of aggregate fractions also had a certain impact on a microbiome of the soil investigated. All systems of land use (fallow grassland, bare fallow and soil with continuous winter wheat cropping) were characterized by biodiversity decreasing in transition from microaggregates to coarse macroaggregates (>7 mm). The increase in number of actinobacteria and alpha-proteobacteria lineages positively correlated with a small size of aggregate fractions while proteobacteria in general were more associated with the large size of aqggregate fractions of a fallow grassland and permanent winter wheat variant. Also microbial taxons which quantity significantly differed between microaggregates and macroaggregates were revealed. In microaggregates there was an increase of actinobacteria of *Actinomycetales* order: families *Nocardioidaceae*, *Pseudonocardiaceae,* *Micrococcaceae*; in macroaggregates the increase of bacteria of *Enterobacterales*, *Pseudomonadales*, *Burkhorderiales* orders was observed. It is known that soil fertility directly depends on its good aggregate structure. Thus the activity of a specific microbiome is the basis of aggregate formation, and mechanisms of formation of soil aggregate structure can be reached due to its metagenomic analysis.

Aggregate structure represents one of the lowest levels in the hierarchy of morphological and structural organization of the soil, the other soil structure is a genetic horizon, an important diagnostic and classification soil characteristic. Organization of soil horizons is connected with soil evolution while soil-forming process occurs with direct participation soil microorganisms which will transform a lifeless matter and do it suitable for growth and development of plants. As a result a soil profile represents some kind of «a biosphere mirror» in which all the processes of a biogeocenosis are recorded. The comparative analysis of vertical stratification of microbial community – the study of microbiomes of humic (A) and illuvial (B) horizons reveled that in microbial community of the humic horizon the most common soil bacterial phyla prevailed – *Actinobacteria, Bacteroidetes, Firmicutes, Verrucomicrobia, Proteobacteria,* whereas in B horizon mainly acidobacteria and some minor phyla increased – *Chloroflexi*, *Gemmatimonadetes, Nitrospira,* TM7, WS3. Interestingly that microbial community of the top horizons was similar to a microbiome of the outer surface of aggregate fractions, and lower – to microbial community of an internal surface of soil structural units. It is known that in an internal space of microaggregates there is an inaccessible-occluded organic matter which can be the reason of relative enrichment of this fraction by representatives of an oligotrophic minor component of microbial community.

Thus, in the soil at different levels there are formed structures having adaptive value for the microorganisms and the formation of these adaptations depend on the activity of microbiome, which could only be studied using the system metagenomic approach. In the era of its birth metagenomic studies generating data on the taxonomic structure of the soil microbiome were often contrasted with the classical methods of microbiology providing information on the functional activity of the soil microbial community. Within modern metagenomic projects the last can be reached in two ways – the analysis of RNA and cultivation of not cultivated microorganisms. Actual portrait of the currently active part of the soil microbocenosis could be possible due to the analysis of expression profiles - extraction of total RNA. Prospects for studying of soil metagenome should include differential analysis of DNA pools of the soil, including the extracellular DNA. The next step is the integration of metagenomic approaches to the analysis of soil microbiomes with modern soil mineralogical and original micromorphological methods, which could provide a more complete view of the environmental habitat of prokaryotic community, and to reveal the features of functioning of microorganisms in concrete manifestations of soil-forming process.

Metagenomics is a new powerful tool which allows not only to consider all of the variety of structural components of a soil biome, but also gives prerequisites to understanding the functioning of this system. Application of metagenomic approach to a soil microbiome investigations will allow to provide science with both qualitatively new fundamentally knowledge as well as, due to its universality, new practical decisions – from the formation of databases of microbiological indicators of soil agroecological status to the creation of scientific and methodological base of substantially new schemes of agrotechnologies and adaptive land use.

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Aromaticity and humification of dissolved organic matter (lysimetric experiment)

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Key word: dissolved organic matter, aromaticity, HIX, lysimetric waters

Introduction

The optical properties of dissolved organic matter (DOM) are widely used to characterize its chemical nature. Ultraviolet (UV) and fluorescent spectrometry are swift and noninvasive methods which require little sample preparation and a small sample volume. Absorption in UV range is governed by presence of C double-bond of benzene-type structures in the DOM. Many authors proposed the UV absorbance to assess a variety of DOM properties, such as aromaticity, hydrophobic content, humification [2]. Specific ultraviolet absorbance (SUVA) is defined as the UV absorbance of a solution sample at a given wavelength normalized for dissolved organic carbon (DOC) concentration. Numerous data sources confirm that SUVA, determined at 254 nm ($SUVA_{254}$), is strongly correlated with percent aromaticity of DOM as determined by standard direct methods (such as ^{13}C NMR), which proves that SUVA is a useful parameter for estimating the dissolved aromatic carbon content in aquatic systems: rivers, soil solutions, lysimetric waters etc.
Fluorescent organic components of DOM include humic substances, derived from the break-down of plant material and aromatic amino acids (in free form or in proteins and peptides). Fluorescence spectra can be used to assess the origin and transformation degree of DOM through calculation of several fluorescence indices. The humification index (HIX) is a sensitive and simple parameter which is often used to characterize DOM; it is calculated from the fluorescence emission spectra obtained at excitation wavelength of 254 nm. HIX index was introduced by Zsolnay et al. [8] in order to estimate the degree of maturation of soil DOM. It was based on the fact that humification is associated with an increase inthe C/H ratio [7] and with a resulting shift of fluorescence maximum to longer emission wavelength [6]. HIX is defined as the area of the emission peak in 435–480 nm divided by the area of the peak in 300–345 nm. When the degree of DOM aromaticity increases, the emission spectrum (measured at excitation wavelength of 254 nm) is shifted to the red zone and thus the HIX index increases. In order to avoid the dependence of HIX values on DOM concentration Ohno [5] proposed to define the humification index as the fluorescence intensity in the 300-345 nm region divided by the sum of intensity in the 300-345 nm and 435-480 nm regions. In this case HIX values characterize the degree of humification in such a way that avoids the sensitivity to the magnitude of the denominator (so named “inner filter effect” correction). The aim of our work was to investigate the aromaticity and humification of DOM in the lysimetric experiments by use of UV and fluorescence indexes.

Materials and methods

Field experiment was carried out at the Soil Science Department of the Lomonosov Moscow State University. Zero-tension lysimeters filled by soil and/or plants residues were used for the study. Soil samples were taken from the arable horizons of chernozem (lysimeter III), plant residues were presented by oak leaves (lysimeter I) and perennial grasses (lysimeter II). Lysimeters IV and V had two components: arable horizons of chernozem (the same as in the lysimeter III) and oak leave or grasses, respectively (the same as in the lysimeters I and II) placed on the soil surface. All samples were taken at Voronezh region, Russia (51°36'21.8" N 38°58'11.1" E). Samples of the lysimetric waters were collected 6 times in the spring 2015: March – samples N4-6, April – samples N10, 11; May – sample N12. After collection water samples were filtered through the 0.45 μm membrane filters and stored at 4°C in the dark before analysis. Carbon and nitrogen contents in lysimetric waters were determined by dry combustion in Vario EL element analyzer (Hanau, Germany). Inorganic C was not present in any sample, thus all of discovered carbon corresponds to organic carbon. UV absorption spectra were measured in a quartz cell with a 1-cm optical path length between 200 and 500 nm with a uniform data point interval of 1 nm at a constant temperature (25°C) with UV-visible spectrophotometer (SF-2000). Index $SUVA_{254}$- (specific UV absorbance at 254 nm) was calculated as a value of DOM solution absorption at 254 nm divided by dissolved organic carbon (DOC) concentration. Fluorescence analysis was performed on a spectrometer Perkin Elmer LS 51. Emission spectra (EM) were obtained from 280 to 500 nm with the excitation wavelength of 254 nm; scan speed was 500 nm/min. In order to avoid an inner-filtering effect (the fluorescence intensity is proportional to the concentration of fluorescent compounds only for low absorbance: D< 0.5 [1]) the UV absorbance at 254 nm of the measured samples was systematically recorded. When the maximum absorbance was higher than 0.5, samples were diluted. Humification index HIX was calculated according to Ohno [5] as sum of fluorescence intensivities from 435 to 480 nm divided by the sum of fluorescence intensivities from 435 to 480 nm and from 300 to 345 nm. HIX values in this formula ranges from 0 to 1 with increasing degree of humification. All data was statistically analysed (Statistica 6).

Results and discussion

The time dynamics of specific ultraviolet absorbance ($SUVA_{254}$) is given at the fig. 1; variation parameters (mean, median and limits) were calculated taking to the account all of the measured values (Table 1).

Table 1

Mean, limits and median values of $SUVA_{254}$ of DOM

Lysimeter	Sourse of DOC	SUVA254 statistics			
		mean	minimum	maximum	Median
I	leaves	0,035	0,023	0,041	0,037
II	grass	0,029	0,020	0,039	0,030
III	soil	0,031	0,012	0,062	0,022
IV	soil+leaves	0,031	0,008	0,044	0,031
V	soil +grass	0,033	0,012	0,067	0,025

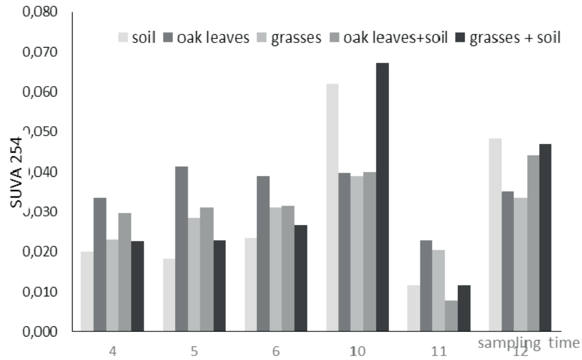

Fig. 1. Dynamics of SUVA254 in the lysimeters leachates.

DOMs of different samples do not differ much in the specific adsorption $SUVA_{254}$ through springtime. Mean values vary from 0,029 to 0,035. This is partly due to the significant differences in DOM optical properties in the early and late spring. In March, during snow melting (sampling time 4-6) specific adsorption of the soil DOM is significantly lower as compared with DOM from the other sources (fig. 1). In the April and May (samples 10 and 12) SUVA values from soil DOM are increased significantly in accordance with the temperature growth and intensification of microbial activity, that lead to the partial decomposition of soil humus. At the same time the dissolution and transfer of these substances into the lysimetric waters are limited by the precipitation rate, volume and type of water movement (matrix or base flow) through the soil. According to Kaiser [3] the composition of DOM in streams and ground waters varies with different hydrological conditions. At the end of the April (sample 11) solutions had organic components with very low SUVA. Probably they are represented by the hydrophilic DOM fraction, that dominate in solutions at the low flow conditions [3], because sorptive interactions of DOM with mineral surfaces result in preferential removal of aromatic compounds (with greater SUVA-values). Such compounds were sorbed by soil as determined from the drastic drop of $SUVA_{254}$ of the DOM from leaves and grasses as compared with the same components from soil (fig 1). Sample 11 (end of April) revealed the substantial increase of the C:N ratio of DOM in comparison with the other late spring samples (12 and 10) that confirms the change of the DOM nature. Values of C:N of DOM from plant residues increased 2-4 times or evern 10 times for DOM from plant residues with soil. The observed change is likely due to the changes in organic residues transformation or to the income of some allochthonic organics (including substanses of the anthropogenic origin).

Median and mean values of SUVA (Table 1) show that plants decomposition leads to the appearance of the water soluble aromatic compounds. Such substances dominated in the DOM from the oak leaves, likely due to the presence of tannines. On the contrary, solutions from the soil arable horizon contained a minimum amount of the aromatic compounds. SUVA of plants DOM is 1,4-1,7 greater than soil DOM (lysimeters I, II, III). After the interaction with soil, SUVA of plants DOM

substantially decrease, due to the absorption of the such substances (they are represented mostly by dissolved lignin-derived compounds), which has been proved before [4].
HIX index (Table 2) demonstrate the extent of the DOM humification: its values correlate with C:H ratio in the molecules of organic matter. Plants derived DOM (lysimeters I, II) are more humificated than soil DOM(lysimeter III) with mean and median values 0,917-0,923 and 0,886-0,866 for plants and soil DO, respectively.

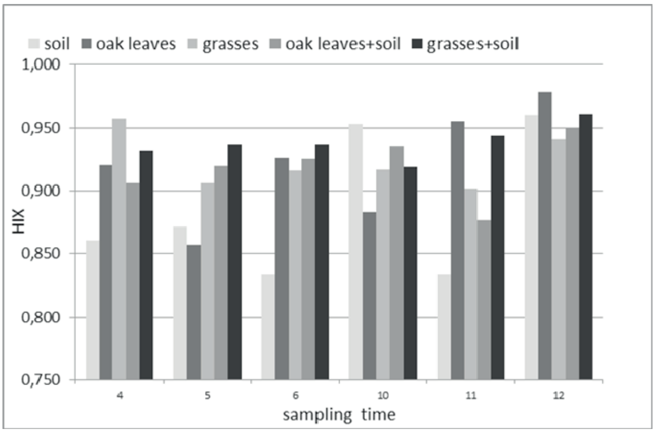

Fig. 2. Dynamics of HIX in the lysimeters leachates

Table 2

Mean, limits and median values of HIX values

Lysimeter	Source of DOC	HIX statistics			
		mean	minimum	maximum	median
I	leaves	0,920	0,858	0,978	0,923
II	grass	0,923	0,902	0,958	0,917
III	soil	0,886	0,834	0,960	0,866
IV	soil+leaves	0,919	0,877	0,950	0,923
V	soil +grass	0,938	0,919	0,961	0,937

Such a tendency is observed for all of the sampling periods except 10th, when HIX value for the soil DOM grew up to 0,953, that is typical for the late spring data (fig. 2). In general in the early spring DOM of grasses demonstrate the most extent of humification and in the late spring (May) the same was true for DOM from oak leaves (fig.2).
Perhaps more resistant organic substances are subjected to decomposition and further humification as the temperatures increases. HIX values increase from March (mean values 0,856-0,935) to May (0,941-0,978). This trend is particularly evident for soil (lysimeter III): mean HIX of the soil DOM in March is 12% which is lower than in May (0,856 and 0,960).
No distinct trends of changes in HIX values after the interaction of the DOM from decomposing plants with soil were discovered. The beginning of March was the only

exception (sample 4, fig. 2), where the most humificated compounds were sorbed from solutions: HIX of DOM eluted from lysimeters with soil+plants were lower than in lysimeters with plants. By the end of the spring (May) this tendency remain the same only for DOM eluted from oak leaves (sample 12, fig. 2).

Conclusions

1. Aromaticity of DOM eluted from plant residues (leaves and grasses) is 1,4-1,7 times greater than DOM from chernozem. DOM from oak leaves show maximum values of UV absorbance, apparently due to the high content of tannins.
2. Mostly aromatic DOM compounds from decomposing leaves and grasses are sorbed by the solid phases of chernozem: $SUVA_{254}$ of DOM from the lysimeters IV and V were 20% less comparing with DOM eluted from pure plant residues (lysimeters I and II).
3. Extent of the DOM humification depends on the season and DOM source. In the early spring (March) grasses have a greater value than soil and oak leaves, at the late spring (May) leaves are characterized by the greatest degree of humification. HIX of soil DOM is substantially less than DOM of plant residues.
4. The most humificated compounds of DOM are derived from decomposing plants not preferentially sorbed by soil except for the period of the early spring (beginning of March).

Acknowledgements

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Application of various systems of fertilizers on gray forest soils Vladimir Opolja

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Keywords: humus, fertility, water-pregeltinized and aggregated silts

Gray forest soils Opole is one of the most fertile soil types Russia. But lately, arable soils are subject to degradation - falling humus content, there are erosion, the formation of sole shoe. To increase the yield of crops on these soils good results are obtained by using mineral and organic fertilizers. But the use of large doses of mineral fertilizers is able to change the properties of these soils due to acidification of the reaction medium. Neutralization of soil ameliorants through any period of time after the last acidification does not lead to the initial operation of the soil, because you can not restore the original crystal-base minerals. Most of the studies carried out on sod-podzolisth soils and black earth. The behavior of the minerals in gray soils under the influence of substances studied included only Rivne [1], the Bryansk Agricultural Station [3] experimental fields Ryazan State Agricultural Academy[2]. The mineralogical composition of gray forest soils Vladimir opolja studied enough, not clear effect of different farming systems, the most widely used on these soils, the maintenance of the battery plant. The aim of this study is to determine the effect of commonly used systems of agriculture on gray forest soils of Opole on the parameters of fertility, for the maintenance of such an important figure as the water-pregelatinized and aggregated silts, changes in the composition of the fine soil.

Materials and Methods

Comparative efficacy of various fertilizer systems was investigated by the results of long-term inpatient experience, pledged in 1991-1993. on gray forest soils on the land in the Agricultural Research Institute of Vladimir Opole. Agrochemical characteristics of soil: humus content 2,65-3,84%, pH_{kcl} 4,98-5,74, humidity 16,08-18,67%, the content of mobile phosphorus (Kirsanov) 116-263 mg / kg of soil content exchangeable potassium (Maslov) 142-173 mg / kg of soil, Hr 3,15-3,52 meq / 100g soil. Use the following rotation: annual grasses (vetch-oat mixture), winter wheat, oats sowing with grasses, herbs, 1, 2 grass, winter wheat, barley. Experience options: 1. Control; 2. lime (background); 3. NPK; 4. 2NPK; 5. manure; 6. manure + NPK; 7. manure + 2NPK . Repeated experience of three times, the area of the plot of 100 m2. Method of placement rendomizirovanny. Isolation of fine fractions (<1, 1-5, 5-10 microns) conducted by sedimentation particle N.I. Gorbunov. The mineralogical composition in selected fractions was determined by X-ray diffractometry using a universal X-ray diffractometer XZG-4A company Carl Zeiss (Jena, Germany).

Results and discussion

The lowest value of exchangeable acidity arable horizon is observed in cases with the introduction of a single (5.36) and double (5.18). This can be explained by the nature itself of mineral fertilizers, which are salts of different acids and acidifying the soil solution and the exchange of substitution of Al and N in soil pogloschyayuschem complex.

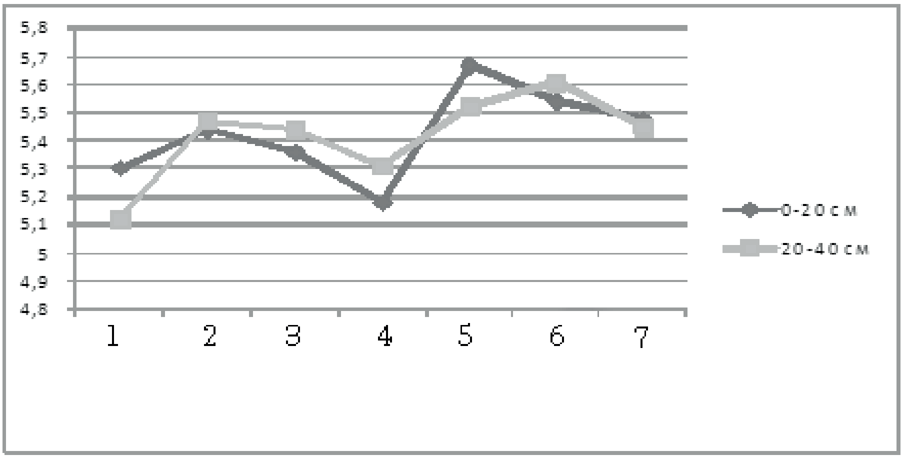

Fig. 1. Variation of exchangeable acidity (rNKSl) arable (0-20 cm) and subsoil (20-40 cm) heavy-soil horizons agroseryh Vladimir opolja (axis X - pH, the axis Y – experiments, have to look in the text).

During the experiment the humus content in the topsoil (0-20sm) was greater than in the subsurface (20-40 cm) by an average of 0.8%. The average content of humus in the arable horizon was 3.26%, and in the subsoil - 2.48%. The increase in the content of humus in the soil fertilized variants compared to the control, the average is 0.65%, with the greatest increase enables the use of organo-mineral fertilizer system. With a positive nitrogen balance humus content of gray forest soils increases. During our research revealed no reduction of organic substances in any embodiment as compared with the control, which may be indicative of a good balance in all embodiments, the nitrogen fertilizer application.

Application of manure in a dose of 60 t / h on a background of lime in combination with a double dose NPK maximum rolling promotes release available phosphorus for the plant.

The smallest amount of potassium in the form marked with lime. Possibly, there is an increase in calcium ion concentration in the liquid phase, it moves toward the ion-exchange processes of adsorption and displacement absorbing complex of a potassium exchange, after which potassium compounds migrate to the underlying soil. The use of mineral fertilizers in single and double dose in combination with manure at 60 tons per hectare on a background of lime promotes the release of the most exchangeable potassium.

The data on water peptiziruemosti factions, their mineralogical composition allow us to judge the degree of mobility of the soil material capable of removal of components of fine soil mass, including elements of plant nutrition. The nature of the soil mass mobility allows us to analyze in more detail than in the analysis of the gross sludge process of formation of soil profiles, which is important for the solution of genetic issues, as well as assessing the level of soil fertility and trends.

Aggregated silt mikroagregatsii characterizes the soil mass, it is an important indicator of agrophysical. The mineralogical composition of the samples of the sludge determines the interaction with fertilizer. In particular, the behavior of potassium, ammonium and phosphorus fertilizers is largely determined by the mineralogical composition and the crystal chemistry of the main minerals and mixed-formations The total content of the clay fraction (amount VPI and AI) in the layer of 0-40 cm of soil study ranged from 6.7% (in the embodiment, manure + 2NPK) to 22% in the variant (manure + NPK). The distribution of the clay fraction of the layers 0-20 cm and 20-40 cm vary greatly depending on the variant of the experiment (Fig. 2).

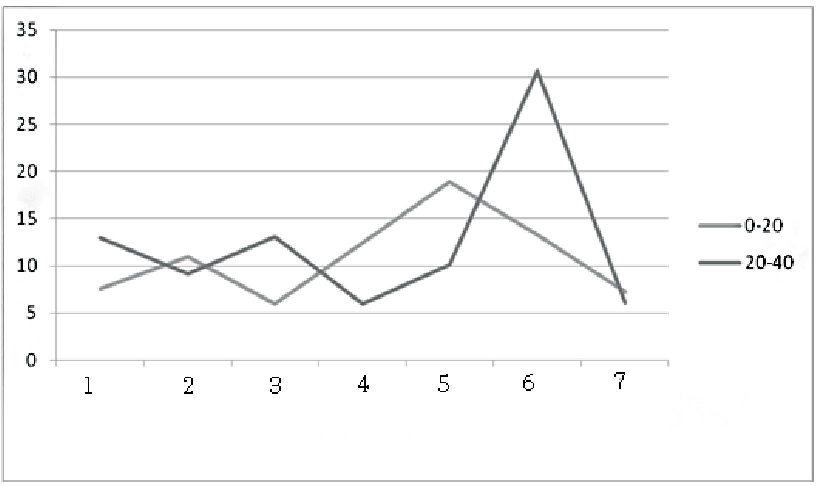

Fig. 2. The content of the clay fraction (the amount of water-peptized aggregated and silts% in the soil, the axis X) in the arable (0-20 cm) and subsurface (20-40 cm) heavy-soil horizons agroseryh Vladimir opolja (variants of experience - Y-axis).

In embodiments of control, NPK and manure + NPK observed takeaway silty material from arable horizon in the subsoil, while in the embodiments lime and manure + 2NPK silt content in the plowing and subsurface horizons were about the same, as in option 2 and NPK variant with the introduction of manure was observed on the contrary, the accumulation of silt fraction in the arable horizon.

The mineralogical composition of the water-peptized silt consists mainly of detrital grains forms of quartz, feldspars, hydromicas, at least smectite phase. Aggregated sludge containing specific paragenetic association hydromica-mixed-layer, with swelling packages and domination hydromica.

The application of mineral fertilizers in a single dose had a major impact on the ratio of the mineral phases. Adding a double dose of NPK resulted in a decrease in the content mixed layers of formations in water-peptiziruemom mud plow horizon (43%). Also in this embodiment, it experiences an increase in the fraction content hydrous water-peptiziruemogo sludge plow horizon by 10% compared to the control one (46% and 36% respectively).

It is established that introduction of the raised doses of mineral fertilizers led to decrease in the contents the smeshanosloynykh of educations. Oozy fractions are replenished with minerals, steadier against aeration, but with a large number of inert components, such as quartz and dioktaedrichesky micas.

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Chitosan as a detoxicant for oil contaminated soils and its subsequent transformations

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Keywords: oilproducts, a natural sorbent, a sorption mechanism, a sorptionbarrier.

Introduction

The problems of oil contaminated soils remediation are relevant due to the rapid development of the oil and gas industry and infrastructure. The common and most effective method of soils detoxification is sorption. At the moment, there are about two hundred species of different sorbents. We first studied a possibility of applying natural biopolymer chitosan for soils detoxification. In the scientific literature there is evidence of its use only for treatment of surface and wastewaters [1, 4].
Chitosan is a natural biopolymer degrading to its typical components (glucosamine, N-acetylglucosamine) under action of ferments; it has a high sorption activity towards heavy metals [8, 9]. The sorbentis made of shellfish chitin[1, 6]. Economic efficiency of using chitosan is conditioned by the presence of a localfeedstock: wastes generated during cleaning turbines of Volzhsky Hydroelectric Power Station. Utilization of chitin containing wastes solves the environmental problem, decreases the sorbent price [3]. The properties of the sorbent are given in Table 1 which review shows the obtained chitosan meets the technical requirements applicable to the sorbent for its use in food industry.

Table 1. Physical and Chemical Propertiesof Finely Milled Chitosan

Parameter	Technical standard, no more than	Test results
Molecular weight, kDa	-	120,000
Deacetylation degree, %	-	87,000
Moisturecontent, %	10,000	9,400
Weight content of mineral substances, %	0,700	0,330
pH 1 % chitosan solutionin 2 % acetic acid	7,500	3,850
Weight content of insoluble compoundsin 3 % acetic acid solution, %	0,200	0,180

Materials and Methods

The objects of the investigation were light-chestnut clay and sandy soils of Volzhskypetrol retail stations № 1 and 3. Sampling and preparation of the soils to the analysis were carried out according to GOST 17.4.4.02-84. The content of carbon in the soils was determined on «Flyuorate 02-3M LUMAX» according to the federal environmental regulatory document PND F 14.1: 2.5-95.Accuracy of equipment for analysis Δ ± 0,03. The Chitosan structure was investigated by FTIR spectrophotometer BRUKER with OPUS software and microscope Altami Polar 312. A portion and an aliquot of the sorbents wereselected so that in all cases there is an equal amount thereof. The experiment was conducted using finely milled chitosan as well as its 0,1% and 0,05% solutions. [3].

Oil products sorption efficiency was tested in laboratory conditions. For this purpose a sample of the soil weighing 50 g was taken. In the first case, 0,1 g of finely milled chitosan was placed to a flask, in the other caseit was0,1% solution of acetic acid in the sorbent. The sandy soil was additionally subjected to sorption in 0,05% chitosan solution. The choice of acetic acid as a solvent was stipulated by its chemical properties. Unlike other organic acids, the process of chitosan dissolvingin it occurs twice intense [1, 4]. For integrity of the test, a weighed portionof finely milled chitosan was selected so that the concentration of carbon in both cases was the same [2]. The obtained data are presented in Table 2.

Table 2. Performance Indicators of Oil Sorption out of the Soils Using Chitosan

Aggregative state of chitosan	Carbon sorbed with chitosan, %	
	Exposure time	
	2 days	4 days
Clay soil		
Solid	94,37	99,96
0,1 % solution	90,18	96,02
Sandy soil		
Solid	46,22	77,85
0,1 % solution	99,60	99,96
0,05 % solution	12,84	70,91

Results and Discussion

Oil products sorption out of the light-chestnut clay soil revealed the highest efficiency when the finely milled chitosan is used, irrespectively of the exposure time. In both variants (solid and liquid chitosan), the sorption increaseson the 4th day of exposure from 94,37to 99,96 % and from 90,18 to 96,02 % accordingly.

Efficiency of oil sorption out of the light-chestnut sandy soil with 0,1% chitosan solution is higher than when it is diluted to 0,05%. After 2 daysof exposure, the sorption is 99,60and 12,84 %correspondingly, and after 4 days it is 99,96 and 70,91 %. The diluted solution sorbs more oil products if to increase itscontacttime with the contaminated soil. The sorption with the diluted solution is more efficient during 4 days and rises from 12,84to 70,91 % accordingly, and oil sorption with 0,1 % solution risesfrom 99,60 to 99,96 % (Table 2).

The values of sorption with finely milled chitosan in 2 days is about twice more in the clay soil than in the sandy soil: 94,37and 46,22 % respectively. In the sandy soil a fraction of the sorbed oil products, depending on the exposure time, significantly rises: from 46,22to 77,85 %.

Chitosan sorption capacity is stipulated by the presence of free amine groups in its macromolecule whereby supramolecular complexes with organic compounds form[4, 6]. The investigation of chitosan using polarizing microscope Altami Polar 312identified the existence of micropores in its structure. It does suggest the possibility of physical sorption of oil and assume the probability of simultaneous occurrence of two types of sorption: chemical and physical ones.

It is seen from Table 2 that the oil sorption efficiency occurs in the clay soil when finely milled chitosan is applied, particularly, on the 4th day. The light-chestnut sandy soil has the inverse dependence: chitosan solution almost twice effective than finely milled sorbent at 2 daysof exposure, and a half time more efficient at 4 days of exposure. Dilution of chitosan solution reduces sorption productivity by almost 8 times at2 days of exposure, and by 1,4 times - at4 days of exposure.

It is interesting to consider the mechanism of more effective sorption with finely milled sorbent in the clay soil, andin the sandysoil -with chitosan solution.

In heavy soils, where the processes of adhesion and conglomeration with a solid sorbent are the most probable, the prevalence of soil biota enhances interaction [6, 7]. Participation of primary minerals in the formation of mineral composition of the soils depends on their particle size distributions; in sandy soils the mineral fraction accounts for 90-98% of the fine grained soil, in loamy soils - 50-80 %, in clay soils - 10-12 % [2]. So, we can assume that light soils have less potential contact with a solid sorbent. Clay minerals have high sorption capacity [2]. It is also one of the reasons for more efficient sorption of oil products withmilled chitosan [3, 7].

Studying the types of interparticle contacts in a soil, prof. E. V. Shein specificated three ones: coagulative (the contacts are formed by surface forces of intermolecular interaction), crystallization (particles are surrounded by the water film with a visible contact area between particles) and combined type. Prof. E. V. Shein, considering the moisture flows in soils, explains the mechanism of formation of a hydrophobic film on the individual particles of sandy soils, especially in case of alternating layers of different particle size distribution [6]. Oil products, similarly, may form a film on the sand grains.

High sorption efficiency of finely milled chitosan in light-chestnut clay soils is conditioned by the following: pores in the finely milled chitosan are one order less than in the soil, which allows the chitosan for mechanical holding down pollutants; the surface tension of the sorbent is less than in the clay structure; chemisorption of oil products from soils with chitosan occurs at the expense of solvation effects coming up through the formation of macromolecular complexes [5, 7].

High sorption efficiency of oil productswith chitosan solution in light-chestnut sandy soils is caused by the next reasons: more reactive functional groups in the chitosan solution [4, 5]; the solid sorbent being in contact with the contaminated sand forms a lower contact surface than the solution which envelops each contaminated sand particle increasing the contact surface.

In the model experiment we found out that chitosan solution forms a film on the soil surface which, if necessary, can be easily removed mechanically. When the film is heated to 40 ^{0}C, the sorbed oil remains in the bound state. The film removal is not required because the soil microflora decomposes the natural biosorbentin 2-3 months.

To eliminate and prevent accidental oil spills on the light-chestnut clay soil, we propose to equidistributethe finely milledsorbent on the soil surface; forthe light-chestnut sandy soil, it is more efficient to use for this purpose 0,1% chitosan solution.

In order to prevent oil spills and their subsequent migration in the soil during the construction of petrol stations, we offer to create a sorption barrier. The barrier is a consecutive alternation of layers of large quartz sand (capacity up to 5 cm), chitosan (up to 1 cm), river sand (up to5 cm), chitosan (up to1 cm), fine sand (up to5 cm), and chitosan. During the construction of small oil storage facilities, it is worthwhile to use an additional barrier formedof2-3 consecutively alternating layers of fine sand and chitosan (all sorption barriers are placed beneath the foundation for temporary oil storage tanks). Layers7, 9, 11 represent fine sand with the particle diameter equal to 0,5 - 1,0 mm (to 5 cm), 8, 10, 12 - finely milled chitosan (to 1 cm), and 13 - an insulating material.

Conclusions

1. Almost complete sorption of oil products out of the light-chestnut clay soil with finely milled chitosan and out of the light-chestnut sandy soil with 0,1% chitosan solution was shown; in both cases it is equal to 99,96%.
2. The effectiveness of 2 days oil sorption with finely milled chitosan is about twice as high in the clay soil as compared to the sandy soil.
3. For more complete oil extraction, the sufficient exposure time is 2-4 days.
4. Optimal oil sorption is achieved at 0,1% concentration of chitosan solution compared to 0,05%concentration.
5. For oil spill response in light-chestnut clay soils,it is better to use finely milled chitosan, and apply 0,1% chitosan solution for conducting sorption in light-chestnut sandy soils. To prevent oil spills and their subsequent migration in the soils during the construction of petrol stations, we propose to create a sorption barrier.

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Application of zeolite in the sustainable land use

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Introduction

An essential requirement of the sustainable crop production is to adapt to the ecological conditions at the same time be environmentally friendly and economical. The rational use, protection and preservation of the soil fertility are inseparable. An outstanding opportunity to preserve the soil fertility is purposive human interference taking place along the soil amelioration. The zeolite as a natural mineral can be suitable for improving soil properties.

The zeolite is collective name of more than 40 minerals. The two most important components are the clinoptilolite and mordenite tectosilicates. The swelling capacity of clay minerals motivated the agricultural use of zeolite; they are able to bind the water molecules. The zeolite is used in the agriculture, horticulture, landscape architecture, the municipal waste management [1, 3, 9], as well as in the field of water treatment [10]. It promotes the water uptake of plants and improves the soil water balance [8, 13]. This mineral can play as soil nutrient source, it increases the soil pH, while hydrolytic acidity decreases, and the uptakeability of microelements improves [2]. The soil biological activity is an important feature of the soil fertility. The minerals, the clay fraction of minerals as a micro-ecological factor affect the activity, growth and life function of microorganisms [12, 15].

The aim of this paper is to show in the frame of a pot experiment the effect of zeolite - as a perspective soil improving material - on the physical, chemical and microbiological properties of a sandy soil.

Materials and methods

The researchers of University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management, Institute of Agricultural Chemistry and Soil Sciences studied on humus sandy soil (pH_{H2O} 5,6) the effects of the various dosages of zeolite (arable dosages are 5, 10, 15, 20 t ha^{-1}) on some properties of soil. Among soil physical examination the water lifting and holding capacity of zeolite and the treatments separately were determined in laboratory conditions.

The effect of zeolite was studied in a pot experiment with four repetitions, lasting four years (2007-2010). Perennial ryegrass *(Lolium perenne L.)* was the test plant. The size of applied mineral powder was between 2-5 mm, 6 kg soil was in each pots. The moisture content of soil in the treatments was set on the 70% of the maximum water capacity.

Among chemical parameters the soil pH in water and 1M KCl suspension, hydrolytic acidity, were measured according to Filep (1995), the nitrate-nitrogen content by

Felföldy (1987), the AL-soluble phosphorus and potassium content were measured with method of [4].
Among the soil microbiological investigation the total bacteria and fungi number [14], the number of cellulose decomposing bacteria [11] and CO_2-production (Witkamp, 1966. cit.[14]) were determined. Among soil enzymes the activities of phosphatase (Krámer-Erdei, 1959. cit [14]) and saccharase [7] were determined.
Along the evaluation the sampling averages and the standard deviation were counted, the significant differences was calculated at 5% level. Statistical analysis was made using SPSS 13.0 software program.

Results and Discussion

According to the soil physical investigation of soil, zeolite and soil+various dosages of zeolite showed that level of water lifting regarding the zeolite was 340 mm along five hours, significantly less than in level of water lifting of soil, which was 468 mm. After mixing the zeolite to the soil, the level of water lifting decreased, in the treatment with high zeolite dose (20 t/ha) this decrease was significant. The soil water holding capacity increased in the zeolite treatments, compared to the control soil. The medium high and the high dosage of zeolite increased the water holding capacity of soil statistically verifiable way. In the experiment the water holding capacity of treated soil increased about 7%.

Table 1

Effect of zeolite on some physical and chemical properties of a sandy soil

Treatments and doses (g/ 100g)	Lifting of water (mm/5/h)	Holding of water (ml/h /100g)	$pH_{(H2O)}$	$pH_{(KCl)}$	Hydrolytic acidity (y_1)	Nitrate-N (mg $1000g^{-1}$)	AL-P_2O_5 (mg $1000g^{-1}$)	AL-K_2O (mg $1000g^{-1}$)
Zeolite	340	58,5						
Control soil	468	38,5	5,34	4,29	12,10	3,69	89,33	229,75
0,5	455	38,0	*5,51	*4,60	*11,15	4,20	*104,70	*255,42
1,0	448	39,5	*5,72	*4,55	*11,31	4,36	99,31	*291,46
1,5	440	*40,5	*5,52	*4,53	*11,36	4,00	*109,96	*313,00
2,0	*438	*41,5	*5,61	*4,40	11,80	3,64	*109,86	*342,50
*$SZD_{5\%}$	29	2,2	0,15	0,11	0,31	1,07	10,28	24,49

The pH of acidic sandy soil is also increased in the treatments, while the hydrolytic acidity decreased. Positive changes were measured in the available nutrient content of soil. The least amount of change was determined in the nitrogen content. The available phosphorus increased in the treatments, the higher dosages (15-20 t ha^{-1}) caused significant increase in this nutrient content. The available potassium content increased significantly in each treatment (Table 1.).
Concerning the soil microbiological properties, favourable effect of zeolite was measured in the total bacteria and fungi number, the applied small (5 t/ha) and medium (10 t/ha) dosages of zeolite increased these two parameters significantly. The number of cellulose decomposing bacteria and the CO_2-production were positively

affected by the medium (10 t/ha) and medium-large (15 t/ha) dosages. Less effect of zeolite was measured on the activity of enzymes, but not statistically proved. The activity of phosphatase was higher in all treatments compared to control, while the activity of saccharase was increased by the small and medium doses (Table 2.).

Table 2

Effect of zeolite on some microbiological properties of a sandy soil

Zeolite treatments t/ha	Total number of bacteria (*10^6 g^{-1} talaj)	Microscopic fungi number (*10^3 g^{-1} talaj)	Cellulose decomposing b. (*10^3 g^{-1} talaj)	CO_2-production (mg $100g^{-1}$ 10 nap)	Phosphatase activity (P_2O_5 mg 100g $2h^{-1}$)	Saccharase activity (glükóz mg 100 g^{-1} $24h^{-1}$)
control	2,56	55,58	2,63	4,34	5,39	4,63
5 t ha^{-1}	*5,85	*62,21	3,39	4,93	6,45	5,52
10 t ha^{-1}	*7,04	*66,42	*3,65	*6,06	6,74	6,24
15 t ha^{-1}	3,21	57,75	*3,80	*6,20	6,98	4,36
20 t ha^{-1}	3,09	53,75	3,14	*5,35	7,21	4,28
*$SzD_{5\%}$	1,25	2,25	0,81	0,95	2,25	1,85

Conclusion

The mineral powder of zeolite had positive impact on the water and nutrient content of an acidic sandy soil, the available nutrient content increased in the treated soil. The zeolite contributed to the positive changes in the microorganism's population dynamics and growth; and stimulated the soil microbial activity. Experimental results showed that the zeolite could be a proper amendment for amelioration of sandy soils.

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Ecological patterns of distribution of uranium and thorium in soils of South Ural

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Key words: radioactive elements, concentration, pollution, republic of Bashkortostan

More than 25 chemical elements are among the radioactive elements, but only thorium (Th232) and uranium (U238) belong to the widespread natural elements. Uranium falls into the group of absolutely rare elements, while thorium falls into the group of relatively common in the environment elements which feature high toxicity. There is little information available in the literature on the content of thorium and uranium in soils. The average world values of thorium in soils are between 3.4 and 10.5 mg/kg, and uranium values are between 0.79 and 11 mg/kg [1]. Uranium and thorium fall into the group of elements of a granite layer and a sedimentary shell of Earth’s crust. Acidic rocks usually contain more thorium (10-23 mg/kg) and uranium (2.5-6 mg/kg), than basic and ultrabasic rocks (1-4 and 0.3-1 mg/kg). More of the studied elements are found in sedimentary rocks of clay deposits than of sandstones and limestones. Production emissions of enterprises, local wind transfer of dust particles and aerated solids from ash and slag disposal areas, extraction and processing of minerals, petroleum and gas, fuel combustion, motor transport, agriculture, state district power plants and combined heat and power plants can be polluters of ecosystems. Moreover, natural deposits of the studied elements are the sources of their income, subsequent scattering and migration [2]. Calculations by L.P. Rikhvanov (1997) demonstrate that one combined heat and power plant of average capacity fitted with modern dust-allaying equipment will release 3-4 tonnes of uranium into the atmosphere annually.

The purpose of the research is to estimate the bulk content and deposits of the studied elements in a half-meter layer of soils of various ecosystems (forest, arable land, grassland) and to trace patterns of distribution of thorium and uranium in soils and rocks of South Ural.

The object of the present study is the soils of the Republic of Bashkortostan in the following geomorphological areas: the Belebeevsky high plateau, the Ufa plateau, the Yuryuzano-Aysky foothill plain, the Trans-Ural peneplain, Kamsko-Belsky plain steeply-sloping lowland, the Zilairsky plateau and the Lowhills of eastern slopes.

ICP-MS (inductively coupled plasma mass-spectrometry) of VG Plasma Quad mass spectrometer was employed to assess the elementary composition of elements in soils and rocks.

So far there has been no extensive study of the content of radioactive elements in the soils of the Republic of Bashkortostan. In this paper we present data of current interest for the region. Table 1 gives data on the average content of thorium and uranium along the profile in soils and rocks of the republic. Concentration of thorium in soils of South Ural varies from 1.0 to 15 mg/kg, the maximum content is revealed in the east of the republic, i.e. the Yuryuzano-Aysky foothill plain features 15 mg/kg (R.13-2000, the gray forest not fully developed mountain soil, Arkaulovo, forest, pine), the Ufa plateau features 14.3 mg/kg (R.1-2000, the dark gray forest soil, Baiki, grassland; R.3-2000, the dark gray forest not fully developed soil, Karayar, forest, pine), the Trans-Ural peneplain features 10.3 mg/kg (R.15-2000, the dark gray forest not fully developed soil, Safarovo, forest, pine).

Similar data were obtained by V. I. Grebenshchikov (2008) in soils of Irkutsk region where the content of thorium varied from 2.9 to 27.4 mg/kg. The average content of thorium was 9.33 mg/kg. In rocks of South Ural the content of thorium does not exceed 9.8 mg/kg. The main deposits of thorium in a half-meter layer of earth, are, as one would expect, concentrated in soils of the east of the republic. This characterictic divides the territory of the republic in two: “western” and “eastern” parts. The Ufa plateau deposits of the element reach 39-82 kg/hectare, in the Yuryuzano-Aysky foothill plain they are 32-62 kg/hectare, in the Trans-Ural peneplain the deposits are 11-62 kg/hectare, the Lowhills of eastern slopes contain 8-53 kg/hectare, in the rest of the geomorphological areas the figure does not exceed 25 kg/hectare.

Table 1

The content of radioactive elements in soils and rocks of South Ural (where *n* stands for quantity of vertical sections, above and below the line – resp. the average of the highest and lowest level of an element along the profile)

Area	Elements							
	Thorium				Uranium			
	in soils		*in rocks*		*in soils*		*in rocks*	
	M	±*m*	*M*	±*m*	*M*	±*m*	*M*	±*m*
Ufa plateau, *n*=7	14/7.8	1.2/0.4	2.5/0.1	0.2/0.01	2.3/1.2	0.2/0.1	12/2,5	1.1/0.2
Yuryuzano-Aysky foothill plain, *n*=17	15/2.5	1.2/0.1	7.2/0.1	0.7/0.01	3.5/0.4	0.3/0.02	4.8/0.1	0.4/0.05
Belebeevsky high plateau, *n*=8	1.9/1.6	0.1/0.1	2/1.1	0.2/0.1	16/13.6	1.2/1	18/10.1	1.2/1
Trans-Ural peneplain, *n*=6	10/1.8	0.9/0.1	8/0.5	0.6/0.03	1.9/1.2	0.1/0.09	1.3/1.0	0.1/0.09
Kamsko-Belsky plain steeply-sloping lowland, *n*=20	4.1/1.0	0.3/0.1	4.4/0.7	0.4/0.05	17.2/9.7	1.6/0.9	19/5.1	1.5/0.4
Zilairsky plateau, *n*=7	7.6/1.1	0.6/0.1	6.6/0.8	0.6/0.07	19/9.6	1.7/0.8	21/8.0	2/0.7
Lowhills of eastern slopes, *n*=7	9.6/1.2	0.8/0.1	9.8/0.5	0.8/0.03	16/0.5	1.4/0.03	15/0.3	1.3/0.01

The described pattern of thorium distribution is accounted for by natural and anthropogenous factors. The pattern is actually affected by occurrence of the element in acid and basic mountain magmatic rocks, extraction and processing of minerals, production emissions of enterprises, local wind transfer of dust particles and aerated solids from ash and slag disposal areas.

The main mining enterprises are located in the territory of the studied areas and more than 500 fields of copper, zinc, iron, manganese, gold and other ore minerals are found there. Operation of these fields leads to accumulation of huge volumes of solid wastes, to dumping of liquid waste and to emission of gas-and-dust waste, thus resulting in " technogenic landscape".
Concentration of uranium in soils is 0.4 – 18.8 mg/kg, in rocks its content is higher and it reaches 0.1-21.3 mg/kg. In comparison, in soils of Irkutsk region the content of uranium varies from 1.0 to 23.3 mg/kg. The average content of uranium reached 2.8 mg/kg [4,5]. The greatest deposits of uranium are found on the Zilairsky plateau at 62-100 kg/hectare and Kamsko-Belsky plain steeply-sloping lowland features deposits of 67-87,3 kg/hectare, deposits of uranium in the rest of geomorphological areas vary in the range of 4-20 kg/hectare. Profile distribution of uranium in soils shows that accumulation of uranium in the developed industrial zones generally occurs in the upper layers, whereas in the areas without uranium deposits its accumulation is observed in the lower layers.
An increase in uranium and thorium along the soil profile from the upper layer to the lower soil forming layer is bound with occurrence of the elements in the bed rocks. A decrease in the elements from the upper to the lower layers correlated with an increase or decrease in the mid-range is connected with soil forming processes and technogenic effect.
Our research has established an important natural pattern of interaction between uranium and thorium and with rare elements. High coefficients of correlation between these elements bear evidence of this pattern and are shown in Table 2.

Table 2

Coefficients of correlation between the content of uranium, thorium and rare elements in soils of South Ural, P = 0.95

Element	Thorium	Uranium
Lanthanum	0,916	0,791
Praseodymium	0,932	0,810
Neodymium	0,951	0,843
Samarium	0,961	0,862
Gadolinium	0,955	0,854
Terbium	0,966	0,882
Holmium	0,950	0,868
Erbium	0,979	0,922
Thulium	0,980	0,960
Ytterbium	0,970	0,907
Lutecium	0,950	0,868
Uranium	0,964	

Thus, the patterns of distribution of thorium and uranium in soils and rocks demonstrate that the studied elements are widespread and the content of these elements depends greatly on the environmental and technogenic factors. We can observe further in-line deterioration of the ecological situation in the examined areas associated with thorium: the Belebeevsky high plateau – the Kamsko-Belsky plain steeply-sloping lowland – the Zilairsky plateau – the Lowhills of eastern slopes– the

Trans-Ural peneplain – the Yuryuzano-Aysky foothill plain – the Ufa plateau; associated with uranium: the Yuryuzano-Aysky foothill plain – the Trans-Ural peneplain – the Ufa plateau – the Lowhills of eastern slopes – the Belebeevsky high plateau – the Kamsko-Belsky plain steeply-sloping lowland– the Zilairsky plateau.

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Clay-Salt Formations in Baer Mound Soils (Caspian lowland, Russia)

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Key words: Baer mounds, soils, salts, clay-salt cutans and microaggregates

Baer mounds are specific relief forms found in the Caspian Coastal Lowland (the mounds are nearly parallel to one another from east to west 4 to 20 km high and 0.5 to 6 km and over in length). Caspian Lowland is characterized by salinity of soil-forming deposits and underground waters, and aridity of climate [1, 2]. Soils in geologic depressions under arid conditions are always saline in a varying degree (carbonates and evaporites). While the problems of carbonate and evaporite formation are rather extensively covered in the literature, the issue of the role of salts (their interaction with clay minerals) in processes of aggregate formation is still open to discussion [3]. The aim of the work was 1 - to examine the structure and composition of salt formations and aggregates in Baer mound soils, 2 – the study of the affect of soluble salts on the microstructure of clay minerals.

The focus of the study was a Baer mound and the adjacent territory in the western part of steppe ilmens in the Astrakhan region. Sampling sites and profiles have been laid on the eastern and southern slopes of the mound according to the uniform grid. On the eastern slope reference profiles up to 1.5 m deep were laid, on the top of the mound, at the foot of the mound within 55 m from the mound, and in the intermound hollow at a distance of 315 m from the mound within the former rice paddy.

The soils of the study mound are zonal brown semidesert solonetzic saline loamy – Endosalic Calcisols Sodic, WRB 2006 [4]. In prof. B soil is brown semidesert; prof. S is meadow hydromorphic solonchak; prof. A is anthropogenically transformed brown semidesert solonetzic soil. Soil water extracts were used to estimate salt composition and concentrations. Particle size distribution was determined by the laser diffraction method. Bulk composition was determined by the X-ray fluorescence method. The morphology of aggregates and qualitative assessment of their microaggregates composition were determined by scanning and transmission electron microscopy. Contact angles were determined with the dynamic sessile drop method using a digital goniometer.

According to data of particle size distribution, the soils of the top mound and southern slope are characterized by the high content of physical sand with the dominant fraction of fine sand (100–200 μm). Soils of the eastern slope along the entire profile are essentially clayey. The dominant fraction is 2–10 μm. In accordance with particle size distribution, the mound soils become saline. The lowest salt content is noted for the mound top and southern slope soils, which are lighter regarding their particle size distribution. The salt content in soils of the eastern slope is essentially higher. Depending on the particle size distribution and soluble salt content, the field moisture and density of composition of soils vary. It is interesting to note that these variations in the upper part of the profile area symbatic. In the middle part of the profile the disturbance of the symbasis of the properties is more distinct as compared with the eastern slope. For example, on the eastern slope, in the area of high salt content areas decreased moisture and density of composition are distinct. The latter can be related to clay-salt aggregation of the soil mass. Therefore, then we pay major attention to the reference profiles of the eastern slope.

Qualitative assessment of microaggregates composition of soils demonstrated that processes of microaggregates formation are mainly characteristic of mound foot and intermound hollow soils. The dominant soluble salts of soils are sodium chloride and sulfate. The maximum value of the salt content along the entire profile is characteristic of solonchak. This is related to the high sodium chloride content in it. The sulfate content is essentially lower, except for hor. Bs. In profile B soluble salts are mainly represented by sulfates. Considerable amounts of chlorides are only present in hor. BC. In prof. A the amount of the soluble salts makes only 0.3%. Na and S high contents in solonchak are also supported by the bulk analysis data.

The SEM analysis of soils made it possible to diagnose formations of insoluble (dolomite, calcite), difficulty soluble (gypsum) and soluble (halite and mixed formations of chlorides and sulfates of sodium, magnesium, and calcium) salts. Dolomite, as a marker of marine genesis of soil-forming deposits, is present in the form of separate crystals along the entire profile of the study soils. The depth, amount and form of calcite formations in Baer mound soils depend on soil location in the mesorelief. Gypsum formations in prof. B (mainly in hor. Bs) are represented by crystals covered with a clay cutans, and their aggregates. At the foot of the mound (more hydromorphic conditions) their major part is concentrated in the saline horizon Bs in the form of tabular hexagon-shaped crystals. Gypsum formations in prof. A are not diagnosed.

Soluble salt formations were only registered in solonchak. In hor. B2 formations of halite, thenardite-mirabilite and astrakhanite were observed. Halite is represented by numerous cubic crystals. Even bigger tabular crystals with flat ingrowths of sodium sulphate were registered. Only solitary glauberite formations are common in the lower part of hor. BC. Besides, pentagonal quasicrystals of sodium chloride up to 3 μm, which contained clay minerals and sodium and magnesium sulphates were detected.

Since it was a problem to assess the structure of these clay-salt assemblages, we conducted a simulation experiment: interaction of smectite (bentonite clay) with NaCl solution containing sulfates sodium and magnesium in static and dynamic conditions. We have shown earlier that in the study soils it is the smectite group minerals that participate in the aggregation processes (formation of clay-salt microaggregates, cutans and quasy crystals) [5, 6].

In static conditions cubic and arrow-shaped NaCl crystals, clay-salt microaggregates are formed. Besides, clay-salt microaggregates measuring up to 3 μm were detected characterized by the pentagonal shape peculiar for clay minerals. Some pentagon angles are close to angles of the regular pentagon. The formation of pentagonal clay-salt microaggregates was also registered in the second variant of the experiment by the SEM and TEM methods. Their shape makes it possible to assume the presence of fivefold rotational symmetry in their structure.

Electron microdiffraction patterns of the formation selected areas were made to support our assumption. Regretfully, the small size of the particles did not allow us to obtain distinct symmetrical microdiffraction patterns. So, there is no sufficient reason to name NaCl pentagonal assemblages of smectite as strictly quasicrystals. However, the presence of reflexes on the microdiffraction patterns, whose aggregation forms pentagons, as well as angles of 36° testify to the presence of elements with fivefold rotational symmetry in the structure of clay-salt formations.

The “forbidden” quasicrystal state of matter was discovered relatively not long ago – in 1984 in alloys by prof. D. Schechtman [7]. Quasicrystals are noted for specific features. One of the major characteristics, apart from a sharp increase in the strength of parent matrix when quasicrystal particles intrude it, is lesser wettability and density. Possibly, the elevated mechanical strength as well as the lesser density of composition and wettability of saline soils after drying are explained by the formation of directly quasicrystals. The results of our simulation experiment (see above) are in agreement with this supposition: the interaction of smectite with NaCl solution containing sulfates sodium and magnesium results in the increase of its contact angle (from 28° to 72°).

As to clay-salt aggregation of the soil mass, the SEM analysis made it possible to establish the participation of clay-salt assemblages in aggregation of the solid phase of the study soils. The type of clay-salt assemblages (coatings and/or microaggregates) depends on the silt content in soils. Given the low content of the silt (prof. B), clay-salt coatings are formed on the surface of quartz grains. The coating diameter reaches 200 μm, which corresponds to the size of the dominant fraction of particle size distribution. The coatings detected in the Ad upper horizon are compositionally ferruginous-clay, in hor. B1 and hor. Bs – calcitic. The formation of clay-calcitic coatings on the quartz grains was registered in profile A too.

Given the high content of silt particles (prof. S and A), mainly clay-salt microaggregates are formed. For example, solonchak is characterized by the formation of clay-salt microaggregates with NaCl participation, the biggest of which (up to 70 μm) were registered in the upper part of hor. A. In the saline hor. Bs calcitic tabularly packed clay-salt microaggregates were diagnosed. In the subsalt horizon B2 clay microaggregates are formed with participation of vitreous rounded assemblages with joint participation of sodium and magnesium sulfates. In the lower part of prof. A mainly dolomitic microaggregates up to 80 μm in hor. BC were diagnosed. In prof. B in the saline horizon Bs with high gypsum content, microaggregates consist of gypsum tabular microcrystals covered with a clay coating. Their packing in the microaggregates is “face-to-face”.

Thus, salts in the soils of Baer mound landscapes form individual crystals, formations of joint crystallization, and clay-salt coatings, microaggregates, and quasicrystals. The type of clay-salt formations (coatings and microaggregates) is conditioned by the silt content in soil. Particle packing, the size and shape of microaggregates depend on the content and properties of salts participating in their formation. The preservation and stability of Baer mound soils are related to the formation of clay-salt microaggregates and coatings.

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The soil water retention, swelling and rheological properties of typical chernozems

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Key words: soil structure, organic matter, soil water retention, swelling, integral zone z.

Introduction

Fertility of soils is defined by their water - physical properties and the content of organic matter. Such indexes, important for fertility, as structure, absorption and water-holding capacity are related to organic matter. The water retention curve contains information about various properties of the soil, such as water-holding capacity, texture, organic content and defines rheological behavior of the soil. In this regard, the aim of our research was to determine the water retention curve, swelling and rheological characteristics of typical chernozems in different land use.

Materials and Methods

The objects of research were the upper layers (0-10sm) of chernozem pachic(WRB,2006).The objects are located in the middle of the forest-steppe zone of the Central Russia to the south of Kursk town in different land use: agricultural arable, adjoining forest belt (the Petrinka area), bare fallow, oak forest, virgin steppe (Kursk Biosphere Reserve named by V.V. Alekhin)

The upper parts of the water retention curves were determined by the desorption of water vapors over the saturated salt solutions, and lower parts - by centrifugation [5]. The kinetics of soil swelling was determined by device "PNG-10" [6]. Granulometric composition was determined by Fritsch Laser Diffraction Particle Sizer ANALYSETTE-22 (Germany). [3]. Soil organic carbon (SOC) contents were determined by combustion (AN-7529 analyzer). The rheological characteristics were obtained by amplitude sweep test (AST) on the MCR-302 rheometer (Anton Paar, Austria) [2].

Results and Discussion

The topsoils of all investigated sites can be characterized as silt loam according to USDA classification system. The upper profile (0-10sm) virgin steppe, oak forest and forest belt have the highest carbon content. They have a higher intake of plant residues in the soil. In bare fallow soil (0-10sm) and arable land the carbon content is less than in undisturbed soils almost doubled (the Table 1):

Water retention curves are shown in Fig. 1 1. The experimental dates of water retention curves was approximated by van Genukhkten's equation in the RETC program (Shein, 2005; Smagin, 2007).

Table 1
Some physical and chemical properties

The variant	Virgin steppe	Oak forest	Forest belt	Arable land	Bare fallow
The content of physical clay, %	42,5	57,54	58,39	49,39	53,21
The total content of carbon, %	6,8	6,5	5,8	3,3	3
Integral zone Z (the area of elastic and plastic behavior)	1,41	1,18	1,15	0,87	0,59

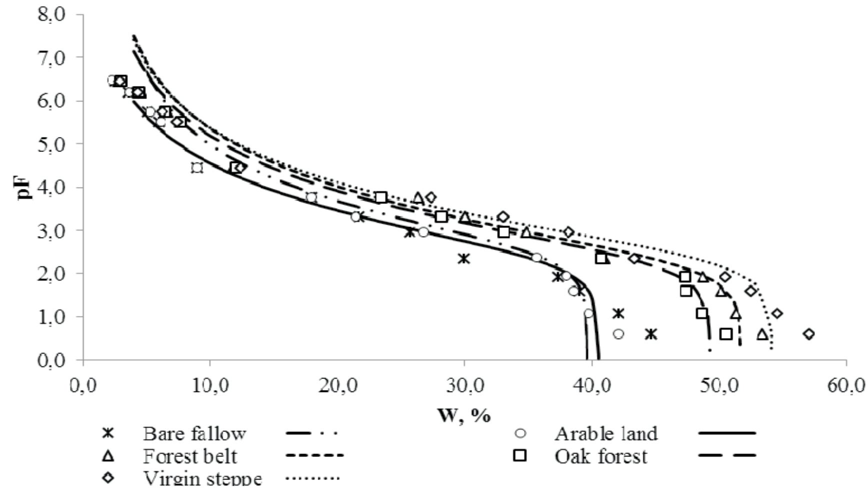

Fig. 1. The water retention curves of the typical chernozems of different land use

Water retention curves have the greatest distinctions in the field of high humidities and divided into two groups of curves: samples with the raised content of organic matter (a virgin steppe, a forest belt, a oak forest) settled down more to the right, in the field of larger humidities; curves of samples with the smaller content of organic matter (arable land and bare fallow) settled down more to the left, in the field of smaller humidities. As can be seen from the figure, the soil virgin steppe has the best water-holding capacity, the worst - the arable soil and bare fallow. Therefore water-holding capacity of rich OM soils is more, than poor.

Swelling curves of the studied soils are presented on fig 2. The greatest swelling characterizes the soil of the virgin steppe, further on decrease: oak forest >forest belt> bare fallow, arable land. Soil of virgin steppe has a maximum value of swelling, further values of swelling settled down in the following decreasing order: oak forest > forest belt > bare fallow > arable land. Apparently, the key role in swelling of the studied samples is played by organic matter. The swelling kinetics considerably differs by samples. Swelling speeds the studied samples settled down in the following decreasing order: virgin steppe > oak forest > arable land > bare fallow > forest belt. The noticeable delay of swelling occurs in soil of forest belt. Perhaps, it is connected with qualitative structure of organic matter.

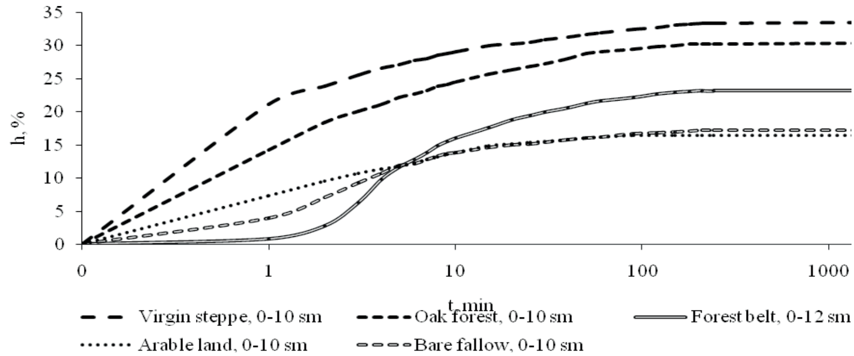

Fig. 2. The swelling of the typical chernozems of different land use

Integral z is a quantitative parameter that is calculated from AST to define stiffness degradation including the non-linear quasi-elastic state of soil. Resulting graphs from conducted AST are plotted as tan δ (γ), where dimensionless loss factor tan δ is the ratio of loss modulus G'' (Pa) (=viscous constituents) to storage modulus G' (Pa) (=elastic constituents), representing the stiffness degradation in a visco-elastic material such as soil
(Baumgarten et. all, 2013). Integral characteristics of the rheological behavior - zone z (Table 1) shows the total area of the elastic and plastic behavior before the transition to viscous flow. On resistance to loadings the studied soils were distributed as follows: virgin steppe > oak forest > forest belt > arable land > bare fallow, according to the contents of OM.
Thus, resistance of structure to loadings, water absorbing and water-retaining abilities of soils are defined by the content of organic matter of soils.

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Types and distribution of soil cover patterns with gilgai topography in Russia

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Introduction

Shrink-swell clay soils (Vertisols and Vertic soils) with particular microrelief gilgai are wide spread in tropics and subtropics in Australia [1, 2], India [3], Central Africa [4, 5], Northern America [6, 7] and many other places [8, 9]. The information on Vertisols and Vertic soils with gilgai topography occurrence in Russia is scarce [10, 11, 12].

Special investigation of soil cover patterns with gilgai topography is carried out in Russia in the last three years. The main aim of research is geographic distribution of soil cover patterns with gilgai topography in Russia, determination of soil properties and parameters of gilgai microrelief at different regions and systematization of types of these soil cover patterns.

Materials and Methods

An inventory of Vertisols and Vertic soils in Russia was performed in 2011-2015. The following procedure was used: the outcrops of swelling clays were recorded basing on published data on soils, parent materials and stratigraphy of sediments, as well as on soil, geological, topographic maps, and space images for the areas in European Russia between N44° and N56°. The chosen sites were supposed to have Vertisols and/or Vertic soils in their soil cover, and were planned as key sites for soil survey. The next step was field research comprising georeferencing the key sites, topographic measurements, detailed morphological description of soil profiles supplemented by photography. Open trenches were excavated to investigate the vertical section of the soil cover pattern with gilgai topography and to measure a number of morphometric characteristics of bowl- and diapir-like morphostructures in Vertisols. Special attention was given to the morphometric characteristics of slickensides, the presence of wedge-shaped structural aggregates, the depth of crack penetration, along with recording the features inherent to other soil processes (solonetz, gley, quasigley, zooturbation, accumulation of secondary carbonates, gypsum and salts, clay and silt illuviation). The soils were qualified in terms of the soil classification systems of the USSR [13], Russia [14, 15] and World Reference Base for Soil Resources [16].

Results and discussion

During the field research, 962 soil profiles were described, and many new areas of Vertisols and/or Vertic soils with and without gilgai topography were found in European Russia. Some results have been published [17, 18, 19].

There are seven regions in European Russia where areas with gilgai topography occur: (1) The Volga-Akhtuba Floodplain (Astrakhan oblast); (2) The second terrace of Volga River at the left riverside (south of Saratov oblast and north-east of Volgograd oblast); (3) The Khvalyn Plain at the right riverside of Volga River (south of Volgograd oblast); (4) The terrace of West Manych River (Rostov oblast); (5) Slopes of Kalach Upland (south-east of Voronezh oblast); (6) Kuban-Azov Lowland (Krasnodar krai); (7) The Yankul Depression (Stavropol krai).

About 300 gilgai areas exist at broad flat or slightly concave surfaces of the central parts of the floodplain with clay alluvium between lakes, anabranches, channels and oxbows at the Volga-Akhtuba Floodplain. At four regions (numbers 2, 3, 4 and 6), several decades of areas with gilgai topography occupy bottoms of large closed depressions (limans). At two regions (numbers 5 and 7), only four gilgai areas occur at slightly concave elevated surfaces.

Parent materials for these soil cover patterns are shrink-swell clays of different origin (marine, lacustrine, alluvial, loess-like clays) and age (Quartenary and Neogene). In accordance with WRB-2014, soils with gilgai topography are Vertisols, Vertic Solonetz and Vertic Stagnosols.

Thirteen types of soil cover patterns with gilgai topography are identified by conjugation of soils at micro-low, micro-slope and micro-high in gilgai. They are as follow (the sequence of soils from micro-low to micro-high):

(1) Pellic Vertisol (Humic, Stagnic) → Pellic Vertisol (Stagnic, Protocalcic);

(2) Pellic Protosodic Vertisol (Humic, Stagnic) → Pellic Sodic Vertisol (Humic, Stagnic, Protocalcic);

(3) Haplic Vertisol (Humic, Stagnic) → Haplic Vertisol (Stagnic, Protocalcic);

(4) Haplic Vertisol (Humic, Stagnic) → Haplic Bathygypsic Vertisol (Albic, Stagnic) → Chromic Bathygypsic Vertisol (Stagnic, Protocalcic);

(5) Endogypsic Vertisol (Stagnic, Protosodic) – all elements of gilgai;

(6) Pellic Endogypsic Vertisol (Humic, Stagnic, Protosodic) – all elements of gilgai;

(7) Vertic Stagnic Solonetz (Clayic, Cutanic, Humic) → Sodic Vertisol (Stagnic, Protocalcic);

(8) Vertic Albic Stagnosol (Episiltic, Endoclayic) → Haplic Vertisol (Stagnic, Protocalcic);

(9) Nudinatric Vertic Stagnic Solonetz (Clayic, Cutanic, Humic) – all elements of gilgai;

(10) Vertic Protosalic Stagnic Solonetz (Albic, Clayic, Columnic, Cutanic, Humic) – all elements of gilgai;

(11) Vertic Albic Stagnosol (Clayic, Protocalcic, Protosodic) → Luvic Vertic Stagnosol (Clayic, Protocalcic, Protosodic);

(12) Vertic Albic Stagnosol (Episiltic, Endoclayic) → Luvic Vertic Stagnosol (Clayic, Protosodic);

(13) Vertic Stagnic Phaeozem (Episiltic, Endoclayic) → Vertic Stagnic Solonetz (Clayic).

Differentiation of soil cover patterns along gilgai microcatena is determined by three groups of processes. The first group is lateral swelling pressure, shear and inner plastic movement of subsoil material from micro-low to micro-high. The second group includes lateral surface movement of water and solids from micro-high to micro-low. The third group consists of vertical processes differentiation of soil horizons.

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Agroecological basis for the production of compost from organic waste

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Keywords: agriculture, soil fertility, compost, municipal solid waste, silt, cattle manure, straw, chemical composition.

Introduction

The main task of agriculture consists of what to provide further increase and stability of agricultural production, worldwide improve the efficiency of agriculture to better meet the needs of the population in food and raw material production. In agriculture, a special attention is given to organic fertilizers that increase crop yield and maintain soil fertility.

It is necessary to mark that in recent years the loss of humus in soil lead to a significant deterioration of soil fertility. For this reason, maintaining a balanced and positive balance of humus in the soil is the main task of agricultural science (Satarov et al., 1990; Khalikulov, 1996).

The lack of ready organic fertilizer makes to seek deposits of various organotherapy waste to produce organic fertilizer. The waste is the silt (sludge fresh water), lake sediment (sapropel), municipal solid waste, waste of food and biochemical industry, etc. The use of waste in agriculture as organic fertilizer solves several problems at once: Improving soil fertility, high crop yields protection of environment, creation of non-waste technologies, cost-effective productions.

For conditions of irrigated soils, where there is an acute shortage of humus and organic fertilizers, it is especially important to study the possibility of production of compost made from organic waste.

Materials and Methods

Were studied municipal solid waste (MSW), cattle manure, silt (sludge fresh water) and straw.

Based on the chemical composition and biological properties of the waste were selected following ratio of compost:

Compost-1: cattle manure-50%, MSW - 20%, Straw- 10%, silt -20%.
Compost-2: cattle manure-40%, MSW - 20%, Straw- 10% , silt -30%.
Compost-3: cattle manure-30%, MSW – 20%, Straw- 10% silt -40%.

Analysis of the components and composts were carried out using methods generally accepted in agricultural chemistry and soil science. In different organic wastes and composts determined the total nitrogen by Kjeldahl method, nitrate nitrogen by colorimetric method with desulfo-phenol acid by the Grandvalja-Ljaschu, ammonia nitrogen - 0.05 g of HCl by distillation, total phosphorus – wet ashing with sulfuric and nitric acid with subsequent determination on fotoelektrokalorimetry type FEC-M, total potassium – was measured by flame photometer, heavy metals by atomic absorption spectroscopic method, carbon – by Tyurin, pH- potentiometric method, ash content- according to the standard technique by calcinations at 400-450^{0}C (The methods agrochemical, agrophysical and microbiological researches in the field of cotton areas, 1963).

Results and Discussion

For the production of composts were studied following types of organic waste: municipal solid waste, cattle manure, silt and straw (winter wheat). Agronomic value of compost as organic fertilizer mainly to inflate the chemical composition and biological properties of organic waste components of the compost. Analysis of chemical composition of organic waste indicates that the waste differ significantly from each other.

Table

The chemical composition of wastes and composts, % by weight

Wastes	pH	Dry matter	Ash	Carbon	Total nitrogen	C:N	Total phosphorus	Total potassium
MSW	7,2	43,8	7,9	11,1	0,30	37,0	0,24	0,75
Cattle Manure	7,4	34,7	4,6	12,5	0,57	-	0,16	0,61
Straw	7,0	17,1	22,0	20,3	0,28	72,1	0,09	0,69
Silt	6,0	73,9	87,1	2,5	0,12	22	0,13	2,01
Compost-1	6,9	-	21,7	10,1	0,40	25	0,158	0,90
Compost-2	6,4	-	23,8	8,8	0,36	24	0,155	1,03
Compost-3	6,3	-	38,0	6,1	0,30	20	0,150	1,20

The data tables show that cattle manure, straw is the richest in carbon. Municipal solid waste and cattle manure richest in phosphorus and potassium.In this composition and ratio of the components can produce composts with a more balanced composition regarding nutrients. The increase in compost in the proportion of silt fresh water and decrease in the proportion of cattle manure and straw leads to a certain reduction in carbon.

The decrease in the proportion of the cattle manure reduces nitrogen and straw increases the amount of potassium, practically does not change the content of phosphorus. All kinds of compost after biothermal processing represent organic mass of dark grey light with a specific smell.

The table data shows that the compost-1, the content of nitrogen and phosphorus is greatest in the compost-2 and compost-3 decreases their content. The increase in the compost gave the silt of fresh water increases the potassium content. The ratio of C:N is 20-25. This indicator is one of the most important factors for biological decomposition. The low ratio of C:N causes the loss of nitrogen, and when the ratio is above 35 slowing the process of decomposition of organic matter (Gladkova, 1979; Afanasiev, Miller, 1986).

Wastes differ in content of microelements and heavy metals. The heavy metals are less contained in the straw, and a high content of different MSW. If the straw is taken as a basis, MSW is 22 times more chromium, 6,8 zinc, 6 times more lead, 2,3 times more manganese, 4,2 times of cadmium. However, the contents of heavy metals in composts can be seen that three types of composts to have almost the same chemical composition on heavy metal, with small variations depending on the amount of manure and sludge fresh water in the compost.

Conclusion

Therefore, cattle manure, municipal solid waste and straw enriched composts organic matter and nutrients. Silt of fresh water increases the content of potassium. From this it follows, from these wastes composts obtained with a more balanced composition of nutrients. The composting process allows for the dilution of waste, to reduce the chromium content in composts in 3,5 times, zinc in 2,7 times that of lead in 1,6 times, manganese 1,2 times etc. Heavy metals in composts prepared contained within the threshold limit value (TLV). The quality of compost as organic fertilizer can be controlled by modeling the composition of components with respect to the positive and negative qualities of waste. The composting will increase the stock of organic fertilizers and reduce environmental hazard of accumulated waste.

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The soil microbial activities influenced by hazelnut husk compost application

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Key words: Hazelnut, compost, soil, microbial properties

Introduction

"The Green Revolution" in agriculture which aimed to produce as much as possible in 1960-70's is no longer in trend. In today's world of 21st century, high quality production is the widely accepted approach in plant production. In late 1970's, people in mass started to become conscious of the negative effects the industrial agriculture left on environmental health. During these years, detecting chemical fertilizer residues both in underground and overground water supplies and revealing the harmful effects of pesticide residues found in food substances consumed by people started the process of questioning the industrial/traditional agriculture methods. In 1980's and 1990's, it was discovered that intensive chemical use in agriculture, which was promoted by traditional agriculture, and monoculture mode of production negatively affected the natural flora and fauna balance of soil and accelerated the sterilization process of soils. Thus, the process of searching for new approaches in agricultural production, which will be respectful towards natural balance and will give nature the opportunity to renew itself, speeded up. These searches brought about new approaches in agricultural production which are referred as "sustainable agriculture", "ecological agriculture" or "organic agriculture" and helped the applications, which question the commonly used agricultural production modes and is completely based on quality management.

The producers, who preferred environmental friendly agriculture systems by emphasizing on the environmental and human health, had to use some alternative products with organic origins that could replace agricultural inputs such as chemical fertilizers and pesticides; and had to increase the effectiveness of the products used. For this purpose, they firstly had to use compost products, which have been used for centuries to increase the level of soil organic matter (SOM). Approximately 600–650 thousand tons of hazelnuts are produced annually on 621,000 ha in the Black Sea Region of Turkey. At the end of the hazelnut harvest, nearly the same amount of HH residues remain as agricultural waste. Dried hazelnut husk has 93.16% organic matter content. Moreover, hazelnut husks are suitable for agricultural use in terms of their pH and salinity. In terms of nutritional elements, while nitrogen and phosphorus were inadequate as limit values, potassium and micro-elements were adequate. Husk is difficult to decompose as it has a high C/N ratio (> 50/1). After mixing hazelnut husk into soil, it can take about 2 or 2.5 years for microbial processes to decompose it. Therefore, HH must be applied soil after composting to increase SOM level and nutrient availability in soil.

In this study, in order to determine the changes in the soil microbial activities when the hazelnut husk compost (HHC), which is obtained through composting HH by using molecular biotechnological methods (Kızılkaya et al. 2015a,b), is applied on the hazelnut orchard soils with different textures at increasing levels (0, 1.25, 2.5, 5.0, 7.5 and 10 ton da^{-1}); were investigated.

Materials and Methods

HH (C/N ratio 55.71; pH 5.81; EC $_{25°C}$ 1.93 dSm^{-1}; 0.97% N) was collected from the hazelnut orchard as a waste material, was inoculated with this HH, C and the microorganisms used as an energy source (Kızılkaya et al., 2005a,b), was composted by "windrow method" and was used as a material in experiments using a windrow machine in the Research Facility of Soil Science and Plant Nutrition Department in Ondokuz Mayis University, Samsun, Turkey. HHC properties are as follows: pH is 6.76, EC 25°C is 3.56 dS m^{-1}, organic matter (OM) content is 94.75%, total N content is 2.48%, and C/N ratio is 22.16. Field experiments were conducted in two different hazelnut orchard with different textures (sandy loam - sand% 76.14, silt% 9.62, clay% 14.24, pH 6.23, $EC_{25°C}$ 0.04 dSm^{-1}, SOM 1.41%- and clayey loam - sand% 33.55, silt% 27.86, clay% 38.53, pH 6.69, $EC_{25°C}$ 1.43 dSm^{-1}, SOM 2.58%-) soil located in Ordu at the Black Sea Region of Turkey. In the experiments conducted in both hazelnut orchards in November 2013 that were based on and carried out in accordance with randomized complete block design. HHC was incorporated into the top 20 cm of the soil around the plant canopy without mixing any other material using a hoe in six application doses with 3 replication. Each experiment was made up of 18 parcels and total experiment consisted of 36 parcels in order to increase the content of SOM by 0, 0.5% (1.25 t da^{-1}), 1% (2.5 t da^{-1}), 2% (5 t da^{-1}), 3% (7.5 t da^{-1}) and 4% (10 t da^{-1}). Soil sampling was done with three replicates after nine months (August 2014) to determine soil microbial analyses. Some soil microbial properties were determined on the soil samples taken from 0 to 20 cm at the end of the experiments as follows: microbial biomass carbon (C_{mic}), basal soil respiration (BSR) total organic carbon (TOC), C/N ratio, total N (TN) and C_{mic}/C_{org} ratio. The experimental data subjected to ANOVA test and statistical differences among treatment means by LSD test were analyzed using SPSS Statistic 11.0 program.

Results and Discussion

The applications of increasing levels of HHC significantly affected soil microbial activities in the 0–20 cm soil layer in a hazelnut orchard soils with different textures. HHC treatments showed significant increments in soil microbial activities according to the control after 9 months of application (Table 1, 2). It was found out that due to the increases in the dose of CHH applied on soils with different textures, while the soils' C_{mic}, BSR, TOC, and TN contents increased their C/N ratio and C_{mic}/C_{org} values decreased (Table 1 and 2). The change HHC application caused on the microbial properties of soils was found to be more distinct in sandy loam soil. In the studies carried out in a similar manner, the organic materials applied on the soils increased the biological properties of the soils.

The most significant function of soil microflora is the resolving of OM. The content of C_{mic} varies between TOC's 1-3%, and consists of an important live part of SOM. This rate in agricultural soils depends on environmental factors such as aeration of soil and moisture content. The main factor affecting this rate is adding organic wastes, which serve as a nutritional source for soil microorganisms, into soils. While C_{mic} amount in TOC decreases when this rate increases; and C_{mic} amount increases when this rate decreases. Therefore, it is clear that neither TOC nor C_{mic} on their own can be a parameter in decomposition and fragmentation of organic substances applied on the soils.

Table 1

The changes soils created on Cmic, BSR, and TOC contents after the application of HHC

Soil	Application doses, t da^{-1}	Cmic (mg CO2-C 24h^{-1}g^{-1})		BSR (mg CO2 24h^{-1} g^{-1})		TOC (%)	
Sandy laom soil	0	187.31	± 2,51 C	0.15	± 0,02 D	0.83	± 0,02 D
	1.25	131.78	± 8,53 D	0.20	± 0,02 D	1.29	± 0,03 E
	2.5	187.20	± 3,17 C	0.40	± 0,01 C	1.74	± 0,02 D
	5	195.43	± 2,49 C	0.48	± 0,02 C	2.73	± 0,02 C
	7.5	220.21	± 8,42 B	0.73	± 0,04 B	3.71	± 0,08 B
	10	334.96	± 7,23 A	1.08	± 0,06 A	4.63	± 0,03 A
Clayey loam soil	0	117.04	± 2,60 F	0.24	± 0,03 E	1.46	± 0,09 F
	1.25	138.12	± 5,73 E	0.31	± 0,01 E	2.02	± 0,09 E
	2.5	181.12	± 3,83 D	0.54	± 0,05 D	2.47	± 0,11 D
	5	218.85	± 2,16 C	0.76	± 0,01 C	3.37	± 0,09 C
	7.5	242.24	± 6,66 B	0.97	± 0,06 B	4.44	± 0,05 B
	10	320.37	± 8,99 A	1.52	± 0,11 A	5.37	± 0,03 A
Statistical Analyses		Statistical Analyses	LSD (1%)	Statistical Analyses	LSD (1%)	Statistical Analyses	LSD (1%)
	Soil type (S)	12.417***	5.220	319.843***	0.034	990.745***	0.063
	Doses (D)	927.846***	9.041	778.619***	0.059	2944.093***	0.109
	S x D	58.393***	12.786	19.531***	0.084	0,820ns	----

(*** P<0,001, ** P<0,01, * P<0,05, ns No significant)

This is because the organic compounds added into the soils will undoubtedly increase the TOC compass of the soils. However, there is some meaning to the fact that C_{mic}, which decomposes these organic wastes, increases at the same time. Similarly, if the nutritional source of the biomass is not added to the soil setting while the cultural processes applied on the soils increase Cmic; this increased C_{mic} will affect the soil fertility and sustainability to a limited extent for only a short period of time. That's why, it is of great importance from microbiological point of view that TOC and C_{mic} increase in a balanced manner as a result of adding organic substances into the soils.

Table 2

The changes soils created on total N, C/N rates and C_{mic}/C_{org} values after the application of compost of hazelnut husk (*** P<0,001, ** P<0,01, * P<0,05, ns No significant)

Soil	Application doses, t da^{-1}	Total N (%)		C/N		C_{mic}/C_{org}	
Sandy laom soil	0	0.15	± 0,01 D	5.45	± 0,52 E	22.62	± 0,97 A
	1.25	0.16	± 0,01 D	7.90	± 0,54 D	10.24	± 0,69 B
	2.5	0.22	± 0,01 C	8.11	± 0,24 C	10.74	± 0,15 B
	5	0.24	± 0,01 B	11.24	± 0,52 B	7.17	± 0,03 C
	7.5	0.25	± 0,01 B	14.60	± 0,54 B	5.94	± 0,20 D
	10	0.29	± 0,01 A	16.04	± 0,43 A	7.24	± 0,21 C
Clayey loam soil	0	0.22	± 0,01 F	6.72	± 0,49 D	8.01	± 0,48 A
	1.25	0.27	± 0,01 E	7.40	± 0,21 CD	6.83	± 0,32 BC
	2.5	0.31	± 0,01 D	8.05	± 0,57 C	7.34	± 0,47 AB
	5	0.37	± 0,00 C	9.15	± 0,18 B	6.50	± 0,12 BC
	7.5	0.43	± 0,02 B	10.26	± 0,34 A	5.46	± 0,21 D
	10	0.51	± 0,02 A	10.47	± 0,33 A	5.96	± 0,19 CD
Statistical Analyses		Statistical Analyses	LSD (1%)	Statistical Analyses	LSD (1%)	Statistical Analyses	LSD (1%)
	Soil type (S)	1530.919***	0.010	198.821***	0.377	857.945***	0.382
	Doses (D)	372.368***	0.017	299.880***	0.653	441.203***	0.662
	S x D	46.292***	0.023	64.967***	0.923	261.478***	0.936

In the control dose of sandy loam soil, on which HHC was not applied, while their C_{mic} content consisted of a high percentage as 22% of TOC (C_{mic}/C_{org}); in the parcels, on which HHC was applied, this rate declined up to 7%. The 5 ton da-1 dose, in which C_{mic}/C_{org} ratio becomes stable, was found to be the most convenient dose for sandy loam soil. This dose is enough to increase the TOM rate in sandy loam soil by 2%. While in the experiment carried out on the clayey loam soil, C_{mic}/C_{org} was amounted to 8% in the control application; in the HHC application this rate declined, however, this decline was not so obvious as it was in the sandy loam soil. In the field experiment of sandy loam soils, while all HHC doses declined at a significant level for control, the differences among HHC doses were not considered to be important. Eventually, it was concluded that the most convenient level of HHC to be added into the soils is 5 t da^{-1}, considering the microbial activity in the soils and consequently the management principles of the organic substances added into the soils. However, TOM content of soils after HHC application is of importance. For this reason, it is suggested that after HHC application TOM level be 4.5% in sandy loam soil (coarse textural soil), and 3.5% in clayey loam soil (fine textural soil) during the application of HHC.

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Accumulation of carbon in dead organic matter on the soil surface in the middle taiga of middle Siberia

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Key words: litter, coarse woody debris, larch forests, conifer plantations

Carbon in forest ecosystems is accumulated in the biomass of plants, mort mass and soil. Soil surface dead organic matter is a complex of dead plants and fractions of components of plants. A special fraction of dead organic matter are coarse woody debris (CWD), which are characterized by relatively complex available for colonization by decomposers, the high concentration of mass per unit volume and low specific surface of contact with the environment. According to ecological conditions and forest species, the residence time of carbon in the litter layers from the top down can be from 1 to 700 years and for CWD from 100 to 500 years [2]. The carbon sequestration in boreal forests in the zone of the permafrost zone coarse woody debris plays a special role, due to the slow and seasonally-depressed organic matter decomposition, hindering the return of carbon to the atmosphere [4, 5]. In the final stages of decomposition trees, which had lost its original shape and density belong to the faction fermentation of forest litter.

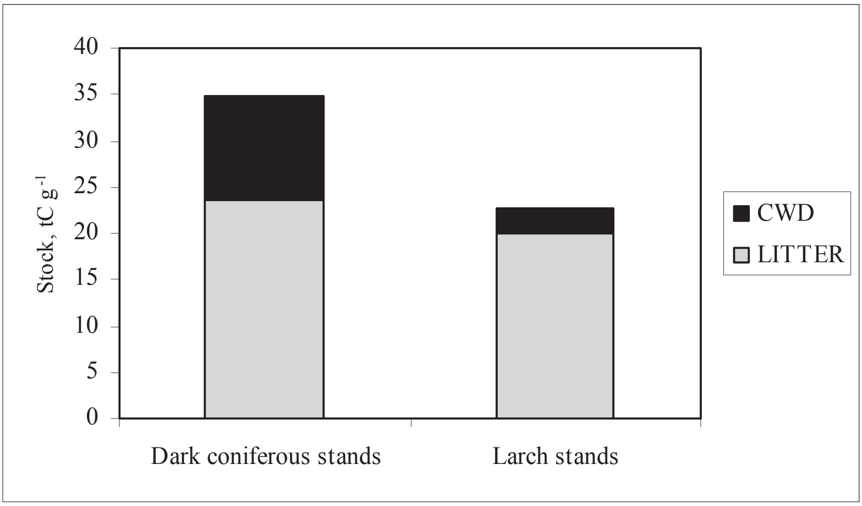
Data on carbon stocks in dead organic matter in the zone of the permafrost zone, in forests with low economic involvement, which mainly perform environmental and environment-stabilizing function, is clearly insufficient, and this determines the relevance of research on this the problem in the boreal zone.

The aim of this work is to estimate the accumulation of carbon in litter and coarse woody debris in the prevailing forest type groups in the middle taiga zone of discontinuous distribution of permafrost in Central Siberia.

The research was conducted in the Baikit forest district mountain taiga forests [1] in the middle reaches of the Podkamennaya Tunguska. The predominant areas of the plantations are larch (55%) and a dark coniferous (31%) uneven-aged forest, which is largely represented mature and over-mature communities. In this work the study of carbon stocks in dead organic matter was conducted in a 200 year old spruce-pine planting moss group of forest types and 200-year-old larch shrub-moss.

The total stock of carbon stored in dead organic matter on the soil surface over-mature conifer plantations is 34.8 tC ha-^{1} and coarse woody debris 11.3 tC ha-^{1} (Fig.1), at stumps accounts for about one third of the reserve CWD. Coarse woody debris is concentrated around a third of carbon on the surface of the soil. According to the average diameter of the CWD at 15cm, with an average diameter live tree stand 21cm tree mortality occurred as a result of natural competition in the development process of succession after a fire.

In the larch plantation, the accumulation of carbon in all mort-mass amounted to 22.6 tC ha-[1], while at CWD accounting for 11%. In the composition of the MLC 78% are the major branches of the larch, due to the high frequency of fires, which burn previously fallen away tree trunk. The larch planting was subjected to repeated low and medium effects of ground fires [3], which did not lead to the death of the most dominant tree layer, which is established by the presence of fire damage many over-mature living trees and the lack of fire damage at a small number of stands. As a rule, in the fires of low and medium intensity stands of larch slightly damaged, due to its high resistance of larch to pyrogenic factor. As a result dendrochronological analysis of fire damage living trees found that the



most severe effects of fire on the larch has been about 130 years ago.

Fig. 1. Accumulation of carbon in dead organic matter in coniferous and larch stands

Dark coniferous and larch plantations contain similar amounts of carbon per litter stocks, which are respectively 20 and 23 tC ha-[1] (Fig.1). A higher frequency of fires in larch ecosystems leads to a decrease in carbon stocks of litter, with higher productivity of larch plantations leads to comparable to the value of the reserves of dead organic matter with dark coniferous planting in over-mature phase successions.

Thus, over-mature coniferous plantation contains carbon in dead soil organic matter in 1.6 times and in coarse woody debris and 4.5 times more than in larch plantation of the same age. Large differences in the amount of carbon attributable to CWD studied plantations are associated with the highest frequency of fires in larch ecosystems. In the absence of a strong high-intensity forest fires that occur in extremely dry years, the spruce-cedar ecosystem in the litter accumulates the amount of carbon comparable to the carbon in all terrestrial dead organic matter of larch.

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Rheological properties of disturbed and undisturbed samples of soddy-podsolic soils

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Key words: soil physics, soil structure, storage and loss modulus, linear viscoelastic (LVE) range, crossover (yield point)

Introduction

The rheological behavior of soils under strain is in most cases investigated in laboratory on the pounded samples of soils in the pasty form. In this case potential ability of soil particles to interpartial interaction is estimated. However, it is a great interest to investigate natural structural contacts in samples of the soil. The amplitude sweep test applied by MCR-302 rheometer (Anton Paar, Austria) [2, 3, 4, 5, 6] allows to investigate rheological behavior both in soil pastes, i.e. in the disturbed samples, and in monolithic samples, i.e. undisturbed samples.

Materials and Methods

Objects of our research were monolithic and bulk samples of the soddy-podsolic soil, (Albeluvisol, WRB), which were taken on an experiment field of Soil institute named V. V. Dokuchayev (Moscow region, July, 2014). Horizon samples: Ap, A2, A2B, B1, B2, BC. Determination of texture of soil samples was carried out by the laser diffractional analyzer «Analysette 22 comfort" [1]. Determination of the total carbon content in the soils was carried out by express analyzer AH-7529 [1]. Determination of specific surface was carried out by BET method [1]. Rheological parameters of soil pastes and monoliths were determined in state of daily capillary moistening. The following indexes were determined: storage and loss modulus G' and G", linear viscoelastic (LVE) range, crossover (crossing of the modules or yield point) [4, 5, 6]. Technical parameters of experiments: gap ~ 2-4 mm, plateau diameter 2.5 cm, shear deformation γ – 0.001 – 100%,angular frequency f – 0,5Hz, quantity of measured points – 30, sample temperature was supported on constant level 20^{o}C by Peletier elements. In this work we carried out the investigations with control of normal force NF<10 N. All rheological parameters were determined in three to six times. Statistical treatment of data was carried out in STATISTICA program. Median values of obtained parameters are used in the discussion. Moisture of investigated samples was determined by weight method after the amplitude sweep test using the moisture analyzer MX-50.

Results and discussion

Results of the research of some properties of soddy-podzolic soils are presented in the Table 1.
The increasing of silt fraction content with depth of profile is observed. The silt content is much less in the eluvial horizon (Table 1).The texture is silt in the international classification (USDA).The total specific surface values increase with depth, this fact is probably due to the increase of silt content. There is the correlation of the total specific surface values and the clay fraction content with a correlation coefficient r = 0, 87. The total carbon content greatly decreases down the profile. However, even in the upper humus horizon its content is low - 1.06%.

Table 1

Some properties of soddy-podzolic soil

Horizon, depth, thickness, cm	Silt content (<0.001mm),%	Physical clay (<0.01mm) ,%	Specific surface,m^2/g	Total carbon content, %	Moisture of monolith, %	Moisture of paste, %
Ap (0-36/36)	2.93	40.84	46.71	1.06	25.36	47.86
A2 (36-42/6)	1.51	27.31	56.66	0.12	21.35	38.16
A2B (42-51/9)	3.85	39.34	68.49	0.22	19.96	46.84
B1 (51-80/29)	4.82	43.74	112.15	0.23	24.65	52.16
B2 (80-129/49)	5.99	47.32	116.07	0.18	26.4	50.37
BC (>129)	6.19	50.06	176.13	0.14	35.23	53.29

It was found as a result of rheological research (Fig. 1 1-3) that initial storage modulus G ' of monolithic samples is significantly higher than storage modulus in pastes; in both cases there is the maximum in the A2B horizon. This is probably due to the fact that the interparticle contacts in monolithic samples are stronger than in the pastes. There is the certain hardening peak of the A2B horizon in both types of samples, possibly due to the fact that the dilatant hardening of horizons depleted of silt fraction takes place. Linear viscoelastic (LVE) range or stability of structural contacts of pastes to deformation has higher values than LVE-range values of monoliths. The paste samples of the horizon BC has the biggest linear viscoelastic range, possibly due to the increasing of the silt content. It is worth noting that, in general, a small linear viscoelastic range is characteristic both bulk samples and monoliths.
The structure destruction or the crossing of the modules (Crossover) in pasty samples is achieved under higher values of strain than in the monolithic samples.
Monolithic samples of BC horizon and pasty samples of B1 horizon are the steadiest. We can say that pasty samples of horizons have a more elastic behavior than monolithic samples. Perhaps this is due to the fact that the monolithic samples having

stronger natural interparticle contacts pore space and behave as a frail body under the influence of external strain, or that the daily capillary moistening of monoliths was not enough to achieve a full filling of the capillary pores. The following correlations between the rheological parameters and the basic physical properties of the pasty samples were obtained: there is a direct correlation between the values of LVE-range with the silt fraction content (r = 0.88) and the specific surface values (r = 0.91). The inverse correlation is observed for values of initial storage modulus G` and specific surface (r = -0.70), Crossover (point of crossing of storage and loss modulus) and the total carbon content (r = -0.92). For monolithic samples obtained correlation coefficients do not have intimate correlation between the rheological characteristics and properties indicated above, which is probably due to the fact that the monolithic samples of the rheological behavior is largely caused by the structure of the pore space.

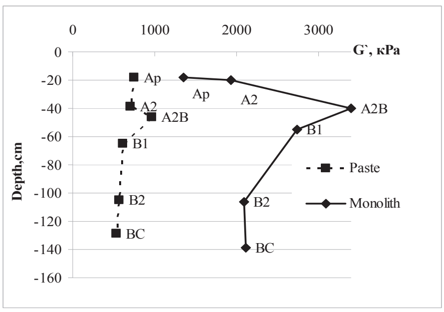

Fig.1. Initial storage modulus G`

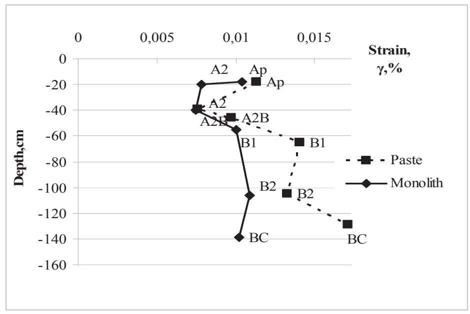

Fig.2. Linear viscoelastic range (LVE-range)

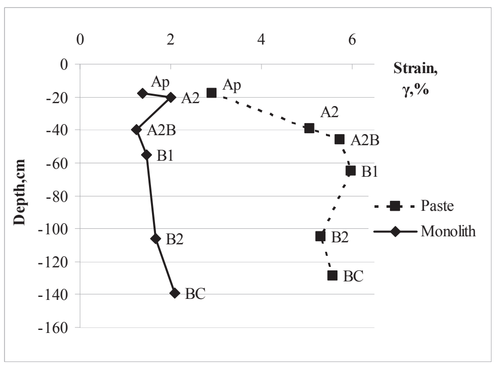

Fig.3. Crossover (point of crossing of the modules)

Conclusions

1. Application of amplitude sweep test established that monolithic and pasty samples are characterized by different rheological behavior: the monolithic samples with higher strength of natural structural contacts under strain behave as fragile body,

while the pasty samples with less strength of structural contacts behave like a plastic body.
2. There is the direct correlation values of LVE-range with the silt fraction content and the specific surface values for pasty samples. The inverse correlation is observed for values of the initial storage modulus G` and the specific surface, Crossover and the total carbon content.

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Microbiological bioremediation of the forest nurseries soils

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Key words: introduction, microbes-antagonists, ecological-trophic groups of microorganisms, enzymatic activity, soil biogenous.

Introduction

In the soils of Siberian forest nurseries a violation of the intensity and direction of microbiological processes, playing a fundamental role in the soil due to the systematic use of agrotechnical and chemical methods of plant protection. Therefore, recent promising approach is the introduction of microorganisms-antagonists in the environment to recover (bioremediation) of the soil and increase its productivity in forestry. Microorganisms-antagonists increase the soil biogenous, improve its phytosanitary condition, suppress phytopathogenic forms of microorganisms and produce biologically active and growth-stimulating substances. In this regard, were conducted research in the experimental nursery, to study the effect of presowing treatment of conifers seeds (Scots pine and Siberian larch) of biologically active strains of microorganisms on the safety, viability, morphological characteristics of the seedlings and increase of the soil biogenous.

Materials and methods

Laboratory seed germination of Scots pine (*Pinus sylvestris* L.) and Siberian larch (*Larix sibirica* L.) were determined according to the methods (Voznyakovskaya, 1969; Klintsare, 1970).
The required concentration (titer of 10^9 spores / ml) of antagonist microorganisms (*T. harzianum*, *Bacillus* sp. *Bacillus subtilis*, *Pseudomonas* sp.) received in the laboratory according to the methods (Voznyakovskaya, 1969). Presowing treatment of Scots pine and Siberian larch seeds by microbes-antagonists was conducted by the method (Novoseltseva, Smirnov, 1983). The coniferous seads treated with KMnO4 and soaked in sterile water (H2O) were used as control.
Field experiments for studying the effects of microbial antagonists on the growth and development of coniferous seeds were conducted at the experimental nursery Pogorelsky station f V.N. Sukachev Institute of Forest SB RAS. Experimental plots were seeded at 150 seeds, which were sown in three rows in three replications. The versions of the experiment were: 1) Control (H_2O); 2) *Bacillus* sp.; 3) *Bacillus subtilis*, 4) *Ps.* sp.; 5) *T. harzianum*. The counting of seedlings were measured monthly throughout the growing season (June-September), and in September of 10 seedlings were selected for biometric research. Every month, at the time of sampling, we measured the temperature of air and soil at each site using a portable thermometer "Hanna Checktemp 1"; soil moisture was determined by the traditional method; the

values of pH - using a portable potentiometer Akvilon-410". Ecological-trophic groups of microorganisms (ETGM) were determined by conventional methods (Workshop on..., 1976; Workshop on..., 2005); study of soil enzymatic activity was done by the methods (Khaziev, 2005). Microbial biomass and the rate of basal respiration were assessed by substrate–induced respiration (SIR) with help of the gas chromatograph Agilent Technologies 6890 N Network GC (USA) (Methods of soil..., 1991; Ananyeva, 2003; Anderson, Domsch, 1978).

Results and discussion

The mass germination of coniferous seeds was observed one month after planting (June). Depending on the treatment, the ground germination of pine seed ranged from 31 to 53%, larch - from 4 to 31%. The maximum amount of germination of seeds of pine and larch was in versions with *Trichoderma harzianum* and *Ps*. sp., that exceeded the control of 1.7 (at pine) and 4.5 times (at larch). Strong drying of the soil during the growing season 2012 have led almost to complete mortality of seedlings, but despite this, at the end of the season (September), the number of seedling to the processing of *T. harzianum* exceeded the control of pine in 12.5 times, larch – 1.3 times, and when processing bacteria of *Ps*. sp. exceeded the control of pine seed in 10 times, larch in 1.3 times.

Presowing treatment of coniferous seeds different impact on the morphometric parameters of seedlings. Treatment of seeds of pine and larch *Ps*. sp. and *T. harzianum* increased the length of the stem and root collar diameter of 1.3 times compared with the control, the root length increased the processing of bacilli (*Bac.* sp. and *Bac. subtillis*) 1.4 (at pine) and 1.7 times (at larch). Thus, the greatest positive effect on the safety and morphometric characteristics of Scots pine seedlings had a seed treatment of *T. harzianum*, *Ps*. sp. and *Bac. subtilis*, Siberian and ones of Siberian larch – *T. harzianum* and *Bac*. sp.

The number of ecological-trophic groups of microorganisms (ETGM) under the sowing the conifers seeds during the vegetative period varied depending on humidity, temperature and soil pH, and from treatment variants. In June-July in soil under sowing of coniferous the oligotrophic microorganisms dominated in all variants of treatment except of *T. harzianum* for pine and bacilli (*Bac*. sp and *Bac. subtilis*) for larch. In August, the oligotrophs continue to dominate, but at the same time, the increase of the number of kopiotrophic was observed. By the end of August, in the variants of *Ps*. sp. and *T. harzianum*, as under the pine and larch, kopiotrophic was dominate group of microorganisms. The number of hydrolytic complex of microorganisms during the growing season (July-September) decreased from 2.7 million to 0.5 – 0.9 million CFU / g of soil. The intensity of the microbiological mineralization of the soil during the vegetative period (until September) was reduced, in comparison with previous year (2011). The values of oligotrofic (K_{OLIG}) coefficient in the soil under sowing of pine and larch were higher values of the mineralization coefficient (K_{MIN}) on average 1.3-1.4 times.

The most important indicators of soil activity are the values of microbial biomass (MB) and the rate of basal respiration (BR), which, together with the microbial metabolic coefficient (qCO_2), determine the ecophysiological status of the soil microbial community and give a qualitative assessment of the soil (Harris, 2003).

During the vegetative period, the values of MB, in general, decreased, depending on the temperature, humidity and soil pH, almost all variants of the experiment as under pine and larch (1.3 times), except for variants with *Bac*. sp. and *Bac. subtilis*. The intensity of microbial respiration, high for three months under coniferous, in September decreased by 1.5 times, which is reflected in the values of qCO_2 and BR. The maximum values of qCO_2 during the vegetation period observed in the control; minimum – in versions with *Bac*. sp. (for larch), and *Bac. subtilis* (for pine). Thus, the bacilli positive impact on the recovery of the ecophysiological rules of functioning of the microbial community in the soil under coniferous seedlingas of experienced nursery.

Analysis of the enzymatic activity (invertase, protease, urease, phosphatase) of the dark gray soil of experienced nursery showed a change in the activity of hydrolases in the soil samples depending on the treatment of conifers seeds. By the end of the vegetative season (September) under the sowing of Scots pine an increase in the content of phosphatase (1.4 times) was observed, while the activity of other enzymes (invertase, urease and protease) decreased in 1.2 times. We observed the increasing the content of urease (1.7 times), and reducing protease and invertase activity (1.3 and 1.1 times, respectively) under the larch at the end of vegetation season. The treatment of pine seeds of all variants of microbes antagonists treatments increased of protease activity (by 1,2-1,7 times) in relation to control. In addition, in the variant of *Bac*. sp. treatment in the soil under pine the urease activity increased (1.3-fold) too. In the soil under sowing of larch seed the pre-treatment of all variants of the experience the invertaese activity increased, and variants of *Ps*. sp. and *T. harzianum* phosphatase and urease activity increased (by 1,8 times), in comparison with control.

Conclusions

1. Presowing treatment of coniferous seeds by microbes-antagonists (*Bacillus* sp. *Bac. subtilis*, Pseudomonas sp. and Trichoderma harzianum) increased soil germination of Scots pine (1.5-1.7 times) and Siberian larch (1.3 to 5.8 times); by the end of the vegetation it has improved the safety and quality of viable pine (1.4-11,0) and larch (1.3-3.5 times) seedlings compared with the control.
2. The best safety of conifer seedlings at the end of the vegetation observed in treatment variants of *Trichoderma harzianum* and *Pseudomonas* sp. Treatment of pine seeds by strains of *Ps.* sp. and *Bac. subtilis*, larch – *T. harzianum* and *Bac*. sp. improved morphometric characteristics of seedlings in 1.5-2.0 times.
3. The dominance of oligotrophic groups of microorganisms throughout the growing season, expressed by prevalence ratios of oligotrophic (K_{OLIG}) coefficient over mineralization (K_{MIN}) coefficients in 2,0-2,5 times, shows a decline of intensity of mineralization processes due to adverse weather conditions (low humidity, high temperatures of soil and air) of the vegetation.
4. Introduction of the populations of spore bacteria (*Bac. subtilis* and *Bac*. sp.) and of micromycetes (*T. harzianum*) together with conifers seeds increased the soil biogenous and productivity in the nursery (MB, enzymatic activity, the number ETGM) in 1.5-3.0 times compared with the control.
5. Entering of bacteria Bacillus into the soil of nursery favorably impacted on the recovery of ecophysiological rules of functioning of soil microbial community, that

confirmed by the values of the coefficients of the specific microbial respiration (qCO_2) during the vegetative season.

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Contamination of soil and vegetation cover due to emissions of mining and metallurgical enterprises

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Keywords: pollution, erosion processes, heavy metals, accumulation, migration.

Abstract. Pollution sources, zones of emission impact of Ridder zinc factory in EKR, area of pollutants spreading have been determined. Condition of soil and vegetation cover of the areas around the zinc factory. Researches have shown a negative impact on soil and vegetation. For example, large areas of soil adjacent to the zinc factory are subject to erosion processes. Erosion is displayed as flush from soil surface, and formation of deep furrows and gullies. The soil surface over a large area is devoid of vegetation. Analytical data made it possible to determine the concentration of heavy metals in soil both gross and mobile forms. The priority elements of pollution are zinc, lead, copper and cadmium. Concentration of heavy metals in soil exceeds the MPC of both gross and mobile forms. The accumulation and distribution of heavy metals in vegetative parts of trees and shrubs is different. The negative impact of plant emissions on vegetation cover is presented by sparse vegetation *clumps*, some preserved species of willow and dropped plants, and lack of vegetation over large areas. The vast majority of plants are depressed. The burns are formed on the leaves under the influence of toxic emissions, drying of branches and axial shoots of crops, weak vegetative and generative development is observed.

The degradation and soil contamination – is a result of mining operations, agricultural production, and natural phenomena (landslides, mudflows, floods, forest fires, haphazard deforestation, accidents in factories, waste pollution and pollution from abandoned ammunition of former military sites, etc.). In Kazakhstan these factors have acquired special relevance. In the country the bowels which are rich in mineral resources are being developed in all regions as mining or open pit. This disturbed soil and vegetation areas, sometimes there is a complete destruction. These areas are infertile, often toxic, do not overgrow for a long time, exposed to erosion and degradation processes with deterioration of the environment, causing significant damage to human health. In this case there is an imbalance in functioning of biosphere, the main part of existence of life on earth. According to the data of the Agency of Land Resources (2011) by qualitative characteristics of lands in the East Kazakhstan region, technogenically disturbed lands cover 14,018 thous. ha, and waste lands - 6702 thous. ha.

Materials and Methods

Object of research includes areas under the influence of emissions from processing enterprises of mining industry in Ridder city in EKR. Effect of zinc, lead plants on the surrounding terrains. Zinc and lead plants are located in the city.
Research methods - are field and laboratory analyzes. Reconnaissance tour of the territory, definition of pollution sources. Impact of industrial emissions on soil-plant cover on eroded processes by external characteristics of plants, their downfall and absence. Determination of physical properties, chemical composition of soil is done by conventional methods in soil science. Determination of heavy metals and other chemical elements in soil, soil grounds, and plants was conducted by nuclear-physical and atomic- absorption methods.

Results and discussion

Emissions of zinc factory have adverse impact on the environment. Soil cover is disturbed, vegetation is destroyed and eroded areas and laydown are formed. The impact of emissions of zinc factory spreads over long distances. The area of spreading of plant emissions is in the range of 2 km, with a special influence on the wind rose in the east of the factory towards the town and hilly mountains, which is devoid of vegetation and has erosion furrows and gullies. In radius of 2 km it is found a strong impact of factory emissions on soil-vegetation cover. Thus, on the territory of impact of factory emissions the scours, grooves, ditches have formed, and there is a continuous flushing of the upper layers of black soil. The areas around enrichment factories are devoid of vegetation due to soil contamination. Specific feature of emissions of non-ferrous metallurgy factories is the simultaneous presence of a large quantity of heavy metals. The group of heavy metal toxins that accumulate in soil and plants is the most dangerous.
According to the results of our researches, in the area of zinc factory it was determined that concentration of total lead in the upper 10 cm soil layer exceeds MPC 1.68 times. Zinc - 25.46 times, copper - 1054.6 times, cadmium - 440.9 times, especially the middle and lower part of the site is heavily contaminated with heavy metals, as the area has a big slope to the Tikhaya river. There is a high concentration of heavy metals in soils. Soils in geochemically anomalous regions are containing a significant amount of chemical elements. Many plant species are adapted to such conditions, but when technogenic emissions of mining plants and enrichment factories have impact on plants and environment, soil cover loses plants and trees on large areas. Emissions of non-ferrous metals are transported over long distances. Accumulation of heavy metals in soil and plants is observed in the range of 10 - 15 km or farther from source of contamination.
The plants – are one of the most sensitive indicators of technogenic environmental changes. They show changes in the environmental conditions under the influence of different factors, and therefore are widely used in the assessment of environmental pollution. Vegetation cover is under heavy technogenic pressure of pollutants coming from air and contaminated soils. Some of them are required for metabolic processes in plants, but their increased concentration becomes toxic for plants, and other metals such as Pb, Cd, etc., are toxic even at low concentration levels [1]. According to some

data, meadow vegetation contamination by Pb and Zn is fixed at a distance of 12 km from the lead-zinc factory [2]. Near Zinc Plant (1 km) the accumulation of these metals in soil is so great that cultivation of any crops for animal feed or human food is dangerous for human and animal health.

Heavy metals are strongly adsorbed and interact with soil humus, they form sparingly soluble complex compounds. Thus, their accumulation in soil occurs. In addition, under the impact of various factors the substances which occur in soil are constantly migrating and transferred over long distances [3]. Heavy metals penetrating into soil with factory emissions are firmly bonded in the top layer. The maximum concentration of metals in soils is observed at distances of 1-3 km from contamination sources [4]. Cereals are less resistant to their excess and legumes- are resistant. The less resistant to lead pollution are species of maple, onion and orchard. The lead concentration above 10 mg/kg of dry weight is toxic for most crops. Several authors have determined a slight intake by plants of such ions as Cd, Br, Cs, while Pb flows slower into plants than other heavy metals and transported to the ground organs [5, 6]. Different species have different ability to accumulate lead that is widely used to reduce the adverse impact on urban plant communities and using them as promising accumulators – phyto-remediants.

Our data show that on the plot, in shrubs (lower part) the concentration of Pb exceeds MPC 1241 times, Zn - 781 times, Cu - 11 times, Cd - 2695 times. In the middle part of the plot in poplar plants Pb contents exceed MPC 1580 times, Zn - 317 times, Cu - 5 times, Cd - 1345 times. In the upper part of the plot in pine trees Pb exceeds MPC 670 times, Zn - 298 times, Cu - 5 times, Cd - 1197 times. Researches on concentration of heavy metals showed that in plants growing on control sites located 25 km to the north from the factory concentration of heavy metal exceeds in herbs: Pb - 2.8 times, Zn - 3.3 times, Cu - 0.6 times, Cd - 3,3 times. In bushes - Pb exceeds 5.8 times, Zn - 3.6 times, Cu - 0.4 times, Cd - 7, 7 times. In concentration of 100-500 mg/kg of lead in soil the curling of old leaves has been observed. On the experimental plot in planted crops the weak growth of leaves in the crown and damage of the edges of leave plate under the influence of atmospheric toxic emissions has been observed [7].

The plants absorb practically all chemical elements from the surrounding environment. The ash composition of plants in technogenic terrains shows that different parts of plants absorb and accumulate certain chemical elements. For example, litter and roots of grass plants have the highest ash and priority chemical elements in ash are silicon, calcium, sulfur, phosphorus, potassium, magnesium, nitrogen concentration is minimal. Tree species have less ash. The ash composition depends on environmental conditions of growth of herbaceous and woody plants [8].

In the course of research it was determined that the main source of pollution is a zinc factory. In the area of impact of factory emissions the erosion processes were observed in the form of continuous flushing of soil, formation of furrows, deep gullies and ravines. Soil loses capacity of the upper horizon due to flushing. In soil morphology on section horizons a significant compaction was observed. The priority elements of pollution are lead, copper and zinc. Concentrations of heavy metals exceed MPC. The negative impact of factory emissions on vegetation is manifested by the presence of sparse vegetation clumps, surviving samples of willow and dropped samples, lack of vegetation over large areas. The vast majority of plants are depressed. Under the influence of toxic emissions, the burns have been formed on the leaves; there are drying branches and axial shoots of crops, weak vegetative and generative development.

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Effetcs of lime application on growth, Ca, Fe, Zn content of grafted and non-grafted tomato plants in acid soil

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Key words: liming, tomatoes, rootstocks, scion, nutrition

Introduction

Tomato (*Lycopersicon esculentum*) is a very important nutritional source for human health and as food that contains many minerals and vitamins (A, B_1, B_2, C, E, K) and it is the leading one of the vegetables grown in the greenhouses in Turkey and the world.
Calcium is an essential macronutrient for plant growth and development. It occupies a unique positon among plant nutrients both chemically and functionally. Calcium plays important role in terms of environmental stresses tolerance and physiological impact on plant growth (Marschner 1995). Calcium deficiency can occur under the circumstances of low soil availability, low transpiration, in acid soils with low base saturation, slightly textured soils exposed to heavy leaching, competition by other cation, low levels of calcium in the soil and lack of soil moisture (Mc Laughin and Wimmer; Evans 1999; Bost 2010). The lime application is the first step for increasing productivity in acid soils. Liming can provide calcium and increase soil pH. Lime corrects both low pH and low levels of calcium while gypsum only affects calcium level (Bost 2010). Blossom end-rot is a local deficiency of Ca and its common problem of peppers, tomatoes and watermelons (Adams and Ho 1993; Bost 2010). Grafting combination in tomato and eggplant determine macronutrient uptake and variation in plant assimilation (Leonardi and Guiffrida; 2006). Grafting tomato scions onto rootstocks of eggplant and tomato can minimize problems caused by flooding, waterlogged soils, soil-borne diseases, bacterial and fusarium wilt. Grafted vegetables can use water and plant nutrients in soils effectively and it will increase the yields and fruit quality (Lee et al. 2010). The aim of this study was to evaluate the effect of Ca, Fe and Zn uptake on grafted and nongrafted tomato with increasing of lime application.

Materials and Methods

Grafted and nongrafted seedlings of Torry tomato cultivar were used. Torry was used as scion while Kudret and Arazi were used as rootstocks. The experiments was a randomized complete design with four replicates. The pots were filled with 4 air-dried soil. Lime requirement was treated in different rates such as 0, 20, 40, 60, 80, 100 and 200 % as calcium carbonate. Lime requirement was determined as 2.01 ton da^{-1} (0-32.2-64.3-96.5-128.6-160.8-193.0 g pot^{-1}) to raise soil water pH to 6.5 according to the SMP method. Macro elements were supplied as follows; N was applied as NH_4NO_3 (250 mg kg^{-1}); P as KH_2PO_4 (100 mg kg^{-1}). The characterisitcs of soil were: clay in texture, pH_{H2O}=5.68, $CaCO_3$ = very low, organic matter = 3.37 %, total N=0.08 %, available P=5.5 mg kg^{-1}, exchangable Ca=4.87cmolkg^{-1}, and K= 0.307 cmol kg^{-1}. Extractable Fe, Cu, Mn, Zn (µg g^{-1}) concentration were 23.1, 1.08, 12.47, 6.38 respectively. Leaves were subjected to one sampling date at flowering. Leaves samples were taken from the middle of the youngest compound (the 6th leaf from the top of the plant) and also from the fully developed ones for each plant. Total Ca, Fe and Zn were determined by AAS. The statistical analysis was performed using MINITAB 16 and the differences between the means were compared using the criterion of the Tukey's multiple range test.

Results and Discussion

There were observed significant differences between in plant species, application levels and interaction on dry matter weight, calcium, iron, zinc content of leaves (Tble 1). The results showed that DM of both grafted and nongrafted tomato plants were exhibited irregular distribution. The highest DM was obtained from nongrafted Torry and grafted Arazi by treatment of the completely eliminating of lime requirement. Nongrafted Torry DM was found higher than grafted tomato plants. Dizdaroglu (1985) reported that grafted tomato can provide the higher yields and earliness to control plants. Leonardi and Guiffrida (2006) determined that biomass can change according to rootstocks which are three different tomatoes grafted onto rootstocks.

The some nutrient content of grafted plants were compared with nongrafted plant. Total Ca concentration of leaves was found the highest in grafted tomato plants compared to nongrafted plant. Besides, the leaf Ca content of both grafted and nongrafted tomato plants were regularly increased. This results expain that increasing levels of lime application was increased Ca concentration in tomato leaves naturally the liming can provide calcium. The highest Ca concentration was obtained from grafted Kudret; the lowest Ca concentration was obtained from nongrafted Torry. Kota and Ogivara, (1984), reported that leaves Ca concentration of grafted melon plants was found higher than control plants. Tuna and Ozer, (2005) determined that increasing Ca doses application were raised total Ca contents in tomato leaves and leaves total Ca content was found higher than control plants.

The total Fe and Zn concentration of leaves was found the highest in grafted tomato plants compared to nongrafted plant. The highest Fe concentrations were determined in grafted plants when there was no lime application; the lowest level occured when the maximum lime application was applied. So; increasing lime application was religiously reduced total foliar Fe and Zn content of both grafted and nongrafted tomato plants. Rivero et al. (2004); recorded similar results and determined that concentration total Fe of foliar was found the higher grafted tomato compared with nongrafted tomato. Tisdale et al. (1985); reported that the liming reduce Fe and Al solubility and usefulness in soils. This can be reason of total foliar Fe content reduce in tomato plants. Micro element uptake on plants was limited by the liming although sufficent amount of zinc supplied in the soil. Also, Zn uptake in plants is limited by the sufficent large amount of Cu content supplied in soil. This condition may result from interaction of antagonism between Cu and Zn. Marschner (1995), reported that advilent cations (Ca^{+2}), Cu and other heavy metals were limited to Zn uptake in plants.

Table 1

Concentrations of DM, Ca, Fe and Zn in tomato leaves of control and grafted plants.

	Lime requirement (%)	Species			Means
		Torry	Arazi+Torry	Kudret+Torry	
	0	59.36Aba	50.75Bb	42.75Bc	50.95
Dry Matter	20	64.33Aa	47.02BCb	43.33Bb	51.56
gr	40	58.68Aba	4.64BCb	49.02Bb	51.11
	60	43.15Cb	40.91Cb	57.58Aa	47.21
	80	56.48Ba	44.52BCb	45.07Bb	48.71
Species**	100	64.38Aa	65.15Aa	47.11Bb	58.88
Doses**	200	42.59Ca	43.79Ca	44.88Ba	43.75
SxD**	Means	55.57	48.25	47.10	
	0	1.77 Da	2.15Ca	1.99 Da	1.97
Ca, %	20	1.88Cda	2.37Bca	2.13Cda	2.12
	40	2.29BCDa	2.61Bca	2.66Bca	2.52
	60	2.57BCb	2.87Abab	3.22Aba	2.88
	80	2.67Bb	2.98Abb	3.62Aa	3.09
Species**	100	2.70Bb	3.42 Ab	3.28Aba	3.13
Doses**	200	3.39Aa	2.70Bcab	3.13Abb	3.07
SxD**	Means	2.43	2.73	2.86	
	0	59.20Aa	67.07Aa	55.67Aa	60.64
Fe	20	53.87Aba	54.50Aba	45.12Aba	51.16
$\mu g\ g^{-1}$	40	41.77Bca	44.67Bca	43.32ABCa	43.25
	60	28.30Cda	42.75Bca	41.07ABCDa	37.37
	80	27.82Cda	33.17Ca	32.32BCDa	31.10
Species**	100	25.17 Da	18.40Cda	28.27Cda	23.94
Doses**	200	23.85 Da	17.15 Da	27.30 Da	22.76
SxD**	Means	37.14	39.67	39.01	
	0	13.83 BCb	19.00 ABa	19.65 Aa	17.49
Zn	20	19.40 Aa	20.88 Aa	18.83 ABa	19.70
$\mu g\ g^{-1}$	40	16.60 ABa	16.25 BCa	15.93 ABCa	16.26
	60	15.15 BCa	16.98 ABa	15.03 BCa	15.72
	80	13.50 BCa	14.43 Ca	16.28 ABCa	14.73
Species**	100	13.30 BCa	13.08 CDa	12.53 CDa	12.97
Doses**	200	11.80Ca	9.95 Da	9.83 Da	10.52
SxD**	Means	14.80	15.879	15.44	

Values in rows (small letters) and columns (capital letters) followed by different letters are significantly different at $P < 0.05$.

Finally, the results of the study indicate that increasing levels of lime application were increased Ca concentration both grafted and nongrafted tomato leaves while it was regular reduced total foliar Fe concentration beacuse of antagonism of the interaction relationship between Ca and Fe. However, grafted tomato plants can be used more effectively Ca and Fe than non-grafted plants. As a result, Blossom end-rot is less likely occur in grafted plants compared with nongrafted plants due to higher available from the calcium concentration. Blossom end-rot is caused by calcium deficiency and is more frequent on acid soils.The lime application can be practical and economical solution to eliminate of calcium deficiency.

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Current state of water-physical properties in soils of Mirzachul oasis

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Irrigated meadow soils presented on mechanical structure by small differences contain heavy-silted fractions less than sierozemly- meadow ones in central part of Mirzachul. It is particularly evident in low horizons. The maintenance of finely sandy fractions (larger of 0.05 mm) fluctuates from 20 to 53 %, and a small share from the tenth shares to 12-16 % of this quantity making up larger particles of (>0.1 mm). The maintenance of finely sandy particles in soil (7.5-25 %) is less than in meadow one.
Quantity of fractions of medium and fine silt in the top horizons of the soil is considerably more, than sandy particles - on a profile it varies from 2.8-2.6 % in sandy horizons and in clay adjournment does 19-34 %. The maintenance of oozy fractions does not exceed 1-17 % in the top meter thickness, and more deeply it fluctuates from 0.1-0.2 % in sandy and to 5.6-9.7 % does in the clay ones. According to our data, the researched soils are very diverse on mechanical structure. This is connected with genesis of soil-forming types and irrigating-cultural activity of a man. Therefore, soils developed on them are presented by variety of different structures from heavy till sandy ones. Heterogeneity of mechanical structure is observed within each profile of soils, too. Irrigated meadow and sierozem soils are presented basically by light and medium loams underlain by layered beddings
Our results and data of other researchers [4.2.3.6] testify that sierozems on loesses, especially light ones in Mirzachul basically possess particles by size from 0,25 to 0,01 mm and by less one, i.e. microstructure of which gives a good capillary porosity, high water conductivity, capillary moisture and mobility of nutritious elements to soils, which cause high fertility of these soils.
S.N.Ryzhov [5] M.U.Umarov [6], explaining the reasons of high natural fertility of light sierozems in Mirzachul oasis writes, that « the predominance of silty fractions of 0,05-0,01 mm and a considerable quantity of strong micro-structural elements by size larger than fraction 0,01 mm, creates a very favorable capillary porosity and high return of water» in such soils. N.F.Bespalov [1] notices, that the culture of grasses slightly raises the macrostructure maintenance in a crop rotation on light sierozem in Mirzachul oasis, but essentially changes micro- aggregation of the soil. According to results of our researches, the maintenance of agronomical valuable macro-units reaches 40-80 % in arable horizon of sierozem-meadow soils, at the same time these units make up 30-40% in newly-irrigated meadow, easily-loamy soils. The sierozem-meadow oasis soils with close strong mineralization subsoil waters contain water-

stable aggregates till 4-6 %, though in arable horizons the quantity humus is more and they are heavier on mechanical structure, and under arable horizons their quantity varies from 3.6 to 5.6 %.

Environment of irrigation territory in Mirzachul oasis is characterized by high intensity of biological processes which lead to fast reduction of stocks in soil, loss of structure of soil, deterioration of physical properties.

The specific mass (SM), the more constant quantity, depends on chemical and in considerable degree, mineralogical structure of soil- forming species. The specific mass of newly- irrigated, easily- loamy meadow soils fluctuates from 2,60 to 2,69 g/cm^3, that of grey-meadow soil does from 2,56 to 2,70 g/cm^3, which is characteristically for soils of a grey sierozem belt. In the top of the most humus horizons of soils its quantity is the least one, the specific mass increases with depth value.

The volume mass, (VM) or configuration density defines the watered, air, thermal and nutritious conditions, microbiological activity and development of root system in plants. The quantity of volume mass changes in the investigated soils in wide limits (1.19-1.71 g/cm^3), its least indicators being in arable horizon of irrigated meadow soils and sierozem-medow and the greatest ones are under the arable and an underground ones.

Under the influence of an irrigation of processing and agricultural crops, big changes take place in morphological, chemical and physical properties of soils, especially, in configuration density. In the process of claying, de-aggregation and watering in law horizons the changes were especially increased in the bottom horizons where the level of subsoil waters lies down more close to a surface and a thin layer of gypsum beds at the level of 40-50sm, the density of configuration of which reaches 1.5-1.7 g/cm^3. Within the top horizons, under arable horizon is differed by more concentration, more precisely, the bottom part of arable horizon. Hence, the soils under consideration have more friable configuration not only in the top part of a soil profile, but also in soil-forming beddings.

General porosity in sierozem-meadow soils in arable horizon is characterized by the highest, general porosity with fluctuations from 49 to 53 %. In considered meadow soils the more the density of configuration is increased in the bottom horizons, in accordance with this, the more the general their porosity is decreased in them. According to it, their decrease reaches to 38-46 %. Above-noted features of mechanical and macro-aggregation of structures, and configuration density, general porosity have a big impact on the water properties of considered soils in Mirzachul oasis

Maximum hygroscopicity (MH) of moisture consists of the maximum quantity of loose-connected one which is revealed in the soil as a result of capillary condensation. The quantity of maximum hygroscopicity depends, first of all, on mechanical structure of soil, mainly, from the maintenance of clay particles, humus, salts and structure of the absorbed bases. According to many researchers [2.3.6], under the influence of irrigation remoteness the quantities of MH which occur in soils, usually are increased in connection with changes.

According to our data, maximum hygroscopicity fluctuates from 1.91 to 6/98% on the samples being washed from salts in the new- irrigated, lightly-loamy, medium- salted, meadow and new-irrigated, easily-salted, sierozem-meadow soils, but in experimental

sites that of does from 4,5 to 6,0% in newly-irrigated, medium-loamy, heavy-salted meadow and newly-sandy, heavy-salted sierozem- meadow soils. Such high MH largely is connected with hygroscopicity of salts being in soils. ($NaCl$, Na_2SO_4, $MgCl_2$, $CaCl_2$, $CaSO_42H_2O$).
Humidity of steady fading(HF) depends both on soil property, and nature of plants. Therefore, while defining (HF) it is necessary to consider density of soils. In new irrigated, easily-medium loamy, poorly-medium meadow, grey-meadow soils of oasis HF makes up 3,4-6,6 %, and in new irrigated easily- loamy sandy, strongly salted grey-meadow and meadow soils it does 6,0-9,9 % to the soil mass. In contrast to non-salted and poorly- salted irrigated meadow soils, HF is a little raised in heavily-salted irrigated meadow and sierozem-meadow soils owing to the large enrichment of their salts, and the quantity of HF is a little raised, too, because of the presence of gypsum horizons.
The least moisture capacity (LMC) or water-retaining ability of soil is characterized by that quantity of the suspended moisture, which is holding in soil thickness after its plentiful humidifying and free running off for a long time. The concept of ultimately field moisture capacity(UFMC) concerns those conditions when the soil water lies down deeply, and the top area of wetting does not merge with law capillary one and the moisture remains as though in the suspended condition. Without definition of this quantity it is impossible to calculate norms of irrigation in plants. The quantity of (NIR) depends on mechanical structure of soil and a ground, the maintenance of humus, structure density, micro-and macro-structures, character of porosity and etc.
From the received data, it is evident, that its quantity makes up 20-25 % in the top meter thickness of soil in medium horizons for medium-salted, easily- loamy soils to the mass for gypsum-bearable, sandy loam horizons of 15 % and grey-meadow heavy-loamy and medium-loamy horizons of soils, especially their solonchak analogies have a little raised (22-24) moisture capacity in comparison with easily-loamy varieties. Thus, it was found out, that the values of water properties are not equal because of their differences on mechanical structure, cjnfiguration density, mineralogical structure and salinization degree.
For water penetration into soils it is important to define a water mode, techniques of carrying out watering, washing of the salted earths, degree of erosion development and other economic important indicators. Water penetration depends basically on mechanical structure of soils, density of configuration and character of mass. Presence of cracks in soils, root emptiness and character of vegetation have a big effect on water penetration.

Conclusion

1. Irrigated meadow soils presented on mechanical structure by small differences contain largely-silty fractions less than the meadow ones in central part of Mirzachul oasis. It is especially seen in law horizons. The maintenance of small sandy fractions (larger than 0,05 mm) fluctuates from 20 to 53 %, and a small share from the tenth shares to 12-16 % being larger particles (> 0,1 mm) of this quantity.
2.According to result of our researches the maintenance of agronomical valuable macro- units in arable horizon of soil-meadow, meadow reaches 40-80 %, at the same time they make up 30-40% in new irrigated meadow, easily- loamy soils. The

sierozem - meadow soils with close strong mineralization of sub-soil waters contain water of strong units to 4-6 % though the quantity of humus is more in arable horizons and they are heavier on mechanical structure, and under arable horizons their quantity varies from 36 to 56 %**.**

3. The specific mass of the newly- irrigated, easily- loamy meadow soils fluctuates from 2.60 to 2.69 g/cm^3, also the sierozem -meadow soil does from 2.56 to 2.70 g/cm^3, i.e.it is a feature for soils of a grey belt. The quantity of the mass is changed in wide limits (1.19-1.71 g/cm^3) in the investigated soils, its least indicators are seen in arable irrigated meadow soils, and the greatest ones are under arable and underground ones.

4. The maximum hygroscopicity fluctuates from 1.91 to 6.98% on the samples washed from salts in newly- irrigated, medium loamy, medium places of strongly-salted soils, newly- irrigated, medium salinity meadow and newly- irrigated soils, poorly- salted sierozem-meadow, it does from 4.5 to 6.o % in newly- irrigated, strongly- salted meadow and newly- irrigated sandy, high salinity of serozyom-meadow soils in experimental sites.

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Evaluation criteria of agrogen transformation in brown forest soils of tea plantations on the Russian Black Sea Coast

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Key words: soil, agrogen changes, soil and environmental monitoring, mineral fertilizers, mobile and conservative criteria

In recent decades, a number of international initiatives, programs and strategies, conventions, agreements and directives aimed at the preservation and restoration of soil to prevent degradation and sustainable use. Brown forest acid soil of subtropical zone of Russia is one of the major subtypes of zonal soils in the structure of agricultural land used for the cultivation of tea and tested at agrogene pressure, which is associated with the use of relatively high doses of mineral fertilizers **[1-5].** In this connection the development of criteria for assessing the status and extent of changes in brown forest acid soil of tea plantation on the Black Sea coast of Russia is actual.
Monitoring studies have been conducted (1983-2011 biennium) on brown forest acidic soils of tea plantations, where the experiment with fertilizers was initiated. The experiment consisted of 16 different combinations of fertilizers types and doses (from 0 to N 600, P 180, R 150 kg/ha). Block of experimental data included the acid-base properties, the composition of the soil-absorbing complex, the content of available forms of macronutrients, humus state; granulometric, mineralogy and elemental composition, biological activity, morphological structure. The properties of soils under tea plantation were compared with soils under natural vegetation (beech and hornbeam forests), which is next to, as well as with the initial state of the soil before planting tea plantation and soils without the use of fertilizers.
It has been found that prolonged intensive rearing of culture tea using high doses of fertilizers (primarily nitrogen) leads to a set of interrelated changes in the properties and composition of the soil. There is intense acidization, increase mobility and impoverishment of the soil by nutrients (calcium, magnesium, potassium, iron, manganese, zinc), reduction in the degree of saturation with bases and increase in the proportion of Al in the soil-absorbing complex; violation of the ratio of major nutrients, accumulation of phosphates in the background of an unbalanced application of fertilizers **[1, 3, 4].**
The annual flow of significant amount of organic residues of the tea plants, riched in aluminum on the surface of the soils, led to an increase in the total content of humus in the soil, raising the mobility and aggression of humic acid, decrease of fractions, associated with calcium and to weakening of the degree of humification. All these processes led to an increase of the differentiation in the soil profile, associated with decrease in the content of clay fractions in the topsoil. Reduction in the functional

biological activity of soil (respiratory, enzymatic, nitrogen-fixing) and changes in the composition and structure of microbocenosis were also noted [6].
A set of criteria to assess the changes in the structural and functional properties of soil, reflecting the taxonomical state and functions, was worked out. In the system of criteria are allocated 2 groups of signs: mobile and conservative (tabl. 1).
Indicators, under rapidly changing are most the influence of external factors (less than 5 years), point at the start of an imbalance in the soil, were assigned to a group of mobile performance. They can be used for early diagnosis of the soil condition, characterized by short-term (seasonal and annual) changes. This group includes the acid-base properties of soils (pH, acidity and the content of mobile aluminum content), the content of mobile forms of macronutrient fertilizers and indicators of biological activity.
Indicators that are stable and slowly changed over time were attributed to a group of conservative indicators. At the same time this changing will testify to serious violations that go beyond the level of buffer capacity of soils; are characterized the long-term and irreversible transformations. This group included the humus state, granulometric, mineralogy and elemental composition of soil, as well as the morphological structure of the soil profile.

Table 1

Evaluation criteria of agrogen transformation in brown forest soils of tea plantations

Diagnostic indicator	The degree of changes in soil		
	low	middle	highly
Mobile indicators			
Acidization of soil	low	middle	highly
The content of mobile forms of macronutrient (NPK)	deficit	middle	excessive
The degree of enrichment of soil enzymes (catalase, invertase, urease)	rich	medium enriched	the poor, very poor
Respiratory soil activity, the degree of reduction compared with the background (control)	low	middle	highly
Conservative indicators			
Changes in humus status (content of humus, fractional-group composition)	absence	insignificant	presence
Changing of the elemental composition of soils (macro- and micronutrients)	absence	insignificant	presence
Changing of the granulometric composition of soils (increased differentiation of the soil profile)	absence	insignificant	presence
Changing of the mineralogical composition of the soil	absence	absence	presence
Changing of the morphological structure of the soil profile	absence	absence	presence

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Creation of electron land-cadastral maps and "E-Agriculture"

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Key words: geospatial, GIS, electron maps

One of the measures to be implemented by SLCC in State Program is "preparation of electronic (digital) land-cadastral maps on administrative districts". As it is known, conduction of land cadastre is conditioned with the preparation of cadastral maps for different purposes. In addition, land cadastre information base, creates wide opportunities for the conduction of monitoring in order to control the use of land since information base of land cadastre has the necessary information in terms of cartography of the territory of the Republic and characterization of lands. Moreover, the most positive aspect is that, as the result of implementation of this work, opportunity to gather and systematize complex and large-scale map materials about cadastre on the basis of modern information technologies are obtained.

Countries which were provided with information about their geospatial frameworks, the main given responses were "Infrastructure for Spatial Information in the European Community (INSPIRE)" and "National Spatial Data Infrastructure (NSDI)". Responses indicating that INSPIRE was their geospatial framework were all from European Union (EU) countries, reflecting the role of INSPIRE within the EU. NSDI responses were more widely distributed across countries reflecting the more general implementation of NSDI's globally, particularly within developed countries. This shows that until now the emphasis with regards to geospatial framework has been on meeting the requirements of geospatial data users and that means there is a need for further development of frameworks that incorporate statistical uses. Only Australia, with the Statistical Spatial Framework, and Mexico, with the National Geostatistical Framework, use frameworks that integrate both geospatial and statistical data uses (1).

For the purpose of this report, geocoding practices are those processes that are used to geospatially enable statistical unit record data (i.e. data relating to individual persons, households, dwellings, businesses or buildings). Geospatially enabling unit records involves taking location information for these statistical units (such as address) and linking this information to a location coordinate (i.e. x, y, z coordinates) and/or a small geographic area. This process is generally described as geocoding. The geocodes, the location coordinates and geographic areas codes, obtained from this process can be stored directly on the statistical unit record or linked in some way to the record. Once the unit record data is geocoded, it can then be used in geographic information systems (GIS), where geospatial operations can be performed on the data. These geospatial operations can occur during the statistical production process and in the creation of aggregate statistics for release.

Close to one□third (31%) of responding countries listed enumeration geography as their main geocoding method. Use of enumeration geography as the main geocoding method was dominated by countries from Asia, Africa and non-European Union countries. This may reflect the developing nature of their data collection and/or geocoding capabilities. It should be noted that some of these countries appeared to be working towards improved geocoding abilities. Using this geocoding method, enumeration geography is linked to the unit record at the point of collection, via the workload assignment for the enumerator which this geography represents. The main issue with using enumeration geography for geocoding is that it forces enumeration geography and dissemination geography to be tied together; where any dissemination geography must be built out of the enumeration geography, limiting the possible dissemination uses. The design of enumeration areas often conflicts with user requirements, and in some instances can result in additional design criteria for enumeration geography that reduces its effectiveness as a workload management tool. Nearly one-quarter (23%) of responding countries proposed the use of national registers as their main geocoding method. Registers were predominately used in European Union countries and included address, building or dwelling registers. Unit record information (such as, name and address, or register identification numbers) are matched or linked to a formal or statistical register which also includes location coordinates or small geographic area codes. A further 9% of responding countries use address coding as their geocoding method. Address coding is a related but less formal approach to using national registers, where a range of geospatially enabled address databases are used to obtain geocodes.

For those countries who listed the additional geocoding practices, address geocoding was the most common at 11%. These countries all used address coding in conjunction with national registers as their main method of geocoding and were mainly European Union countries. It is possible that these countries use address coding to compensate for gaps in national register data. Countries are also using block, locality and community coding and direct capture using GPS as additional methods – each 8% of all responding countries. It seems that block, locality and community coding is being used in a wide variety of contexts, and for differing reasons. While use of GPS data capture appears to be used in specific contexts or as a supplement to registers or address coding indexes.

So, today statistical indicators are already considered wrong not only by being connected to administrative territorial units, but also with address information. All information must be connected with co-ordinate. The next problem is that information gathered during works is in different formatted on digital maps. Today these 3 problems mentioned above must be solved in some areas, including providing execution of the decree of the President of the Azerbaijan Republic connected with creation of the "Electron Agriculture".

There are different approaches. For instance, in the Russian Federation the government decided to eliminate negative results of the reform and spend a great deal of money on this issue. However, desirable results are far from reality. All information placed in the Internet in Ukraine is implemented only on the basis of citizen's appeal. The quality of a country's cadastre is specified with its completeness in the nature. So, it is not practically possible to compare a country with 15 years cadastre system history with the European countries with hundred years of cadastre system.

There is a need to carry out new field investigations in some cases connected with register and we carry out field investigations connected with on the basis of co-ordinate. Even scientific investigations are carried out in this direction and theses are

defended. As I mentioned before, this is one of the most modern challenges. Probably, it needs a number of changes in acts of legislations connected with this matter.
We have informed that the biggest hardship is the different format on maps in management of spatial data process. We must accelerate our activities in the direction of preparing the unique system for solution of this problem.
So, we could not speak of electron register system of the land yesterday. It may be late tomorrow. So, solution of this problem for connected organizations of the country is a very important issue and responsibility.
Usage of information of the Azersky satellite of the Azerbaijan Republic is one of priority technological problems. Today, works are carried out to use opportunities of the Azersky satellite not only in civil work, but also in military geodesy. Demands for requiring space descriptions are defined.
Strengthening of the state support for agricultural development, determining of strategic objectives and institutional changes in the spheres corresponding to the new challenges laid the foundation for the transition of this sphere to a qualitatively new level. The modern agrarian parks and large farms are established in the country to ensure food security of the population and to increase the export potential of the agrarian sector. The modern infrastructure was created as part of the state programs of socio-economic development of regions. The inter-village roads were widened.
Commissioning of the Shamkirchay and Tahtakorpu reservoirs creates conditions for involving new land plots in crop rotation and preservation of soil fertility (2;3).
The state has set a number of benefits for farmers. That is, the producers of agricultural products were exempt from taxes other than for land. Farmers and entrepreneurs have an opportunity to receive loans and seeds on favorable terms. They can also receive, on favorable terms, fertilizers, equipment and breeding cattle through Agroleasing OJSC.
At the same time, the state allocates subsidies for fuel used in cultivation of sown areas.
Azerbaijan's president declared 2015 the Year of Agriculture in order to give a new momentum to the development of agriculture and accelerate its modernization, to ensure a systematic and comprehensive approach to solving existing problems in the agrarian sector, for an effective involvement of administrative and financial resources in this area, and wide promotion of the agrarian potential of the country.
As it is known “E-Agriculture” is an emerging field in the intersection of agricultural informatics, agricultural development and entrepreneurship, referring to agricultural services, technology dissemination, and information delivered or enhanced through the Internet and related technologies. More specifically, it involves the conceptualization, design, development, evaluation and application of new (innovative) ways to use existing or emerging information and communication technologies (ICTs). E-Agriculture goes beyond technology, to promote the integration of technology with multimedia, knowledge and culture, with the aim of improving communication and learning processes between various actors in agriculture locally, regionally and worldwide. Facilitation, support of standards and norms, technical support, capacity building, education, and extension are all key components to e-Agriculture. There are several types of activity related to e-agriculture applications that are widely recognized around the world today. The delivery of agricultural information and knowledge services (i.e. market prices, extension services, etc) using the Internet and related technologies falls under the definition of e-Agriculture. More advanced applications of e-agriculture in farming

exist in the use of sophisticated ICTs such as satellite systems, Global Positioning Systems (GPS), advanced computers and electronic systems to improve the quantity and quality of production.

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Ecological fertility model of soils

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Keywords: soil fertility, ecological assessment

According to the theory of genetic soil science, fertility – is the ability of the soil to provide the plant with required amount of nutrients, water, heat and air for the its normal development. Fertility is the most important distinguishing feature, quality indicator, attribute of the soil from main rock of which it emerged. That is the existence of fertility (in a relative sense) is impossible without soil. In other words, the concept of fertility is only about the soil.

Natural fertility of the soil can be characterized as a complex effect of biological, chemical and physical processes supporting growth of autotroph plants. However, as a result of human economic activity, it was changed purposefully to better meet the demand of the plant. Thus, the natural fertility of the soil in the social production process acts in fertility or cultural fertility form. Positive or negative influence of human on nature, as well as the level of economic fertility depends on the development of productive forces and science.

Unlike natural ecosystems, structure and the soil-plant relationships in agro-ecosystems (cereals, tea, grapes, melons, gardens etc.) are manifested in another way. These systems include the following distinguishing features:

1) Agro-ecosystems were simplified by human for the purpose of obtaining higher yields (vineyards, tea, orchards, grain, etc.);
2) In addition to solar energy, additional energy sources (fuel, fertilizer, etc.) and human labor force are used in agro-ecosystems;
3) Regulation and management of agro-ecosystems doesn't occur with intra-system processes (competition, symbiosis etc.), but rather with through the influence of human factors.

Therefore, the natural qualities of the soil fertility formed under the influence of human factors on agro-ecosystems, being its objectivity sign, also serves as a socio-economic category. Soil fertility in agro-ecosystems depends not only on the physical, physico-chemical, chemical, biological properties and modes, heat and moisture of the area, but also, as mentioned, on agricultural techniques and irrigation, in other words, from the human factor.

In contrast to the natural ecosystems, the agro-ecosystems fertility increase on the world scale, including progressive countries, are in parallel with the development of agriculture in the history of civilization.

Fertility forming factors within agro-ecosystems can be grouped as follows:

- Environmental (climate, topography, groundwater level and composition) factors;
- Soil (biological, chemical, physical and physical-chemical indicators of the soil from significant agronomic point of view) factors;
- Economic (agricultural techniques, irrigation, etc.) factors;
- Plant bio-potential;

Since the late 50s of the last century there had been such an idea in science that complex systems cannot be fully realized by the traditional research methods. However, it changed and soon most of the system approach and modeling is becoming science research method. This method of approach has several advantages; on the first stage, in spite of the fact that the system does not create an adequate idea of the approach in the system, it reveals us its main components, the internal and external relations, delivers us the current structural model that we observe. Although being the exact opposite of its prototype model, it displays correctly and considered safe for use.

In 70-90 years, many scientific centers of the former Soviet Union, as well as a number of different models of fertility were developed by different authors. In this regard, fertility agro-ecological (environmental) models for the structure and form of presentation of both theoretical and practical aspects were more interesting. Agro-ecological fertility (environmental) model corresponding to the level of an uncertain term productivity of soil plants is relized as the sum of important agronomic properties and regimes (1; 2; 3); grouping within model blocks shaping and restrictive factors of fertility reflects it in correct manner and also, on the basis of this information, makes the management measures easier.

Dutch scientist de Vit offered a more modern version model of fertility. He advised to allocate the agro-systems on three levels according to the type of restrictive factors: in the first level fertility is limited by the efficiency of solar radiation, in the second level by solar radiation and water regime, in the third level by nutrients, water regime and solar radiation. Frid A.S. divided agro-ecological models of fertility into two groups; the first group included information models (static and dynamic), the second fertility management models. According to the author, fertility management model consists of three information blocks: 1) the parameters of the planned indicators of fertility or high levels of fertility; 2) fertility indicators of actual or current settings (medium and low levels of fertility); 3) sterility indicators and quantitative nature of the internal and external relations.

Both model groups can be made either in conceptual or in regional forms. In this respect, for the first time in the middle 80s, the conceptual model was put forward in agriculture, forage and forestry under-plant soil (4): 1) summer pastures and meadows and grassy areas designed to improve the productivity of grassland; 2) designed to increase the productivity of forest conservation brown mountain forest, dark brown and mountain forest; 3) mountain black soils, gray-brown, brown, brown for grain and potatoes,; 4) gray for the vineyards, grain and forage crops; 5) for cotton meadow-gray and meadow-gray; 6) yellow soils for tea and other subtropical plants.

In the next decades, six models of ecological soil fertility were developed based on the same concept in different regions of Azerbaijan: tea, wheat, cotton, grapes, forage, citrus, olive, vegetables, forest.

Since the soil acts as a fertility system "indicator", the models are made on the basis of its indicators. Therefore, in agro-ecological (environmental) fertility models, most of the blocks are those having direct relation with soil indicator blocks:

Ecology block . This block includes fertility factors being out of the soil, but directly involved in the formation of fertility and crop productivity: area height (m) and the inclination, climate indicators - plural radiation (kcal / cm^2), the average annual temperature (C^0), Sum of temperatures more than 10^0C (C^0), precipitation (mm); evaporation (mm); humidity ratio (HR), continentally coefficient (CS), the duration of vegetation, snow cover density, groundwater levels, and so on.

Agrophysics block. This block is directly involved in the formation of soil fertility and crop productivity in terms of agronomic soil developed on the basis of the physical properties and modes. Agricultural Physics block includes the following indicators: the soil density (g / cm^3), porosity (%), water-resistant aggregates (> 0.25 mm) Number (%), natural clay (<0.01 mm) and silt particles (<0.001 mm) less capacity of water in soil (%), soil water permeability (mm / min).

Soil composition and properties block. This block includes significant composition and properties of soil from agronomic point of view: Content (%) in the plow layer of humus or "A" accumulation layer (natural biocenosis), humus reserves in the soil profile 0-20, 0-50, 0-100 cm soil layers (t / ha), total nitrogen, phosphorus and potassium content (%), sum of absorbed bases (in soil mg / eq. 100 gr.), and Ca^{+}+Mg^{+} and Na % amount, the reaction of the soil environment (pH), carbonate etc.

Block agrochemical properties. This block includes very variable indicators of soil fertility N/NO_3+N/NH_4, flexible phosphorus (mg / kg), exchanging potassium (mg / kg), and micro-elements etc.

As mentioned above, the main purpose of drawing up economic model of fertility is fertility management, and performance optimization of agricultural crops in accordance with the requirements of its indicators. This approach regulates the ecoethic relations between man and the soil, a very important component of the natural complexes. Ecological model of fertility defined by the following factors on ecoethic relation of humans to soil:

1. Ecological model of the fertility is an ecoethic approach method from scientific point of view not damaging the ecological parameters of the soil which can keep requirements of the plant. Investigations (J.A.Aliyev, 1974; A.Rasseli, 1955) show that management of soil fertility indicators within optimal parameters allows keeping natural and historical dimensions of the soil and also its increase.

2. Management of soils on the basis of ecological models on which agricultural plants are cultivated prevents the soil from degradation processes such as – erosion, salinization, and saltiness. This may help solving a number of environmental ecoethic problems.

Thus, management of fertility on the basis of the environmental model can be considered a new phase in "soil-society" ecoethic relations, as well as the next growth phase of the culture. Soil agro-ecological (environmental) model is facilitated in a single form of drafting, it means “ecological passport of fertility” for the purpose of making easier preparation of projects on fertility increase, organization of soil safety measures on this ground, and application of this model in practice.
Ecological and economic importance of the territory of the Republic, the amount of information given on available soil agro-ecological (environmental) passports of major taxonomic units fertility models - have been drawn up based on soil types.

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Relationship between soil water retention model parameters and structure stability

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Key words: aggregate stability, structure stability, pore size, water retention, stability index.

Introduction

Soil structure is a basic property of soil fertility, quality and hence soil health. The formation of soil aggregates and structure is the result of biotic and abiotic factors and their interaction. It is important for understanding the influence of structural condition on the rhizosphere water-nutrient regime and crop yield, and also surface runoff generation and soil erosion. Thus, studying the effects of soil properties and management practices on soil structure is vital for the development of effective soil and water conservation, and predictive modeling tools in order to avoid risks of soil deterioration. Tillage, soil compaction, crop rotation and amendment application can alter pore size distribution (PSD), and subsequently affect physical and chemical properties of soils, and nutrients availability. Furthermore, plant growth associated with activities of soil biota interacts with environmental variables such as dry-wet and freeze-thaw cycles to modify soil structure. The ability to study soil structure dynamics and affecting mechanisms thereon are complicated by the (i) magnitude of temporal variability which in itself is affected considerably by the spatial location and growing season, (ii) effects of management practices, and (iii) difficulties involved in relating results from laboratory measurements to real field behavior (Kay and Angers, 2002; Strudley et al, 2008; Mamedov and Levy, 2013).
The difficulty to quantify the impact of soil properties and conditions, coupled with management practices, on soil structure stability, either by empirical or by conceptual models, has been widely recognized. Characterization of soil aggregate stability has commonly been used to portray structure stability, although aggregates are not necessarily a suitable proxy of soil structure. This complexity is also associated with a variety of physical and physicochemical mechanisms involved in soil aggregates breakdown by water (Levy and Mamedov, 2013). Several aggregate stability methods, utilizing diverse primary breakdown mechanisms (e.g. wet sieving, drop

test, application of ultrasonic energy, etc.), are used for establishing an index of soil structure, which makes comparison between treatments difficult. A recent method, the modified high energy moisture characteristic (HEMC) method (Pierson and Mulla, 1989; Levy and Mamedov, 2002) is sensitive and capable of detecting even small changes in aggregate and structure stability of a range of soils from arid and humid zones (e.g. review paper by Mamedov and Levy, 2013).

Resistance of soil structure to changes induced by management practices largely depends on soil genesis and properties (Mamedov et al., 2010). Structure and aggregate stability can be inferred from changes in the soil water retention curve even at the low end of the matric potential (e.g., as employed by the HEMC method). Changes in the model parameters used to describe the water retention curve are considered to be related to changes in the PSD, and therefore in aggregate (particle) size distribution; thus, they may characterize the contribution of aggregates size to soil structure condition. If model parameters can be related to measured soil properties, then soil water retention curves can be derived also from easily measured field data (Lipiec et al., 2007; Mamedov and Levy, 2013). The objectives of the current study were to (i) characterize structure stability indices of semi-arid soils using the HEMC method, and (ii) examine the relationship between these soil structure stability indices and the water retention model parameters.

Materials and Methods

An arry of samples from semi-arid cultivated soil (Azerbaijan, Israel, Turkey, USA) varying in type and exyrinsic conditions were used: (i) three soil varying in texture and treated with two biosolid amanedments (composted manure and sweage sludge); (ii) long term cutivated soils (~100 samples) varying in texture from loamy sand to clay; (iii) clay soil treated with fresh and composted poultry litter, and zeolite under corn production, and (iv) loam soil (rhizosphere and bulk) used under various wheat types. Soil water retention, modified van Genuchten model parameters and structure stability indices were determined using a modified version of the HEMC method and soil-HEMC model (Pierson and Mulla, 1989; Levy and Mamedov, 2002; Mamedov and Levy, 2013). In this method, 15 g macroaggregates (0.5-1 mm) are placed in a funnel with a fritted disc (pore size 20-40 µm) which is wetted from the bottom in a controlled manner (slow ~2 or fast ~100 mm h^{-1}), with a peristaltic pump, and then a water retention curve at high energies of matric potential (0 to 50 cm H_2O), corresponding to drainable pores (> 60 µm), is performed using small steps (1-2 cm). Soil structure stability is expressed in terms of a structural index (SI) defined as the ratio of volume of drainable pores (VDP) to modal suction (MS). Soil-HEMC model (Mamedov and Levy, 2013), which enables an accurate fit of the water retention curves (ψ, 0 to 50 cm) for a wide variety of soils (R^2>0.99), was used to calculate structural indices (VDP, MS) and model parameters (α and *n*) by the following equations (Pierson and Mulla, 1989):

$$\theta = \theta_r + (\theta_s - \theta_r)\left[1 + (\alpha\,\psi)^n\right]^{(1/n-1)} + A\psi^2 + B\psi + C \qquad [1]$$

$$d\theta/d\psi = (\theta_s - \theta_r)\left[1 + (\alpha\,\psi)^n\right]^{(1/n-1)}(1/n - 1)(\alpha\,\psi)^n n/\left[\psi(1 + (\alpha\,\psi)^n)\right] + 2A\psi + B \qquad [2]$$

where, θ_r and θ_s are the residual and saturated water content, respectively; α (cm^{-1}) and *n* represent the location of the inflection point and the steepness of the S-shaped water retention curve; A, B and C are the coefficients.

Results and Discussion

Changes in soil structure following aggregate breakdown by wetting, generally, results in the shift of the wetting curve to the left resulting from formation of a larger number of aggregates or particles of smaller sizes (leading to smaller inter-aggregate pores) than the original ones. Semi-arid soils, known to have weak aggregates, were found to be sensitive to aggregate breakdown by fast wetting (i.e., slaking); with the effect being more pronounced in the soil with low clay content (Fig.1).

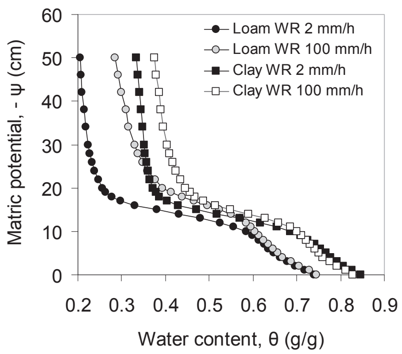

Fig. 1. Soil water retentiaon as affected by texture and wetting rate (WR)

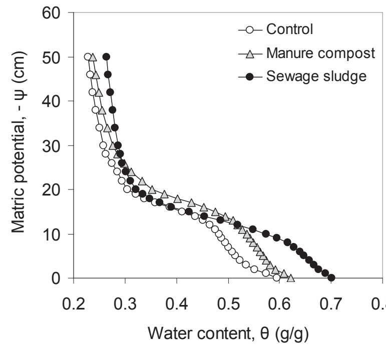

Fig. 2. Loam soil water retentiaon as affected by composted manure and sewage sludge application

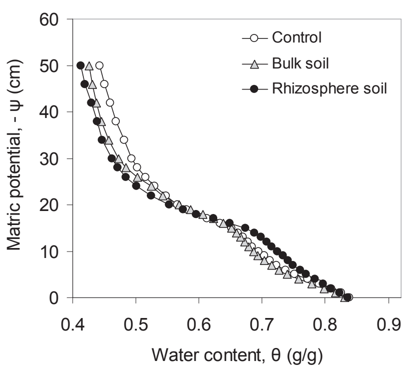

Fig. 3. Loam soil (rhizosphere and bulk soil) water retentiaon as affected by cropping

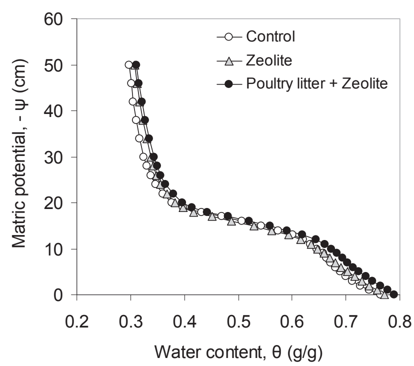

Fig. 4. Clay soil water retentiaon as affected by poultry litter and zeolite treatments

Differences in the water retention curves between the less stable and stable soil aggregates (originating from differences in soil type or extrinsic conditions) were mostly in the matric potential range of 0 to -12 cm, and smaller in the range of 12 to -

50 cm corresponding to differences in macro-, meso-, and micropores (>250; 60-250 μm) (Figs. 1-4). Aggregates' breakdown is reflected by a decrease in SI and α or α/n and by an increase in *n*. The SI of soil increased exponentially with increase in water retention model parameters α and a decrease in *n* (Figs. 5 and 6). Furthermore the relationship between the SI and α/n could be considered as linear, yet of different properies (Figs. 7-9). In the coarser textured loam, aggregate resistance to slaking was attained mainly by the presence of the coarser fraction of organic matter (e.g., plant roots and fungal hyphae), whereas in the clay soil it was obtained by the high clay content. The rhizosphere soil is directly influenced by the root, plant residues, root secretions and symbiotic associated microorganisms (e.g. mycorrhizal fungi). Poultry litter and zeolite application increased or enhanced soil water retention; treating soil with composted manure and sewage sludge coated bridge between soil clay platelets, and analogous to the effect of hydrophobic humic substances, they improved structure stability and aggregate resistance to slaking by water (Mamedov and Levy, 2013).

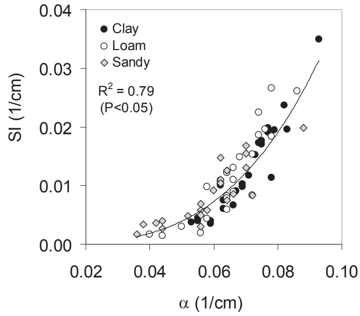

Fig. 5. SI as a function of α for soils treated with composted manure and sewage sludge

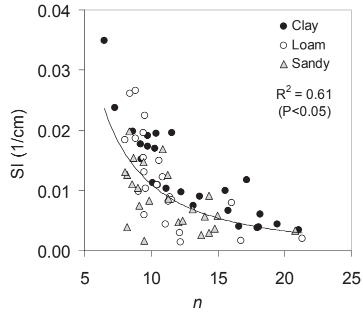

Fig. 6. SI as a function of *n* for soils treated with composted manure and sewage sludge

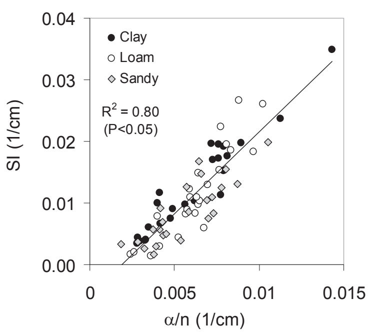

Fig.7. SI as a function of α/n for soils treated with composted manure and sewage sludge

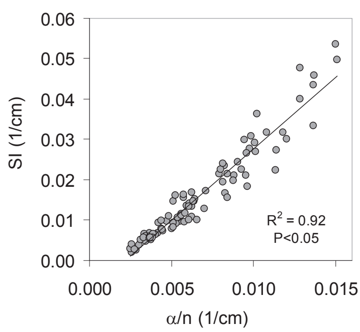

Fig. 8. SI as a function of α/n for long term cultivated soils varying in texture from sandy to clay

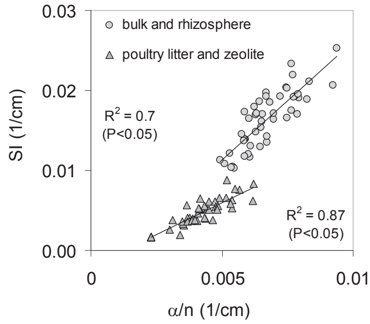

Fig. 9. SI as a function of α/*n* for (▲) loam used under wheat varieties (•) clay treated with poultry litter and zeolite

Conclusion

The paper presents results obtained from studies, in which the HEMC method was employed to characterize soil structure stability in terms of changes in macro pore size distribution obtained from water retention curves at near saturation (ψ, 0 to -50 cm). Research data reporting a wide range of changes in PSD, and structure stability indices of semiarid soils widely varying in intrinsic properties and management histories were used and relationship between SI and model parameters α and *n* were established. The results indicate that pore and aggregate size distribution of cultivated semi-arid soils can be strongly influenced by agricultural management, but the resilience of the structure largely depends on soil type and properties. It is postulated that description of the water retention by soil-HEMC model and linking model parameters to soil structural index and thus pore- and aggregate size distribution, may help to select proper management practices for obtaining the most suitable type of aggregation depending on the desired soil function or soil type.

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Bioavailability of heavy metal compounds from the soils contaminated by the power station emissions

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Key words: contamination, plant, soil, translocation

Introduction

Energy industries, along with the steel companies, coal-mining industries are active sources of environmental pollution by heavy metals. To obtain a clearly expressed picture about the environmental situation at the territory within the influence zone of the power station, it was necessary to determine the available relationship in distribution of trace elements in soils and plants. Every metal taken up by plants for a long period of time was accumulated in them to a definite level, above which significant harmful changes occur in the plant quality. Adverse consequences of such accumulation were manifested in time, depending on technogenic loads and the response of the soil-plant system to trace elements. The main objective of the work was to study bioavailability of heavy metals (HM) compounds under technogenic emission of Novocherkassk power station (Russia).

Materials and methods

The objects of research were abandoned plots of grasslands near Novocherkassk power station (NPS), one of the largest power stations in Russia. The majority of the soils of monitoring plots were ordinary chernozems; the low-humus calcareous sandy alluvial meadow soil, which had a light texture and a low cation exchange capacity (CEC), and the low-humus silty clayey meadow-chernozemic floodplain soil with a high CEC that differed from the control soils.

Plant sampling was taken to analyze the averaged samples of grass harvest at monitoring plots. Since 2000 the soil and plant sampling has being taken yearly in the period of the active plant growth and development.

The total contents of Ni, Mn, Cd, Cu, Zn and Pb in the soils were determined with the X-ray fluorescence method. The metals compounds classified as loosely bound were transferred to solution by means of parallel extractions using the following reagents (Minkina et al., 2008): 1 N ammonium acetate buffer (NH_4Ac) pH 4.8 capable of solubilizing the exchangeable forms of metals characterizing their “actual” mobility. 1% EDTA solution in NH_4Ac with pH 4.8, which supposedly solubilizes the relatively unstable complex compounds of metals together with their exchangeable forms. The concentrations of the metals in the complex compounds were calculated by the difference between the metal concentrations in extracts 2 and 1. The acid soluble metal compounds extracted with 1 N HCl characterize the reserve of the mobile metal compounds in the soil. They are supposedly represented by the metal

ions capable of exchange and by the specifically absorbed compounds including the Fe and Mn retained by the amorphous oxides and carbonates. The amount of specifically absorbed metal compounds was calculated by the difference between the metal concentrations in the HCl and NH_4Ac extracts. The group of loosely bound compounds is the most important from ecological viewpoint and capable to enter adjacent areas and the plants in particular.
The concentration of trace elements in the plants was determined using the wet combustion in a mixture of HNO_3 and HCl at 450˚C (Methodological guidelines on determination of heavy metals…, 1992). The content of elements in extracts from soils and plants was determined by FAAS.

Results and discussion

Metals total content in soil of the monitoring plots located far from the power station didn't exceed the maximum permissible concentration (MPC). The content of loosely bound compounds was insignificant in soils of these monitoring plots and well agrees with their average content in grass plants of the given region (Table 1).

Table 1

Total content and loosely bound compounds of heavy metals in soil of monitoring plots, mg/kg

Plot number; distance (km) and direction from the NPS	Pb	Cd	Zn	Cu	Ni	Mn
1. 1.0 NE	**42**/3.5	**0.6**/0.03	**104**/10.8	50/2.4	58/2.2	905/23
2. 3.0 SW	21/2.2	**0.6**/0.03	79/11.6	44/3.7	37/1.7	612/30
3. 2.7 SW	30/1.8	0.5/0.02	100/4.6	54/1.9	50/1.4	647/19
4. 1.6 NW	**67**/6.7	**1.0**/0.17	**111**/16.5	**73**/4.7	65/3.5	931/63
5. 1.2 NW	**60**/6.4	**1.3**/0.19	**141**/25.0	**63**/3.5	65/3.5	894/69
6. 2.0 NNW	**59**/4.7	**1.1**/0.15	**115**/13.0	**59**/4.0	61/2.7	932/52
7. 1.5 N	**34**/3.4	**0.6**/0.04	92/5.6	42/1.2	55/1.6	731/31
8. 5.0 NW	**43**/3.0	**0.6**/0.02	**116**/14.0	**60**/3.2	56/1.5	731/23
9. 15.0 NW	28/1.0	0.3/0.01	**82**/2.1	41/1.0	41/0.7	699/13
10. 20.0 NW	**37**/3.1	0.3/0.01	**77**/1.4	41/0.7	41/0.9	756/11
11. 1.0 SE	27/1.6	0.5/0.02	**108**/1.7	38/0.6	47/0.8	719/43
12. 1.1 S	25/1.4	0.4/0.05	92/2.4	35/1.2	48/1.0	628/27
$LSD_{0.95}$	3/0.7	0.1/0.01	4/2.7	4/0.2	3/0.5	18/4
MPC	32/6	0.5/0.05	100/23	55/3	85/4	1500/700

Note: in the numerator - the total content; in the denominator - mobile units; in bold – the monitoring plots, situated on the wind general direction, as well as the excess of MPC

Due to the effects exerted by discharges of the power station the total content of metals proved to be increased in soils located near this contamination source along the line of the wind general direction. The amount of loosely bound compounds increases as well. The total content of Cu, Pb, Zn and Cd and the content of their exchangeable compounds exceed the MPC in these soils (Table 1).
The plants at the plots located near the power station (within 5 km) were contaminated with Ni, Cu, Zn and Pb, thus exceeding the MPC in the terrestrial part

of grass plants (Table 2). The maximum content of metals in plants may be presented in the following way: Zn > Mn > Cu > Pb > Ni > Cd.

The trace elements accumulation by plants was affected by soil properties. The concentration of Cd, Ni, Mn, Zn and Cu in plants grown on the meadow-chernozem soil was lower by 1.2-2.6 times than that on alluvial meadow sand soil characterized by insignificant buffering capacity to metals.

The studied heavy metals take part in the formation of the soil-plant system stability to contamination in the following way: Cd > Zn >> Pb > Cu > Mn > Ni. Thus, it is advisable to evaluate an environmental risk in the soil-plant system taking into account not only the total HM content in soils but also the amount of their loosely bound compounds.

Probably, the metal compounds adsorbed from the polluted atmosphere play an important role in accumulation of these metals by the terrestrial organs of the vegetation.

Table 2

The heavy metal content in natural grass vegetation at monitoring plots, mg/kg

Plot number; distance (km) and direction from the NPS	Pb	Cd	Zn	Cu	Ni	Mn
1. 1.0 NE	**8.2**	**0.8**	44	6.9	3.0	37
2. 3.0 SW	4.3	**0.5**	48	11.4	**3.2**	42
3. 2.7 SW	**5.6**	0.2	32	4.3	2.4	35
4. 1.6 NW	**13.8**	**1.3**	**80**	10.9	**3.2**	53
5. 1.2 NW	**8.9**	**1.2**	**64**	14.5	**4.4**	58
6. 2.0 NNW	**7.6**	**0.4**	34	11.0	**3.2**	40
7. 1.5 N	**5.5**	**0.5**	43	6.4	2.9	60
8. 5.0 NW	4.2	0.3	**54**	8.1	2.3	29
9. 15.0 NW	4.2	0.2	28	3.2	1.7	33
10. 20.0 NW	**12.0**	0.2	26	8.2	1.5	32
11. 1.0 SE	5.1	0.1	49	8.0	1.6	18
12. 1.1 S	**11.0**	0.1	29	14.5	**4.0**	9
$LSD_{0.95}$	1.3	0.06	3.0	1.6	0.4	4.5
MPC	5.0	0.3	50	30	3.0	-

Note: in bold – the monitoring plots, situated on the wind general direction, as well as the excess of MPC

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Entropy chemical composition of mountain soils in the middle Ural

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Introduction

Development of soil information systems and statistical world view leads to the necessity to consider a soil as an information-carrying medium [1-6]. Entropy S is a characteristic of diversity. It is a quantitative measure of the information carried by an object. The well-known formula by K. Shannon [7], in which the entropy is represented as a sum of series of probabilities multiplied by their logarithms, allows us to calculate the amount of information. Entropy has long attracted scientists' attention, and therefore its scientific application was developed in the soil science among other. Entropy is widely used to assess the differentiation of components in various systems of different levels [1-6, 8-15] in order to characterize the degree of lack of order in the system. To understand the genesis of soils one needs to know their chemical composition, which is the most conservative of soil properties, but still it contains a huge amount of information on the composition and migration of elements, heterogeneity of the soil profile, the "memory" of soil and other important issues. Bulk chemical composition is a multi-component system which can be characterized using a fundamental physical characteristic – the entropy *S*. In terms of the soils chemical composition entropy characterizes the measure of differentiation of chemical elements or oxides.
In mountain areas, problems of studying soils are associated with many factors. The bulk composition of mountain soils is an informative indicator of their genesis and evolution. Entropy has not been calculated for bulk composition of mountain soils before.
And therefore the purpose of the study is to explore a variety of bulk composition of mountain soils using information and energy approach.

Materials and Methods

The study of informational diversity of bulk composition of mountain soils was carried out in the Middle Urals in the territory of the "Basegi" State Natural Reserve. On the reserved territory there is a Basegi mountain range elongated in the meridian direction. It is located between 58°50' and 60°00' N on western spurs of the Urals in the east of the Perm region. The studies were conducted in 2009-2012 at an altitude from 950 m (goltsy altitudinal belt) to 315 m (mountain forest belt) on North Basegi mountain. Soil cross sections were made on the slopes of different exposures in the goltsy, subgoltsy (crooked forest, subalpine meadows, park forest), and mountain forest belts. Sampling has been conducted through genetic horizons of the soil profile. The bulk content of the elements was determined in 12 cross sections using X-ray fluorescence analysis instrument "ReSpect" with atomic-absorption ending in the laboratory of soils physical chemistry of Soil Institute named after V.V. Dokuchaev. Calculation of the entropy (*S*) was performed based on the chemical composition using the formula [10]:

$$S = -\sum_{i=1}^{N}\left(\frac{x_i}{G}\right)\log_2\left(\frac{x_i}{G}\right) \quad (1)$$

where x_i – proportion of i oxide; G – sum of all oxides, %; N – number of oxides. Statistical analysis was performed in the "Data Analysis" software in Microsoft Excel and the STATISTICA 6.0 software.

Results and Discussion

There were discovered spatial heterogeneity of soil covering and diversity of soils belonging to five formations of post lithogenic soil forming: alfehumic (cross section 18), eluvial (cross section 31), structural and metamorphic (cross sections 15, 17, 19, 26, 27, 30, 32), organic-accumulative (cross sections 28, 29), and gley (cross section 24).

The maximum values of entropy in the upper horizons and throughout the profile are marked in soils under subalpine meadows (S = 1.66-1.73; organic-accumulative soils, cross sections 29, 28), which is above average for soils (1.36-1.40). These values indicate poor oxides differentiation in soils under miscellaneous meadow grasses and the possible prevalence of soil-forming processes over weathering. Feature variation in the soil profile is insignificant (V = 1.0-1.9%).

In the brown soils, entropy values are slightly lower which is probably due to the greater oxides differentiation under the spruce-fir forests with large grass (cross sections 15, 17, 19, 26, 27). Moreover, it should be noted that in the brown soils on the slopes of the western exposure soils entropy is greater (1.54-1.65) than in the brown soils on the slope of the eastern exposure (1.32-1.47). Thus, this suggests a greater differentiation of the soils chemical composition on the eastern slopes. The degree of feature variation is insignificant, but still it is different at slopes of the western (2.3-2.8 %) and eastern (4.3 %) exposures.

In soils forming in more severe conditions (at an altitude of 600-955 m above sea level), the entropy of the soil bulk composition is less than in other soils studied. For example, in alphehumic soil (dry peat podzolized brown soil, cross section 18, 900 m above sea level) S = 1.36-1.37, variation of the feature through the profile is insignificant. In eluvial soil (cross section 31, 755 m above sea level) entropy values <1.0 and only in the soil eluvium is equal to 1.09. The differentiation of chemical composition is maximally expressed and ratios of the elements are contrasting in the profile. The coefficient of variation of the feature in the profile for these particular soils is the maximum and corresponds to 14.1 %.

As a parameter characterizing the pedogenesis [10], entropy can be used for diagnosing soil-forming processes by change of entropy in the soil profile. Thus, in horizons with signs of gleyzation there is an increase in S (in gley soils, c. 24). In the horizons where eluviation is observed, entropy decreases since unstable compounds are removed and stable are accumulated. In illuvial horizons ratio of chemical elements equalizes leading to an entropy increase. Thus, the degree of differentiation of the chemical composition of the soil profile can be evaluated using the entropy.

Aanalysis of the relationship between entropy and oxides content regardless of altitude and vegetation belt and the area altitude shows a high dependence of the entropy on Fe_2O_3, K_2O, MgO and negative on SiO_2. It is possible that the release and distribution of these oxides is the feature of brown soils forming, resulting in destruction of the primary minerals and forming secondary clay minerals. It is believed that a high dependence between entropy and content of SiO_2, Al_2O_3, Fe_2O_3 is an essential feature of podsolization [10]. In the studied soils of the Middle Urals, this dependence is not apparent.

Assessment of the degree of soil differentiation by chemical composition was also performed by types of soils allocated in the North Basegi. In alfehumic soils, there is a strong correlation between the entropy and the content of all determined oxides. In eluvial soils the degree of differentiation of the profile by the chemical composition is mostly dependent on the content of Al_2O_3, K_2O, Fe_2O_3, TiO_2, MnO. In structural and metamorphic soils, profile differentiation is due to the distribution of bulk Fe which is involved in brown soils forming. In the organic-accumulative soils, entropy is greatly associated with the distribution of Na_2O (0.85) and in average degree (more than 0.5) with the content of sesquioxides (Al_2O_3, Fe_2O_3). In gley soils, entropy depends on the distribution of oxides through the profile: MgO, Al_2O_3, Fe_2O_3, TiO_2, K_2O, SiO_2, MnO. In soils of mountain forest belt, entropy of the bulk composition does not depend on the elements accumulation factor (*R*) and subsurface weathering (*Kw*) in the soil profile, depends weakly on the eluviality (*Ke*) and oxidation (*Kox*) of mineral part of soils. This suggests a uniform distribution of system components. In soils of subgoltsy and goltsy belts the bulk composition entropy has a strong connection with the calculated geochemical coefficients. Bulk composition entropy directly strongly depends on the accumulation of chemical elements (*R*) and the degree of oxidation (*Kox*): r= 0.772 and r=0.933 correspondingly. Increasing of the pedogenic weathering and eluviality of the mineral part leads to a decrease of entropy in the system, indicating that distribution of components in the system becomes less uniform. Interaction of accumulation, synthesis and destruction processes determines the extent of order in these soils. Considering the bulk composition entropy by the types of soils in the North Basegi, dry peat podzolized brown soil (955 m), eluvial soils (755 m), gley soils (518 m) are distinguished. In these soils, entropy strongly depends on the processes of accumulation of chemical elements, weathering and oxidation of the mineral part of the soil. This dependence is weaker in brown soils and organic-accumulative soils.

Entropy in soils of mountain forest belt depends on the chemical composition of the silicate and crystallized forms of iron compounds. Entropy in soils of goltsy and subgoltsy belt depends on the chemical composition of all forms of iron compounds and their proportion in the chemical composition. Thus, increasing the proportion of non-silicate iron compounds in bulk iron content causes the bulk composition entropy to decrease, indicating a reduction in the system equilibrium and the non-uniform distribution of its components. In eluvial and gley soils, reducing of content of silicate forms of iron compounds is followed by increasing of the bulk composition entropy, indicating that the system is moving away from the static equilibrium and the degree of order decreases. In brown forest and especially in organic-accumulative soils bulk composition entropy depends weakly on the iron compounds in the soil. However, the ratio of the proportion of silicate iron to non-silicate affects the entropy in the brown forest soils. Only in brown forest soils bulk composition entropy is directly correlated with the content of silicate forms of iron. In the organic-accumulative soils, entropy is more dependent on the proportion of amorphous iron in the non-silicate part. The smaller the proportion of amorphous iron, the less bulk composition entropy, which indicates that the system approaches a static equilibrium and greater order.

Conclusion

The use of entropy allowed determining the degree of differentiation and heterogeneity of soils by chemical composition of the mineral part of the soils.
Evaluation of the soil elemental composition of the undisturbed ecosystems in the "Basegi" reserve showed the presence of correlation between entropy and the oxides content, which is mostly apparent with the content of iron oxide and oxides of alkali and alkaline earth metals as well as titanium and manganese.
Homogeneity of horizons within the soil profile (slight variation of entropy) was found, which indicates the absence of podzolization processes. The degree of change of entropy within the profile allows diagnosing humus accumulation processes, eluviation, illuviation, gley soil forming, and brown soil forming. In general, the entropy of the chemical composition of mountain soil is lower than lithosphere entropy, indicating manifestation horizon and profile forming soil processes that disrupt the steady equilibrium of the system components resulting in a decrease or increase in the system entropy.

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Contemporary changes of information characteristics of the humus content in southern chernozems in Western Siberia

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Key words: monitoring, climatic cycle, probabilistic distribution, entropy, divergence

Introduction

The climatic factor is one of the soil forming factors therefore cyclic changes of its indicators influence soils, their properties and the modes. Changes of properties of soils in very long cycles are studied by paleo pedological and geological researches. Changes of properties of soils in cycles of small duration from one to several decades can be traced by monitoring of current state of soils and its comparisons with similar data of previous years that allows to consider a temporary chain of the conditions of the soil which are consistently replacing each other. Allocation of anthropogenous and climatic component in contemporary changes of soil properties is important for assessment of modern states and transformations of soils and forecast of future ones.
The concept of different characteristic times the soil forming processes was offered in [Armande, Targulian, 1974]. Existence of direct connections between processes of different characteristic times rather obvious, within a chronological sequence whereas feedback can have latent character, representing special "a temporary bomb" [Targulian, Krasilnikov, 2007]. The climatic recurrence which is shown in the periodic changes of amount of heat and moisture coming to the soil leads to energy fluctuations the soil forming processes [Volobuyev, 1974]. It, obviously, influences fluctuations of speed the soil forming processes which, apparently, have to lead to the peculiar "portionity" of soil formation connected with climatic recurrence. In this regard, an objective of this research is to estimate changes of properties of soils for rather short (about 30 years) interval in which features of climatic recurrence in the south of Western Siberia on moisture content degree are shown.

Materials and Methods

Territory of investigation. The territory in which researches were conducted, is located 53 °15'N - 53 °47'N; 75 °05'E - 77 °01'E. In the geomorphologic relation the territory of researches represents the central and east part of the Priirtyshsky uval. It is put from the breeds of sandy and sandy loam texture which are replaced by loams, and then clays on the slope in direction to the East. The climate of the area is sharply continental with dry hot summer and cold low-snow winter. It is characterized by dryness of the spring and summer period, a maximum of rainfall usually happen in the middle of the summer. An average annual amount of precipitation — 275,5 mm, sometimes to 400mm. The mean annual coefficient of moistening is equal 0,4-0,6 – that is characteristic for the droughty steppe. Soils generally are chernozems, meet solonetzic and saline complexes.

Research methods. In the concept of holistic assessment of states and changes of natural objects taking into account their internal variability it was offered to use information characteristics of states and changes of soils [Mikheeva, 2011] (table1).

Table 1

Information characteristics of states and changes of soil objects

Category	Indicator	Calculation
State of soil in moments *t1*, *t2*	Probabilistic distributions *W(x)* of soil property in moments *t1* , *t2*	$W1(x) = W^{t1}(x, \theta_0^{t1}, \theta_1^{t1}, \theta_2^{t1}, \theta_3^{t1})$ $W2(x) = W^{t2}(x, \theta_0^{t2}, \theta_1^{t2}, \theta_2^{t2}, \theta_3^{t2})$
	Statistical entropy, *h in t1* , *t2*	$h_{t1} = -k \int_{-\infty}^{+\infty} W1(x) \ln W1(x)\, dx + h_0$ $h_{t2} = -k \int_{-\infty}^{+\infty} W2(x) \ln W2(x)\, dx + h_0$
Change of soil during period $\Delta t = (t2 - t1)$	Increment of statistical entropy, Δh during period $\Delta t = (t2 - t1)$	$\Delta h = h_{t2} - h_{t1}$
	Informational divergence $d = \Delta W(x)$ during period $\Delta t = (t2 - t1)$	$d = \int_{-\infty}^{+\infty} (W1(x) - W2(x)) \ln\left(\frac{W1(x)}{W2(x)}\right) dx$

In this work were used contemporary records of studying of soils by standard methods at large-scale mapping and monitoring of soils, laboratory methods of determination of soil properties [The all-union instruction …, 1973]. As initial data served materials of the large-scale (1:25000) soil investigations conducted in the studied territory at different times by standard techniques[2]. Formation of databases, grouping and the analysis of data were carried out by methods of the statistical analysis. Volumes of the received statistical samples were n = 40-130. They were enough for carrying out the probabilistic analysis consisting in an assessment of parameters and choice of the most suitable theoretical probabilistic distribution on the basis of a new technique of check of statistical hypotheses [Lemeshko, 2005]. Information characteristics were calculated using received probabilistic distributions, by formulas in tab. 1.

Results and Discussion

In the studied territory chernozems southern, low-power, deep-solonetzic, sandy loam and loam (in Russian classification) are the most widespread soils. Therefore in this article the conditions of these soil verities were estimated for the beginning (1963) and for the end (1989) of the considered period. The quantitative model of a condition of the soil offered by us represents set of probabilistic-statistical distributions (PSD) of soil properties within the studied object. In the work the analysis and identification of probabilistic distributions of the humus content in sandy loamy and loamy southern chernozems in layers of earth 0-20, 20-30, 30-50 and 50-100 cm for the beginning and the end of the studied period were carried out. The type and parameters of mathematical functions of PSD were determined by set of statistical criteria in the best way (with the maximum average reached probability) correspond to the statistical distributions constructed according to factual data of soil investigation.

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Basic types of PSD of the humus content in soil layers – Ln-normal, the Maximum value – the distributions which are characterized by essential right asymmetry and more or less wide center. Other group of distributions: Normal, Double exponential, Logistic, Laplace, Cauchy –are symmetric functions, with various degree of expressiveness of the central part – from wide central part at normal distribution to very narrow center at Laplace and Cauchy's distributions.
The happened transformation of PSD of the humus content in 0-20 cm characterizes the tendency to reduction of the humus content in the top soil layer in whole on the soil cover presented by southern sandy loamy chernozem. It transformed from Ln-normal in the 63rd to Double exponential in 89th year. Changes of PSD of the humus content in loamy chernozem are similar, but they are expressed to lesser extent. Here the type of the PSD in 89th year remained the same that was in the 63rd - Ln-normal, changes concerned only parameters of function. The graphical analysis and comparison of PSD of the humus content in 63rd and 89th, showed existence of the positive tendency consisting in increase in the humus content in layers of 20-30, 30-50 and 50-100 cm.
The described above visual tendencies in change of PSD can be quantitatively estimated by means of such information indicators as an increment of statistical entropy and information divergence. Results of calculations of these characteristics are given in tab. 2.

Table 2

Information indicators of PSD of humus content in southern chernozems

Layer, cm	Statistical entropy		Entropy increment (1989)-(1963)	Informational divergence (1989)-(1963)
Year	1963	1989		
Sandy loamy soil				
0-20	0,80	0,34	-0,46	0,45
20-30	0,69	0,74	0,05	0,55
30-50	0,42	-0,23	-0,65	4,49
50-100	-0,31	-0,25	0,06	1,22
∑ по профилю	1,60	0,6	-1,0	6,71
Loamy soil				
0-20	0,75	0,48	-0,27	0,18
20-30	0,81	0,78	-0,03	0,53
30-50	0,35	-0,14	-0,49	2,50
50-100	- 0,25	-0,56	-0,31	2,18
∑ по профилю	1,66	0,56	-1,1	5,39

These data show that statistical entropy of the humus content in soil layers and in general on a profile of chernozems is small. For the studied thirty-year period statistical entropy of the humus content decreased: in a profile of the sandy loam soil for 63%, and in loamy soil for 66% of a reference value. It means that the condition of chernozems significantly changed in spite of the fact that absolute values of the humus content practically didn't go beyond variation intervals for the beginning of the studied period. Essential reduction of statistical entropy testifies the reduction of a variety of micro conditions in the soil.

The quantitative assessment of transformation of probabilistic distributions is given by value of information divergence. This value doesn't depend on dimension of a property therefore it gives the chance of relative assessment of intensity of processes of changes of soil properties in a profile in spite of the fact that their absolute values in a profile significantly differ. In layer of 0-30 cm information divergence is moderate, but in deeper layers it is very considerable to 4.5. In sandy loam chernozems total on the profile information divergence is much more, than in the loamy soils. It means that the condition of the soils located generally on the most sublime part of the Priirtyshsky uval changed rather more strongly.

Amphiphilic components of humic substances and wettability of the soil solid phase surface

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Key words: wettability, contact angle, humic substances, amphiphilic components, densitometric fractions.

Introduction

The soil solid phase surface as the boundary between elementary soil particles and the pore space govern all important processes in the soil – from sorption and desorption of chemical compounds on a micro-scale to the soil wetting at the macro level. Wettability is one of the most important features of soils as it directly influences their physical, mechanical, chemical, biological and fertility properties. Water stability of the aggregate structure is directly related to the surface properties of elementary soil particles (ESP) in the solid phase (SP) of the soil. In the case of ESP hydrophilicity water flows through the capillaries in the dry aggregate, which leads to an increase of water disjoining pressure in the aggregate and its destruction. When ESP surface is hydrophobic, adhesion is reduced because there is no attraction between water molecules and non-polar surface. Thus "dead zones" unapproachable to water and plant and microorganisms nutrition particles appear in the aggregates. Contact angle (CA) is used to characterize the wetting quantitatively, determining physicochemical interactions at the interface between the liquid and the solid phase [6]. CA, or more specifically, water-air CA is an intrinsic property of solid-liquid-gas systems such as soils [7]. It is important for many physical processes involving the interaction of soil and water [1,3], i.e. water infiltration, redistribution, groundwater recharge, solute transport in unsaturated zones, compaction and aeration in variably saturated soils, and temperature-induced water redistribution [2,5]. The aim of this study was to establish a connection between the wettability of surface densitometric fractions with hydrophobic and hydrophilic components of humus substances within these fractions.

Material and Methods

The samples were taken from the two horizons (10-15, 40-45 cm) of chernozem within an oak wind-proof forest strip without grass cover (51°36'21.8" N 38°58'11.1" E, Voronezh region, Russia). The content of water-stable aggregates (> 1 mm) was 60-75 %. Densitometric fractions were isolated with sodium polytungstate solutions with variable density. We used the previously described method [4] to obtain the density fractions from the bulk soil: occluded particulate organic matter (oPOM) with a density of <1.6 g cm^{-3} ($oPOM_{<1.6}$), 1.6–1.8 g cm^{-3} ($oPOM_{1.6–1.8}$), 1.8–2.2 g cm^{-3} ($oPOM_{1.8–2.2}$) and mineral fraction with a density of > 2.2 g cm^{-3} ($MF_{>2.2}$). Allocated, but did not analyze free particulate OM with a density < 1.6 g cm^{-3}. To disrupt all samples, we used an energy input of 160 J ml^{-1} (Digital Sonifir 250, Branson Ultrasonics, USA).

Carbon and nitrogen contents of bulk samples and their density fractions were determined by dry combustion in Vario EL element analyzer (Hanau, Germany). Inorganic C was not present in any sample, thus all of discovered carbon corresponds to organic carbon.

The contact angles (Sessile Drop Method) were determined using a goniometer (Drop Shape Analysis System, DSA100, Krüss, Germany). Sample preparation: a monolayer of each sample fixed on a double-sided adhesive tape, which was glued on a glass slide, was used for the contact angle measurements. To determine the contact angle, the drop contour was mathematically described by the Young–Laplace equation using DSA100, and the contact angle was determined as the slope of the contour line at the three-phase contact point. The measurements were repeated 10-15 times for every sample.

For contact angle measurements, the syringe needle was positioned 0.2 mm from the surface of the sample, and a drop of the test liquid (2 μL) was dispensed at a constant rate of 1.75 μLs^{-1}. The drop shape was monitored with a digital camera for 20 s, and contact angle, drop diameter, and volume were recorded.

Using Octyl_Sepharose CL-4B, humic substances isolated from densitometric fractions (NaOH + $Na_4P_2O_7$) were fractionated by hydrophobic interaction chromatography (HIC) with low pressure liquid chromatograph BioLogic LP (BioRad, USA). Column: Octyl Sepharose CL-4B, 1x10 cm; sample: 100 µl; flow rate: 1 ml/min; Detection: A280. Elution of HS sorbed on the matrix gel was performed by a gradual attenuation of HS hydrophobic contacts with matrix gel – first with 0.05 M Tris-HCl buffer with a negative concentration gradient of $(NH_4)_2SO_4$, and then with increasing concentrations of Sodium Dodecyl Sulfate (SDS) in buffer. Last fraction was desorbed with 5 mM EDTA+0.2 N NaOH solution). Details of the used method are described in [8]. Hydrophilic components dominate the content of first (1, 2, 3) chromatographic fractions, whereas hydrophobic ones are mostly present in fractions 4 and 5.

Results and Discussion

Total organic carbon content and C/N ratio of the fractions are inversely proportional to their density, dropping from 30-47% to 0.6% and from 21-28 % to 8 %, respectively (Table 1).

With fractions densities increase, wettability of their surface increased as well. The surfaces of the $oPOM_{<1.6}$ was hydrophobic (CA 90º), and the rest was hydrophilic (CA 59-50-33º). HIC allows to physically divide a set of humus substances in extract into components (5 fractions) differing in ability to participate in hydrophobic interactions with a gel matrix (Fig. 1**)**. The decrease in contact angle of wetting of densitometric fractions was found to be accompanied by an increase of the relative content of hydrophilic components of humic substances (fractions 1, 2, 3) and the reduction of hydrophobic compounds (fractions 4, 5). The correlation coefficient between the value of the contact angle of wetting of densitometric fractions and the relative proportions of hydrophilic (fractions 1, 2, 3) and hydrophobic (fractions 4, 5)

HS components is 0.90 and 0.94 respectively. In the first case there was an inverse linear correlation, while the second correlation was direct.

Table 1

Organic carbon, C/N and the contact angle for the soil and its Density fractions

Horizon	Depth, cm	Sample		OC, g kg-1	C/N	Contact angle, degree
A1	10-15	Bulk soil		398.0	13	31.0±1.8
		Density Fractionation, g cm-3	< 1.6	295.0	21	90.6±1.2
			1.6-1.8	250.0	17	59.7±0.9
			1.8-2.2	47.9	10	47.5±0.7
			>2.2	6.0	8	34.5±0.7
AB	40 - 45	Bulk soil		202.0	12	30.0±0.6
		Density Fractionation, g cm-3	< 1.6	474.3	28	90.5±1.4
			1.6-1.8	360.0	16	57.0±1.0
			1.8-2.2	52.6	10	50.0±0.8
			>2.2	5.8	8	33.2±09

Humus and structure of soil aggregates are two specific, interrelated and interdependent product of soil genesis. Studies conducted allow us to create a first approximation of the spatial and structural-functional organization of the hydrophobic-hydrophilic HS components in chernozem aggregates. Hydrophobic components of soil humus substances are indigenous formations spatially dated for humification products of organic material *in situ* within the aggregates [8]. Our results indicate that the heterogeneity of surface wettability of the solid phase components of soils is related to heterogeneous distribution of hydrophilic and hydrophobic organic matter within the aggregates [9].

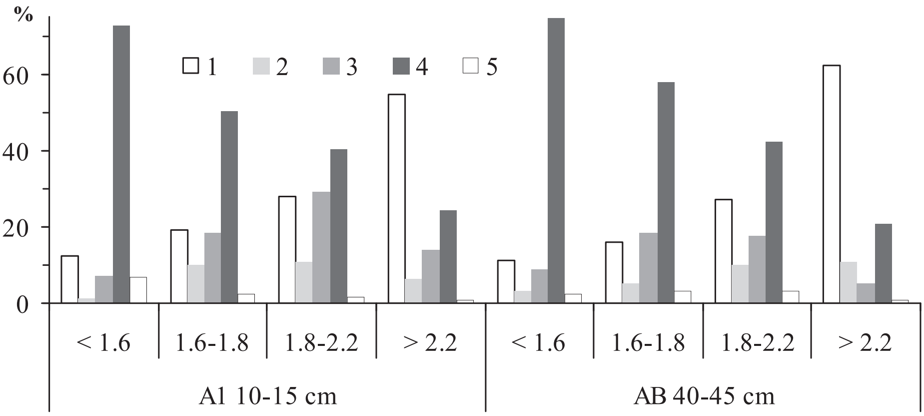

Fig. 1. Content of hydrophilic (1,2,3) and hydrophobic (4,5) components of HS extracted from densitometric fractions.

The data obtained allows creating highly schematized model of the structural and functional organization of the hydrophobic-hydrophilic components in the chernozem aggregate formation. In the mineral horizons profile during humification of organic material *in situ* the heterogeneous system of SOM is formed whose components differ by hydrophobic-hydrophilic properties. Water-soluble (hydrophilic) products are removed from humificated plant residues and, contacting the surface of the mineral particles, form sorption and organo-mineral complexes with this surface, reducing its hydrophilic properties due to mutual locking of polar groups of the mineral matrix and organic molecules, covering her surface. In other words, the surface of mineral solids becomes hydrophobic. In turn, the hydrophobic products of organic material humification, incapable of water migration, remain at the place of formation. These hydrophobic components are spatially "isolated" from mineral particles, being caught between them. Accumulation of hydrophobic components of HS in the internal volume of the aggregate is helped by quasianaerobical conditions of organic material humification. These conditions of the formation of "fresh" humus were described in works of V.R. Williams. Nonpolar molecular fragments, on the one hand, determine their hydrophobic properties, and on the other – their resistance to oxidative, microbiological waste mineralization, especially in quasianaerobical conditions. Presence of non-polar HS in the aggregate volume causes distortions in the structure of water that can be transmitted over considerable distances along chains of hydrogen bonds and cause long-range hydrophobic interaction. The combined action of HS, which makes the surface of mineral matrix hydrophobic and isolated in the micro areas, nonpolar molecules, stochastically distributed in the aggregate, cause its water-stable properties. In the aqueous environment, the non-polar areas gravitate towards each other, as the approaching minimizes their thermodynamically unfavorable contacts with water. The total effect inside the hydrophobic areas of the aggregate counters the rapid flow of water into the aggregate, reducing its swelling and promoting its stability in saturated state. The last point is proven by data on water-resistant aggregates. Mineralization of the hydrophilic HS components, localized on

the surface of the mineral particles, leads to the exposition of the hydrophilic surfaces of mineral solid soil phase, the efficiency of hydrophobic interactions within the aggregate drops and it is dispersed by water.
One should specifically highlight the role of hydrophilic components in soil humus. The role of hydrophobic interactions in soils, in particular, is emphasized by the fact that the stability of soil aggregates correlates with the content of hydrophobic humus fraction in the soil. Water-stability of aggregates increases with addition of nonpolar liquids to the soil. In addition, as a prerequisite for modifying the surface properties of soil solid phase by organic matter, it should be located in the liquid phase of soil, i.e. hydrophilic fraction or water-soluble organic matter.

Conclusion

1. Our results indicate the heterogeneity of surface wettability of the solid phase components of soils, caused by heterogeneous distribution of hydrophilic and hydrophobic organic matter within the aggregates.
2. Formation and accumulation of hydrophobic humification products occurs in the structure of organic particles, which are not connected with a mineralogical matrix. Accumulation of hydrophilic humification products occurs in structure of compounds of clay and humus. Hydrophobic light fraction particles may function as bonding mediators between organo-mineral particles inside aggregate.
3. The spatial differentiation of components of SOM in the aggregate is represented by localization of hydrophilic humification products of allochthonous genesis on the surface of mineral particles, and hydrophobic humic substances of autochthonous genesis – inside the structure of organic particles stochastically distributed in pore space of the aggregate. The structurally functional organization of components of humus substances in the aggregate provides formation of hydrophobic properties on the surface of pore space of the aggregate. The total effect of intra-aggregate hydrophobic zones consists of counteraction to fast water inflow in the unit and rise of disjoining pressure.

Acknowledgements

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Aggregate composition and the contact angle of the soil solid phase after incubation with peat gel

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Key word: soil amendments, aggregate composition, water stable aggregate, peat gel, contact angle

Introduction

Organic matter and soil aggregate structure under virgin vegetation - two interdependent and interrelated natural products of soil formation.
Architecture of soil aggregate, which provides its agrophysical properties, is a combination of organic and mineral elementary soil particles (ESP), the surface of which differs by water wettability. Organic ESP, which are products of chemical and microbial transformation of organic residues in situ, have hydrophobic surface. The degree of surface wettability of mineral ESP is controlled by organic compounds of various origins sorbed on them - the water-soluble humus organic substances, exudates of higher plants roots, products of microorganisms metabolism. In natural soils there is a constant renewal of exposed mineralization both organic ESP and adsorbed organic matter acting in conjunction with natural regulators of the speed of water flow into the machine and its water-holding capacity. The mineralization of humus in soilы under tillage leads to a degradation of the aggregate structure and formation of adverse agrophysical properties and thus reduces fertility. Restoration of the natural mechanisms of self-regulation in the agroecosystem that enhance crop yields, based on the concept of Green Chemistry is a solution of environmental problems with the use of cleaner and less polluting processes.
The purpose of research was an analysis of changes in the aggregation state and the contact angle of wetting of the solid phase of dark gray forest soil after incubation with peat gel.

Material and Methods

The incubation experiment was carried out with dark gray forest soil (Kursk region, Russia). 3-inch layer of soil (1.5 kg) at a humidity of 19.3% was sprayed with a 5% solution "CAVITA BIOCOMPLEX" (Trade and Industry Company "Kavita", Russia) in the experiment variant "peat gel." The treated soil was placed in pots and incubated at 20-22 °C for 14 days at a humidity of 19-22%. In the control experiment, the soil was sprayed with water. The soil samples from control and "peat gel" experiments were analyzed for aggregate composition by dry and wet sieving. The content of

organic carbon was determined by dry burning (900 °C) in a stream of oxygen (carbon analyzer AN-7529, Russia). After filtering the solution through a 0.45 micron filter, dissolved organic matter content (TOC-Vcpn Shimadzu) and the carbohydrate content were determined in torfogele according to phenol-sulphuric acid method [2].
The contact angles (Sessile Drop Method) were determined using a goniometer (Drop Shape Analysis System, DSA100, Krüss, Germany). Sample preparation: a monolayer of each sample fixed on a double-sided adhesive tape, which was glued on a glass slide, was used for the contact angle measurements [1]. To determine the contact angle, the drop contour was mathematically described by the Young–Laplace equation using DSA100, and the contact angle was determined as the slope of the contour line at the three-phase contact point. The measurements were repeated 10-15 times for every sample.
For contact angle measurements, the syringe needle was positioned 0.2 mm from the surface of the sample, and a drop of the test liquid (2 μL) was dispensed at a constant rate of 1.75 μLs-1. The drop shape was monitored with a digital camera for 20 s, and contact angle, drop diameter, and volume were recorded.

Results and Discussion

The content of agronomically valuable aggregates in the original soil and peat gel-treated sample (dry sieving, 10 - 0.25 mm) was virtually identical, and characterizes the aggregation state as good (Table. 1). Characteristics of the aggregate structure by its water resistance was carried by the number of aggregates of a certain size, obtained after wet sieving. Relative amount of aggregates (1 – 0.25 mm) after wet and dry sieving (API criterion) characterize water resistance of soil aggregates from control sample as poor and from peat gel-treated as good. Similar data (poor water resistance in control and goof water resistance in peat gel-treated sample) was obtained with classification by Kuznetsova I.V. [3].

Table 1

Aggregate composition of dark gray forest soil, %

Sieving method	Variant of experiment	Size fractions of aggregates, mm.									
		> 10	10-7	7-5	5-3	3-2	2-1	1-0.5	0.5-0.25	0.25-0.10	< 0.10
Dry	Control	8.9	7.5	7.7	12.7	12.0	19.0	14.3	7.5	3.9	6.5
	Peat gel	4.3	12.1	10.3	13.1	11.1	16.0	13.5	8.2	5.9	5.5
Wet	Control	0.0	0.0	0.0	0.2	0.1	0.3	2.4	4.4	14.7	77.9
	Peat gel	0.0	0.0	4.8	3.8	3.0	5.2	14.7	8.8	12.9	46.8

As compared with control, soil incubation with peat geal, on the one hand, has led to a high content of water-resistant aggregates of 7 - 0.25 mm, and on the other, reduced the content of water-resistant aggregates less than 0.25 mm.
After soil incubation with peat gel, dry sieving aggregates demonstrated increased carbon content by 0.6 - 0.7% (Fig. 1), while in water stable aggregates it remained at its original value in aggregates of 1 - 0.1 mm in the control sample (2.6 – 2.2 %).

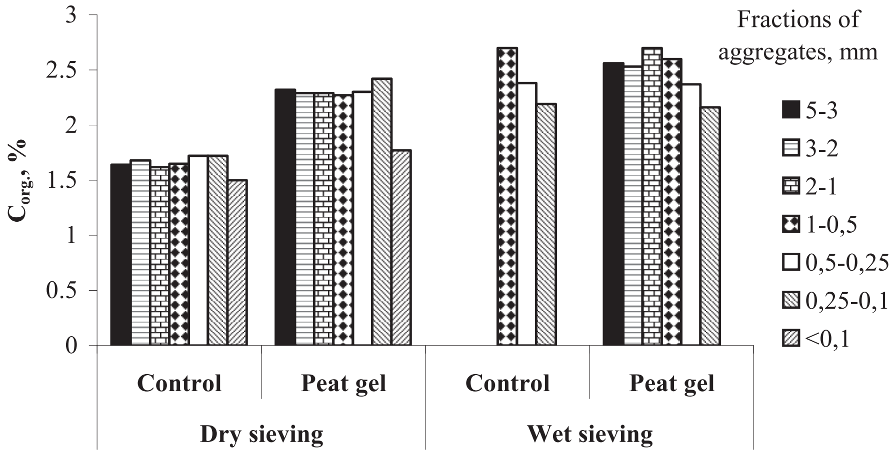

Fig. 1. The organic carbon content in the fractions of aggregates of dry and wet sieving

For both variants of the experiment CA value of solid phase surface (SPS) of dry aggregates increased with decreasing of their size (Fig. 2, a). Increase of the hydrophobicity of dry sieving aggregates with decreasing of their size was noted in [4].

According to the authors, the organic substance at the external surface of the aggregate has a higher content of hydrophobic groups as compared with the organic substance in the aggregate core. After soil incubation with the peat gel, an increase of SPS contact angle by ~11.3° was detected. This effect was attributed to the peat gel particle localization, which have CA of 130º, on the outer surface of the aggregates. SPS contact angle of wet sieving aggregates did not depend on their size (Fig. 2, b).

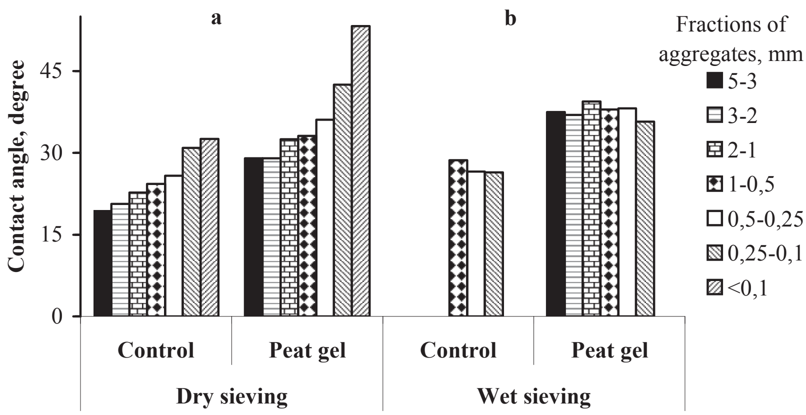

Fig. 2. The contact angle of wetting of the solid phase of aggregates dry and wet sieving

Soil incubation with peat gel increases SPS contact angle of waterproof aggregates by an average of 10.0°.

Agrodrug "CAVITA BIOCOMPLEX" was produced by ultrasonic cavitation dispersion of lowland peat in the aquatic environment [5]. More than 50% of its organic particles have a size less than 20 microns and DOM carbon content of 228 mg/l. We believe that specifically DOM penetrates into the aggregate, is adsorbed on the surface of the mineral particles and makes it hydrophobic. As a result, soil aggregates become water resistant. It is clear that soil amendments are a necessary to restore severely disturbed landscapes in a reasonable timeframe. These the results, obtained in a laboratory experiment, promote the efficiency of peat gel as soil amendment. Further studies are needed to demonstrate temporal stability of water-resistant structure as well as peat gel impact on agrochemical and microbiological properties of the soil.

Conclusions

Treatment of dark gray forest soil sample with 5% solution of peat gel promotes accumulation of organic carbon in the dry sieving aggregates and the formation of the soil waterproof structure.

Acknowledgements.

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Application of methods based on synchrotron radiation for assessment of speciation of copper and lead compounds in soil

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Key words: synchrotron radiation, XANES, copper, lead

Introduction

The determination of element speciation and distribution within heterogeneous environmental systems, such as soils, is crucial to developing a thorough understanding of soil processes and reaction mechanisms that control not only the transport of nutrients and contaminants, but also biomineralization and soil formation processes. The application of numerous spectroscopic and analytical techniques is required to solve these and other complex problems facing soil scientists (Synchrotron-Based Technique, 2010). X-ray absorption near edge structure (XANES) and extended X-ray absorption fine structure (EXAFS) are the most commonly used spectroscopic techniques. They provided essential information about the forms of heavy metals in soils. XANES spectroscopy is widely used for studying the electronic structure of substances: the determination of symmetry and energy of vacant molecular orbitals in molecules or electron zones in solid materials. In particular, this method can provide information on the degree of oxidation of the absorbing atom and the symmetry of its coordination sphere. The energy of X-ray absorption edges is typical for an element with a specific atomic number; therefore, the metal and even its oxidation state in different compounds can be identified (Soldatov, 2008).

The study is aimed at analysis of the spatial-structural organization of Cu (II) and Pb (II) compounds in soil and at analysis of the relationship between metal ions and soil components using methods based on synchrotron radiation.

Materials and Methods

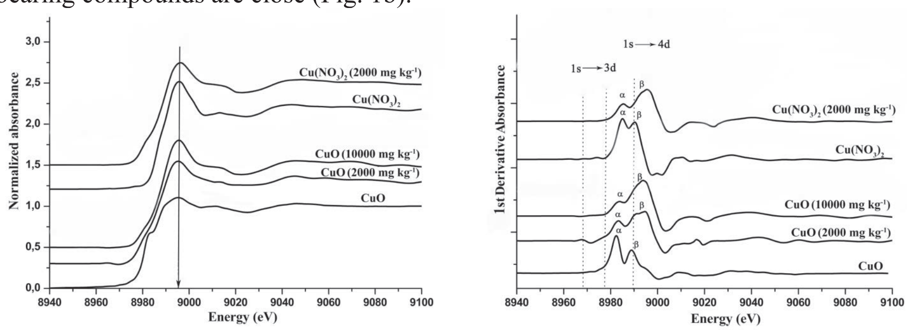
Soil sampling was taken in the 0-20 cm topsoil of the virgin area covered by the heavy-textured ordinary chernozem on loess-like loam of the Lower Don region (Haplic Chernozem). In a model experiment the samples taken were artificially contaminated with higher portions of nitrates ($Cu(NO_3)_2$ and $Pb(NO_3)_2$) and oxides (CuO and PbO) (2000 and 10000 мg kg^{-1}). The metals were incubated in soil samples for a year.

The measurements of X-ray absorption spectroscopy EXAFS and XANES spectra at the K-edge Cu (~8985–8990 eV) and L_{III}-edge of Pb (13040 eV) were performed at

the Structural Materials Science beamline of the Kurchatov Center for Synchrotron Radiation (NRC "Kurchatov Institute", Moscow). EXAFS spectra at the K-edge Cu and the Pb L_{III}-edge were measured at the same synchrotron beamline in the fluorescence yield mode using a Si avalanche photodiode to count fluorescence photons and an ionization chamber to monitor the incident intensity. A Si (111) channel-cut monochromator providing an energy resolution of $\Delta E/E \sim 2\cdot10^{-4}$. Copper and lead foils were used as standard samples for the energy calibration. Every spectrum was measured by a step of 0.5 keV. To obtain the data for statistical method the exposition time of 60 sec was taken for each point in the spectrum. Five to seven spectra were statistically averaged to determine a final spectrum for every sample.
To obtain detail information on the state of Cu^{2+} and Pb^{2+} ions in the studied soil samples the first derivatives of XANES spectra were calculated and permitted to identify differences in these spectra.

Results and Discussion

The morphology, size, and peculiarities of edge and near-edge areas on XANES spectra of soil samples contaminated by CuO and $Cu(NO_3)_2$ have clear differences mainly controlled by the differences in their local atomic structure around the central Cu ion (Fig. 1). The spectra of soil samples contaminated by CuO demonstrate close similarity to experimental spectra of the initial copper-bearing compound CuO. By contrast, the spectra of soils treated by $Cu(NO_3)_2$ differ significantly from the spectra of the initial copper-bearing compound providing evidence for transformation of the environment of the copper ion introduced into the soil. Copper nitrate is well-soluble in water; because of this, copper ions during the one year of incubation were sorbed by the soil and formed complexes with organic components (Minkina et al., 2013).
The intensity of the α peak is controlled by the degree of bond covalence and characterizes the coordination environment and chemical bonds of the absorbed metal ion with its closest surroundings. With a decrease in the α peak energy, Cu complexes with soil components have predominantly the covalent character of the bond. The intensities of the α and β peaks in the experimental spectra of the initial copper-bearing compounds are close (Fig. 1b).



a b

Fig. 1. The experimental Pb L_{III}-edge XANES spectra (a) and their first derivatives (b) for the reference compounds (CuO and $Cu(NO_3)_2$) and the soil samples

The low intensity of the α peak on the first derivate of the XANES spectra of soil samples contaminated by CuO and $Cu(NO_3)_2$ is controlled by the electron transition $1s \rightarrow 4pz$ and provides evidence for electron transfer from the metal to a ligand (Xia et al., 1997). Analysis of the EXAFS revealed that lead to ion exchange in the tetragonal plain of water molecules with ligands. The interaction between copper ions and humic acid may result in the formation of multilateral 6-coordinated spatial structure of humate complex.

Parameters of the experimental XANES spectra obtained for the studied soil samples saturated with high rates of Pb compounds, as well as the spectra of the initial PbO and $Pb(NO_3)_2$ are given in Fig. 2. The spectra are characterized by an energy region of ~13030–13058 eV related to the presence of lead ions, from which the molecular-structural state of the metal is assessed. The highest absorption intensity is recorded in the energy region of ~13038–13040 eV for the samples saturated with PbO and at ~13042 eV for the samples saturated with $Pb(NO_3)_2$, which characterizes the $2p_{3/2} \rightarrow 6d$ electron transition (Fig. 2b).

The modulations of $2p_{3/2}$ electrons in the first derivative spectra of PbO and PbO-saturated soil samples are appreciably different (Fig. 2b), which is due to the different shoulder amplitudes in the energy region of ~13032 eV, especially for the initial PbO. This X-ray absorption peak is manifested only for the spectra of PbO and PbO-saturated soil samples and is related to the $2p_{3/2} \rightarrow 6s$ electron transition, indicating the 6s and 6p hybridization for Pb and $2p_{x,y}$ for oxygen; therefore, Pb^{2+} participates in the formation of numerous distorted complexes, because the adsorbed Pb ions can have different O–Pb–O valent angles.

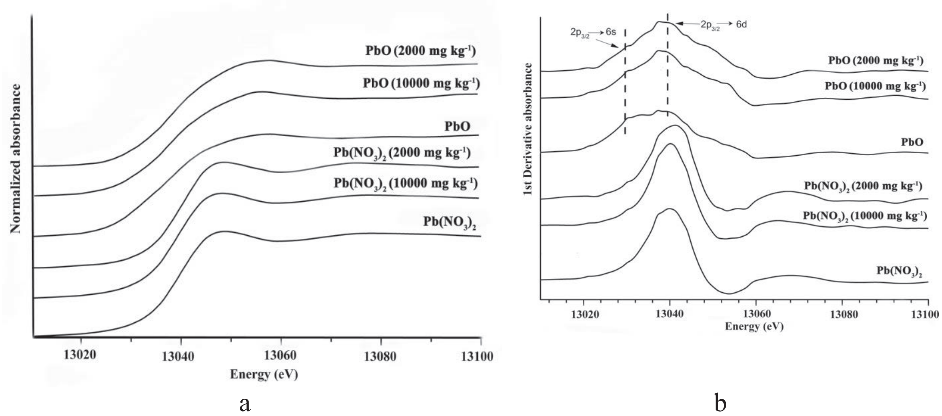


Fig. 2. The experimental Pb L_{III}-edge XANES spectra (a) and their first derivatives (b) for the reference compounds (PbO and $Pb(NO_3)_2$) and the soil samples

Using results of EXAFS method was determined that lead ions incorporated in the phyllosilicate minerals structure favoring a decrease in the bond distances between Pb^{2+} ions and O atoms in equatorial and axial coordination positions in Pb-bearing octahedrons. Divalent Pb has the $6s^2$ electronic configuration of the outer shell. This lone electron pair is frequently stereochemically active and causes a strong deformation of divalent Pb in polyhedrons. Thus, it can be concluded that Pb is sorbed as a bidentate inner-sphere complex at the edges of the octahedrally coordinated aluminum ions.

Conclusions

Synchrotron radiation's methods are an effective approach for the study of bonds between metals and soil components. Application of these methods demonstrated different orbital transitions in the electron shells of Cu^{2+} and Pb^{2+} ions for monoxide and soluble salt, which affect the ion properties and determine the individual structure of the coordination sphere. Copper is absorbed after being introduced as $Cu(NO_3)_2$, and copper ions are incorporated in the octahedral and tetrahedral sites of minerals and bonded with humic materials at the expense of covalent bond and the formation of coordination humate copper complexes. Lead ions are sorbed as a bidentate inner-sphere complex at the edges of the octahedrally coordinated aluminum ions.

Acknowledgments

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Indicators of soil ecological condition under pollution of lead

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Key words: soil, lead, fractional and group composition, environmental indicators

Introduction

The development of a system of parameters adequately reflecting the environmental status of contaminated soils is of current importance. The determination of the metal forms in soils and the consideration of their presence in soil components are necessary for studying the small geochemical cycles of elements in landscapes of technogenic zones and revealing the diagnostic group of heavy metals (HMs) compounds in the assessment of their negative effect on the environment and the sustainability of soil systems to contamination with HMs (Fateev and Samokhvalova, 2002). The knowledge of the laws of metal transformation in contaminated soils facilitates the choice of methods for the efficient inactivation of the metals (Minkina et al., 2008 a).
The aim of this work was to study the formation and transformation laws of Pb compounds in an ordinary chernozem artificially contaminated with metal and to perform their environmental assessment. Lead was selected because they are priority pollutants in the contaminated areas of Rostov oblast.

Materials and Methods

The object of the study was a deep low humus clay loamy ordinary chernozem on loess like loams of Rostov State Construction University. The upper (0- to 20-cm) horizon has the following properties: humus, 3.5%; pH, 7.5; nitrate nitrogen (N–NO_3), 1.0 mg/100 g; available phosphorus (P2O5), 6.2 mg/100 g; exchangeable potassium (K_2O), 35.8 mg/100 g; Ca^{2+}, 30 mmol/100 g; Mg^{2+}, 7 mmol/100 g; CaCO3, 0.1%; physical clay, 58.0%; and clay, 34.5%. A model pot experiment was established. The experiment involved the analysis of the original ordinary chernozem, the soil contaminated with Pb. A layer of washed glass beads 3 cm thick was put on the bottom of plastic vegetative pots of 1 L. Soil artificially contaminated with Pb and sieved through a 5 mm sieve was added to the pots (1 kg per pot). Lead was added in the form of dry acetates at rates of 10000 mg/kg. Acetates were used because they are well soluble, which favors their rapid and complete interaction with the soil material; their hydrolysis is not accompanied by an abrupt pH shift toward a strongly acid region; acetate ions are natural products of plant metabolism and insignificantly affect the nutritive regime of soils. The soil was wetted to 60% of the field water capacity. The soil was incubated for a year.

The content of the total PB in the soil was determined by the X-ray fluorescence method; the concentrations of the metal in the extracts were determined by atomic absorption spectroscopy.
The groups of strongly and loosely bound HM compounds were separated. These groups include metal compounds similar in their interaction strength to soil components. The part of the group differing from the other parts of the same group by the form of binding to the soil components is proposed to be called the fraction. The group of strongly bound compounds includes metal presumably fixed in the structure of primary and secondary silicate and nonsilicate minerals, as well as metal of insoluble salts and stable organic and organomineral compounds.
The group of loosely bound (mobile) compounds includes metal retained on the surface of organic and mineral soil components in an exchangeable or specifically sorbed state. The loosely bound soil compounds of the HM form the most important HM group in environmental terms, because they are capable of passing from the soil to the adjacent environments, i.e., to plants and natural waters.
We focused our attention on the determination of the proportions of the HM groups and their fractions in the soils. Their ratios indicate the migration ability of metal in contaminated soils and the role of soils in the protection of ecosystems from HM. To determine the fractional and group composition of the HM compounds, we used 3 parallel extraction of the metal compounds from soils. In this procedure, the loosely bound HM forms were extracted with the following solutions: 1 N ammonium acetate buffer (AAB) with pH 4.8, a 1% solution of EDTA in 1 N AAB, and a 1 N HCl solution. The solutions used are not strongly selective extractants. The 1 N AAB solution with pH 4.8, presumably extracts exchangeable HMs from soils. The 1% EDTA solution in an AAB buffer with pH 4.8 presumably extracts, along with exchangeable forms, metals loosely bound in organic complexes. From the difference between the content of the metals in the 1% EDTA solution and that in the 1 N AAB solution, the content of the HMs in the organomineral complexes was calculated (Nosovskaya et al., 2001) .
The content of HMs in the 1 N HCl extract characterizes the potential reserve of mobile metal compounds in the soil. The acid soluble HM compounds presumably include exchangeable and specifically sorbed HM forms. Their content was found from the difference between their contents in the 1 N HCl and 1 N AAB solutions (Kabata-Pendias, 2004). In the strongly bound HM compounds, their components composed of metals retained by organic substances, iron (hydr)oxides, and silicates were determined.

Results and Discussion

The average content of the total Pb in the studied soils 25 mg/kg (Table 1), which correspond to the background level for ordinary chernozems (Ecological Atlas…, 2000; Minkina et al., 2008 a).
The major part of Pb in the studied soil occurs in the strongly bound form; their loosely bound forms make up 18% of the total content, respectively. The loosely bound compounds of the studied metal mainly include their specifically sorbed forms (85% of the sum of the loosely bound Pb compounds). The content of exchangeable and complex compounds of metal is insignificant. After the artificial contamination of

the ordinary chernozem with Pb, the total contents of metal significantly increased. The absolute contents of three fractions of mobile metal compounds increased. The contents of the exchangeable forms increased by 3000 times for Pb. The contents of their complex compounds increased by 5000 times, and the contents of their specifically sorbed compounds increased by 800 times. The hazard of soil contamination with metal involves an increase in their mobility. Because of soil contamination, the obvious predominance of strongly bound metal compounds is replaced by the prevalence of their loosely bound forms (up to 81% of the total content). This is accompanied by qualitative changes in the metal mobility, as is confirmed by the changes in the proportions of their fractions in the group of loosely bound compounds. The mobility of the metals increased predominantly because of the most mobile compounds: the exchangeable Zn and complex Pb forms. The Pb portions of the exchangeable forms increased (by 1.8 times), as well as those of the complex forms (by 2.8–3.0 times). The portions of the specifically sorbed metal forms decreased by almost 2 times.

Table 1

Contents of the total and loosely bound Pb compounds (mg/kg), the ratio between the strongly and loosely bound HM compounds, the mobility coefficients (MCs) and the stability coefficients (SCs) of the soils for Pb in an ordinary chernozem at monoelement contamination

Experimental treatment	Total content	Loosely bound compounds			Exchangeable/complex/specifically sorbed*	LB/SB**	MCs	SCs
		Exchangeable	Complex	Specifically sorbed				
Without addition	25	0,9	0,5	3,0	20/11/69	18/82	0,1	65
Pb	9851	2962	24443	2568	37/31/32	81/19	6,1	9

*% of the loosely bound metal compounds in the soil;
**% of the total content

We proposed parameters of the environmental status of contaminated soils based on the fractional and group composition of the metal compounds. Of information value is the mobility coefficient (MC) of metals, which is calculated as the ratio between the content of loosely bound metal compounds with loosely bound soil components (LB) and strongly bound ones (SB):

$$MC = LB/SB$$

At the increase of the metal concentration in the soil to 10000 mg/kg, the value of the MC increased by 21 times for Pb.

The proposed stability coefficient (SC) accounts for the portion of the most strongly retained residual metal fraction in the group of strongly bound compounds:

$$SC = Cres \times 100\%/SB,$$

where Cres is the content of metal in the residual fraction, mg/kg, and SB is the content of the group of strongly bound HM compounds, mg/kg.

It can be used as an indicative parameter at the determination of (anthropogenic or natural) the contamination source (Minkina et al., 2008 b). This is the portion of metal compounds incapable of being released into the soil solution within a realistic observation time. The SC visualizes the changes in the content of the metal bound to silicates depending on the technogenic load on the soil. It was found that the addition of Pb at 10000 mg/kg to the soil decreased the SCs by 7 times (to 9%).

Conclusions

Our study revealed the deciding effect of two essential groups of Pb compounds on the environmental status of soils contaminated with metals. The group of loosely bound HM compounds determines the environmental hazard of contaminated soils. The group of strongly bound HM compounds determines the ability of soils to protect the adjacent environments from contamination. From the obtained data, two parameters were proposed: the mobility coefficient of HM in soils and the stability coefficient of soils with respect to the impact of HMs. The advantage of these parameters over those proposed earlier is that they more adequately reflect the role of the soil components determining the environmental status of soils under contamination with HMs. The contamination of soils with Pb of 10000 mg/kg metal is accompanied by the transition from the predominance of strongly bound metal compounds to the domination of their loosely bound forms.

Acknowledgments

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Changing of soil properties under the influence of irrigation erosion of irrigated dark chestnut soils in foothill zone of the Trans-Ili Alatau

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Keywords: soil, erosion, water stability, granulometric composition, properties

Introduction

Analysis of current status of soil surface and agricultural production, evaluation of the dynamics of change of soil quality indicators gives reason to say that there is a tendency of soil fertility decline and deterioration of the overall environmental situation in agricultural sector of the country.

Issues of protection of irrigated soils from erosion are becoming more relevant. Irrigation erosion is one of the forms of manifestations of water erosion and it is common in almost all irrigated land cultivation areas in the south and south-east of Kazakhstan. Therefore, the research and implementation of water-saving technologies is essential.

Materials and Methods

Research aim: to explore the effect of irrigation erosion on the properties of irrigated dark chestnut soils under irrigation.

The research object - irrigated dark chestnut soils of foothills of Trans-Ili Alatau, which are subjected to intense planned works under irrigated land cultivation, which result in the fact that zonal soils lose their natural fertility. Humus horizon capacity of irrigated dark-chestnut soil is 40cm. The humus content is in the range of 2.0-2.9% and its gradual decline was observed down the profile; 0,14-0,01% of total nitrogen; 0.2% of total phosphorus; 2.2-2.4% of total potassium.

Results and Discussion

Foothill dark chestnut soils differ from dark chestnut soils in the plains, so that they have less capacity, there is almost no alkalinity, salinity and high humus content in the upper horizon. These soils on loess are mainly used for agricultural purposes.

The irrigation erosion processes have been studied in the vegetable crop rotation in the furrow irrigation method. According to the degree of erosion, vegetable fields were weakly, medium and heavily washed out, steep slopes of the explored fields were from 3^0to7^0.

Water resistance The important factor of anti-erosion resistance of soils is water resistance of the structure The essential factor in the dynamics of change of water resistance of soil arable layer is irrigation. As a result of irrigation of piedmont dark chestnut soils in Almaty region the content of water-resistant aggregates of more than 0.25 mm in the layer 0-10 cm has reduced from 84.8% in the not washed out (virgin) to 45,64-55,34% under irrigation, and content of aggregates >1 mm respectively - from 63.51% to 1,9-2,78%.

Results of determination of water-resistance of aggregates show that irrigated dark chestnut soils have a very low water resistance. Therefore, the structural status of soils by presence of water-resistant aggregates larger than 0.25 mm in all explored samples of arable layer is estimated as unsatisfactory Not regulated flow of irrigation water in the furrow is the main reason of the decrease of water-resistance of the structure.

Granulometric composition of soils has a great influence both on soil-formation process and agricultural use of soils. Annual agrotechnical methods in fields destroy the content of agronomically valuable aggregates.

In irrigation, an increase of clay fractions by 7.8 -7.9 % and dust fractions by 15.7 - 19.0% has been observed. In non-eroded soils the content of fine dust in the horizon 0-10 cm is 13.2% and physical clay 34.6%. The presence of a significant amount of big dust particles (33,41-34,94%) indicates a weak anti-erosion resistance of irrigated dark chestnut soils.

Chemical indicators of irrigated dark-chestnut soil. Our research results confirmed the findings of many scientists that irrigation erosion results in significant change in soil nutrition content. During the growing season vegetable crops absorb a large amount of nutrients from soil. The soils used in land cultivation system differ from virgin analogues. Dark chestnut soils in virgin land plot in the upper layer contain 3.8% of humus, a sharp decrease in humus content in depth has been observed by the profile. The dark chestnut soil in experimental field contains humus almost 2 times less.

Before irrigation humus content in the upper (0-10 cm) horizon of dark chestnut soils on slope elements (irrigated field) is as follows: in the top - 2.10, in the middle (mark 40 m) - 2.15 and in the lower part (accumulation area - 80 m) - 2.25%, after the growing season - respectively 1.90, 2.08 and 2.02%. Similarly, changes the concentration of total nitrogen, the amount of which has decreased in the top by 0.028%, and in the bottom - by 0.014%. The sharp decrease of humus content and total nitrogen from soil surface is due to irrigation erosion. Partial deposition of suspended sediments has been observed in the area of accumulation, which is due to reduction of energy capacity of water flow. Humus content was 2.02%, total nitrogen - 0.140%, mobile forms of phosphorus and potassium, has decreased respectively - by 29.0 and 136.0 mg / kg.

Conclusion

In irrigated dark chestnut soils of the southeast of Kazakhstan the soil investigation has been conducted on identification of mechanism of manifestation of irrigation erosion in using furrow irrigation method . The mechanism of manifestation of irrigation erosion due to the genetic properties of irrigated soils, topography and interaction of irrigation water with soil has been determined.

Protection of soils as an important problem of protection of soil genofund of Azerbaijan

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Keywords: degradation, arid, polluted, reference soils.

Introduction

The problem of soil resources, their use in agriculture and protection now is actual. A problem of soil science demanding deep studying and working out of scientifically well-founded measures of their protection, protection and effective inclusion in agricultural manufactures. Soil resources in various soil-climatic zones of the world are considerably limited both on the area, and on quality. Besides not effective operation of soil resources, i.e. incorrect placing of agricultural crops, with the account of potential possibilities of soils, building of various industrial targets leads to destruction and serious degradation of soils. Any forms of anthropogenous influence on soils and in particular technogenic character promotes loss of soil fertility and their alienation from an active agricultural turn. Therefore, correct use of soils should be based on the strictly scientifically quantitative and qualitative account of soil resources. For the decision of this problem drawing up and conducting a soil cadaster which represents sets of authentic and necessary data about natural, economic and a legal status of the soil is necessary. Data of the state soil cadaster serves the purposes of the organization of an effective utilization of the earths and their protection, planning of a national economy, placing and specialization of agricultural production, land reclamation, etc. (G.S.Mamedov, 2000). Accepted in Azerbaijan state (1996; 1999) laws on wildlife management and soils as the first object of the nature, which is subject to protection, the earth is underlined. To protection is subject not only unique soils on the evolutionary development (reference, relic soils with the limited area of distribution, etc.), but also arable, fixed to separate farms, as basic means of production in agrarian sector. Another, but during too time very important form of the quantitative and qualitative account of soils are various a material of large-scale researches: soil cards, cartograms, soil reports with the analytical data, and also results on classification, systematization and the morfo-genetic description of soils developing in arid and humid ecological conditions. The essential importance at more detailed quality standard of soils occupy agro industrial grouping and valuation of soils (M.E.Salayev, M.P.Babayev, V.G.Hasanov, C.M.Jafarova, 2004; G.S.Mamedov, 1990; G.S.Mamedov, M.P.Babayev, A.I.Ismailov, 2002). Among soil researches, the special place should occupy studying of the degraded and biological features of the tehnogenno-polluted soils. Because these soils after their restoration are an additional reserve of soil resources (M.P.Babayev, 2000 ; P.A.Samedov, L.A.Bababekova, etc., 2011).

Materials & Methods

The basic object of our researches are various types of soils of the republic extended in characteristic environmental conditions. A scientific material on these soils i.e. archive, encyclopedic, cartographical, accounting, monographic, etc. For the purpose of comparative studying of morfo-genetic features of separate types of soils - reference, disappearing, relic, with the limited area of distribution, tehnogenno - polluted soil cuts to depth почвообразующей breeds are taken.
All collected scientific materials are basis for creation and activity of a soil museum. Methodical basis for museum creation is the standard technique of museum business (Aparin B.F, etc., 1984), and also spent in the Institute of Soil Science and Agro Chemistry on gathering of museum pieces, a demonstration material and publication of some scientific articles on museum business (Mirzazada R. I, Babayev M. P, 2013; Mirzazada R. I, 2007, 2008, 2011,2012).

Results and Discussion

Creation of a soil museum has paramount value for protection of a unique genofund of soils of Azerbaijan. With that end in view in a museum, special demonstration departments in various directions of soil science, agro chemistry and ecology are issued.
Studying of historical annals formation and developments of a soil science in Azerbaijan was the first stage of museum business.
In our opinion, without knowing development history in republic of an irrigation, agriculture, and as a whole soil science it would be difficult to develop further methods of development of soils and an embodiment in life of nature protection actions.
The historical annals of development of a soil science in Azerbaijan develop of the several periods:

1. The end 19th and the beginning of 20th centuries (1875 – 1920)
2. The period before creation of the Institute of Soil Science and Agro Chemistry (1920 – 1945)
3. The period of activity of the Institute of Soil Science and Agro Chemistry (1945 – 1991)
4. The period covering since 1993 on the present.

Each of these periods has the priority directions which studying gets now actual value from the point of view of protection and protection of a unique soil genofund of republic, which is formed in 9 climatic zones of 11 climatic zones available in the world.
Protection of soils at the present stage of development of soil science has special value when various forms industrial and agricultural production intensively develop. Anthropogenous loading on the one hand increases by surrounding ecosystems, and with another, a technogenic waste of the enterprises arriving in polluted soil and threat of loss of fertility by them and even a total disappearance as soil type is created. Creation of such encyclopedic books as «Life of animals» and «Life of plants» providing protection and protection of unique kinds of animals and plants, demands creation to the Red book of soils of Azerbaijan where will be included endemic and other protected types of soils. It is possible to present actions for soil protection in the following forms (table 1).

Table 1

Actions for protection and protection of soils

Protected soils	Actions
Reference, disappearing, relic, endemic, soils with the limited area the distributions which have been tehnogenno-polluted	1. Organizational – economic 2. Agrotechnical 3. Bookmark of artificial forest belts 4. Hydromeliorative 5. Recultivated 6. Creation of regional soil museums 7. Creation of "the Red book of soils of Azerbaijan».

Conclusion

1. The theoretical analysis (on the basis of the having experimental and literary data) is carried out and separate types of soils demanding protection and protection are allocated
2. The historical annals of development of a soil science in Azerbaijan are considered.
3. Some actions for protection and protection of soils of republic are offered.

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Spatial variation microelements in soils Perm krai

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Introduction

Soils are involved into multiple relationships in the environment and are of great practical and scientific interest for many researchers. Due to worsening environmental conditions in the modern world, scientists are increasingly paying attention to the content of heavy metals in plants and soil and studying sources of their contamination. It is known that some heavy metals (eg., Pb, Zn, Co, B, Cu, Mn) at low concentrations are vital for plants, animals and human beings, but at the same time their accumulation in human or animal body is dangerous for us. When assessing the environmental hazards of soil contamination, both intensity and composition of pollutants are taken into account. It is subject to the elements of the first class sanitary hazard according to GOST 17.4.1.01-83 [1], in the first place.
The purpose of the paper is to determine amount and spatial distribution of boron and zinc in the sod-podzolic heavy loamy soil in the Perm Krai.

Materials and Methods

The subject of the research is on the educational and scientific experimental field of Perm State Agricultural Academy (Fig. 1).

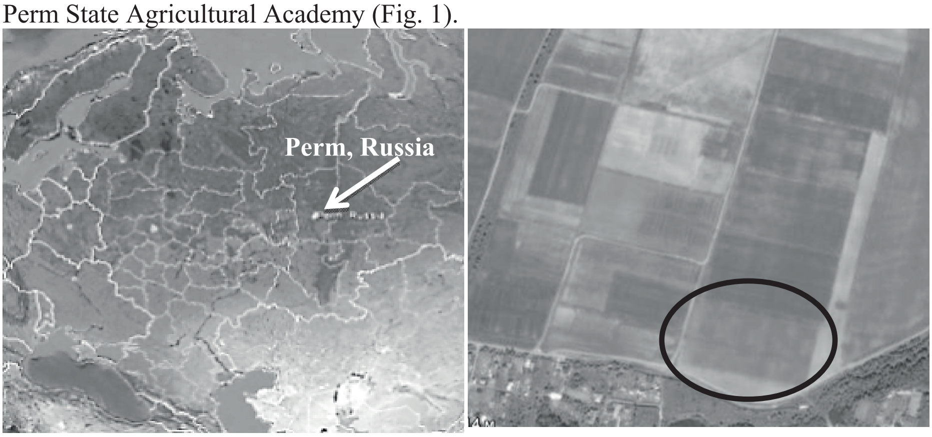

Fig. 1. Location of the experimental field

A composite surface soil sample from 0-20 cm depth was collected from the experimental site before initiating the experiment and analysis of soil samples on agrochemical indicators was carried out by standard techniques. Soil samples were air dried at room temperature; sieved with < 1 mm screen. Experimental area soil is fine sod-podzolic heavy loamy; it is characterized by neutral pH (pH_{KCl} = 6.8-7.2), a very high content of labile phosphorus (304-1090 mg/kg) and potassium (255-702 mg/kg). Organic carbon content range is 0.56-2.32 %, electrical conductivity ranges from 0.09 to 0.25 dS m^{-1}.

To determine the degree of soil contamination with boron and zinc, we calculated enrichment coefficient using the equation proposed by G. Sposito (1989), T.O. Agdenin (2002), B. Cemek, R. Kizilkaya (2006), R. Kizilkaya and et al. (2011):

$$EF = \frac{C_1}{C_2} \ , \qquad (1)$$

where C_1 – the concentration of the element of interest in the soil sample, mg/kg; C_2 – an average concentration of the element in the earth's crust, mg/kg [2].

The mathematical processing of the research results was carried out using the Microsoft Excel, STATISTICA and MINITAB programs.

Results and Discussion

The content and variability of minor elements in the soil depends on many factors, including features of parent rocks, particle size distribution, vegetation and soil properties. The degree of element variability is different for different soils. N.G. Zyrin [3] suggests the following sequence of descending the degree of variation of minor elements in the soil:

Mn > B > (Cu, Zn, Ni, Co, V, Cr) > Mo > J

Research papers of a number Russian researchers [4-8] are devoted to studying variations in the distribution of minor elements. Research scientists proved that the greatest diversity in concentration of minor elements is found in podzolic soils due to a variety of parent rocks and vegetation. I.V. Yakushevskaya gives interesting examples illustrating fluctuations in zinc content depending on the particle size distribution. Thus, zinc content in the sod-podzolic soils was 15 mg/kg in sand, 51 mg/kg in loamy, and 70 mg/kg in clay soil [4].

Analysis of soil samples showed that content boron in the soil is also very high and changes from 1.38 to 6.75 mg/kg (Fig. 2). It is interesting to note that at equal distance between the defined points the essential difference in values is observed. For example, in point 11 boron content in the soil was 1.87 mg/kg while in the neighboring points it was and 1.86 mg/kg (p. 10) and 6.75 mg/kg (p. 12).

The zinc content in the soil is also very high (13.32 mg/kg) and varies from 3.83 to 36.77 mg/kg (Fig. 2). Changes in zinc concentration in the sampling points are subject to variation. For example, in point 11 zinc content in the soil was 6.25 mg/kg while in the neighboring points it was and 4.33 mg/kg (p. 10) and 36.77 mg/kg (p. 12). Such concentration variation is probably due to zinc migration down the slope, since some decrease is observed in the field at samples the measuring points.

Descriptive statistics of soil properties are given in Table 1.

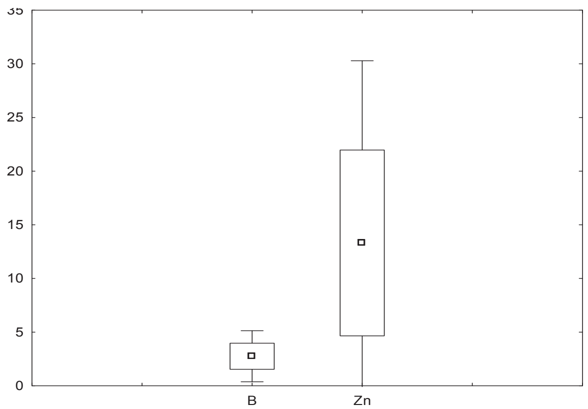

Fig. 2. Content boron and zinc in the soil, mg/kg

Table 1

Summary statistics on the soil properties and microelements

Properties	Mean	S_E	Min	Max	S_D	Skw	Kur	C_V
pH	6.95	0.038	6.78	7.24	0.170	0.482	-1.444	2.45
EC, дСм/м	0.16	0.011	0.09	0.25	0.050	0.382	-0.771	30.89
Organic carbon content, %	1.23	0.102	0.56	2.32	0.458	0.743	0.225	37.13
B, mg/kg	2.75	0.271	1.38	6.75	1.213	2.018	5.430	44.08
Zn, mg/kg	13.32	1.936	3.83	36.77	8.657	1.171	1.207	64.97
EF_B	0.23	0.022	0.11	0.56	0.101	2.018	5.430	44.08
EF_{Zn}	0.18	0.026	0.05	0.49	0.115	1.171	1.207	64.97

S_E – standard error, S_D – standard deviation, Skw – skewness, Kur – kurtosis, C_V – coefficient of variation

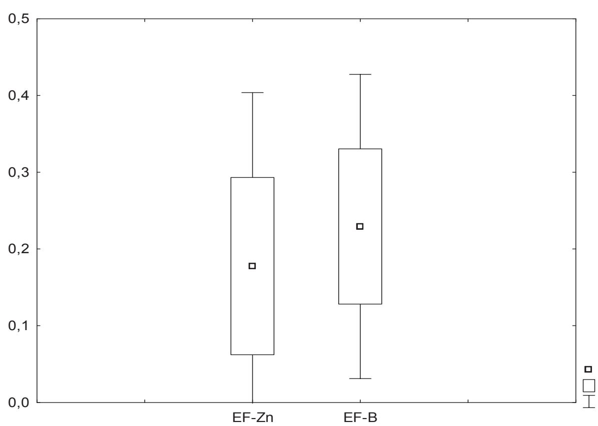

Fig. 3. Coefficient of enrichment of the soil zinc and boron

Scientific studies show that some physical and chemical properties of soils, such as pH, content of organic matter, electrical conductivity and other parameters are important for minor elements accumulation in the soil. Mathematical analysis shows a low correlation between boron, zinc content and pH_{KCl} (r = -0.228 and -0.280 respectively). We observed the closest relationship between boron, zinc and organic carbon (r = 0.949) and EC (r = 0.841) content.
The coefficient of variation for boron (44 %) and zinc (65 %) concentration in the area soil is high, which confirms high diversity in the distribution of minor elements.
Results of calculation of enrichment factor for the analysis soil samples showed that there is no enrichment of the soil with boron and zinc in present time, since EF < 2 (Fig. 3).

Conclusions

Based on these studies, the following conclusions can be drawn. The boron and zinc content in the sod-podzolic heavy loamy soil is very high and changes respectively: 3.83-36.77 and 1.38-6.75 mg/kg. Contents boron and zinc strong variation in the experimental area (Cv = 44 and 65 % respectively). EF_B and EF_{Zn} values indicate that there are no enrichments of the soil with minor elements compared to the average background level.

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Internal Soil Moisture Exchange and Chemistry of Interstitial and Ground Water

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Keywords: Water balance, infiltration, aeration zone, total evaporation, ground water evaporation.

Chemical agents content and composition in the soil and in the ground water (GW) is significantly determined by peculiarities of the internal soil moisture exchange. Internal soil moisture exchange [Muromtsev, 1991: Muromtsev and others, 2013] is the exchange of water and chemical agents dissolved in this water between the separate soil layers. Main income and outcome items of water balance and internal soil moisture exchange are infiltration of meteorological water into the soil and ground water evaporation, in other words moisture translocation from the ground water to the soil evaporation front. Underexplored questions are correlation of vertical and horizontal moisture streams located into the soil derived under the effect of matrix potential and hydrochemistry of interstitial water.
Methodological basis for the research is water regime performance simulation using lysimeters. From hydrological point of view lysimeter is a device, enclosing soil element simulating ground water (GW) level. Dependence derived from the balance equation simulated with the water bearing stratum lysimeter was used for more exact calculation of GW evaporation and infiltration values (Pylenok and others, 2004):

$$\pm q = 10\,\mu\left(H_{i-1} - H_i\right) - h_{\partial} + h_c\,,$$

where $\pm q$ - ground water infiltration (+) or evaporation (-), mm; μ – lack of water saturation or water return, H_{i-1}, H_i - water levels in lysimeter -
The research was conducted under controlled conditions using hydrographical type lysimeters (Semyonov and others, 2005; Muromtsev and others, 2015). As agricultural crops early potato of grade "Krasavchik" superquality reproduction was used on sod-podzol sandy loam soil, and winter ruttishness was used on dark grey forest heavy loamy soil (ecological field test site of Meshchersk Branch of VNIIGiM). Options with ground (lysimetric) water level (depth) (GWL) of 70, 95, 120 and 145 cm were studied on sod-podzol soil; triple replication for every option. Options with GWL of 80, 100, 120 and 140 cm were studied on dark grey forest heavy loamy soil. **Ground water evaporation (or recharge) rate was determined by the amount of water, added to the lysimeter, infiltration rate was determined by the amount of substance poured off the lysimeter after rainfalls.**
Interstitial water sampling was made with the help of penetrometer, positioned at the depth of 50 cm from the soil surface. The device operates in a manner of

capillarimeter. Stream of moisture is directed toward collecting tank under the effect of the exhausting (70 kPa) generated in the device and potential gradient in the system "soil-penetrometer". Solution obtained was analyzed in the laboratory with a use of standard methods of soils chemistry. Possible agents sorption in ceramic penetrometer was not determined and considered.

Chemical analyses of snow and soil samples has shown that total amount of the agents contained in snow is equal to only 27 mg/l, but in ground water this value varies from 173 mg/l in lysimeters with sod-podzol soil to 199 mg/l in lysimeters with dark grey forest soil. Calcium and manganese content was quite low: their maximal content did not exceed 29 and 8 mg/l respectively in sod-podzol soil and 21 and 12 mg/l in dark grey forest soil.

Under conditions of droughty vegetative period all experiments had shown that soil feeding with water by means of ground water prevailed infiltration during the whole research period and especially in August. Volumes of feeding directly depended on GWL. Taking into account the fact that GWL is located quite close to the soil surface (GWL = 70 cm), feeding was more intensive that during experiment with GWL of 95 cm. Infiltration of precipitating moisture during experiments with GWL 70 and 95 cm was quite small; but during experiment with GWL of 95 cm (i.e. under condition of more strong aeration zone) it was a little higher. Volumes of feeding and moisture infiltration under effect of different average GWL amounted at GWL 70 cm – 86 and 17 mm respectively, at GWL 95 cm – 97 and 45 mm; at GWL 120 cm – 28 and 34 mm, and at GWL 145 cm – 13 and 51 mm. So soil feeding with moisture from ground water in total decreases simultaneously with ground water level lowering, and infiltration increases. Therefore the stronger is aeration zone the slower seepage of precipitation moisture to GW. At the same time at deep GWL infiltration significantly drags on and can last a long period after rains (even during droughty period).

Microelements content in ground water is small. Ferrum content in snow makes an exclusion (0,311 mg/l), which amounts maximum allowable concentration (MAC) as well as Cadmium content in some samples of sod-podzol (0,001 mg/l) and Plumbum content nearly in all samples of both soil types (0,002 mg/l), which is close to MAC.

Interstitial water in soil is collected from 4 and 6 lysimeters at GWL of 100 and 120 cm respectively from the soil section depth of 50 cm.

Microelements content in interstitial water differs from their content in lysimetric (ground) water. For example, Potassium (0,92 mg/l), Sodium (3,72) and Ferrum (0,01) content is much lower in comparison with lysimetric water, 3,74, 14,50, 0,22 mg/l respectively. The biggest content is typical for Calcium, Manganese, Sodium and Calcium.

Ground water level has quite significant influence on chemical agents content in interstitial water. It was determined that while GWL rises, chemical agents content in interstitial water significantly increases, which is related to the increase of incoming volumes of ground water and agents dissolved in this water to the aeration zone. Hence in lysimeter at GWL of 100 cm Potassium content amounts 0,726, Sodium content – 4,78, Calcium content – 107,720, Manganese content – 8,045, Ferrum content – 0,0133 and Copper content – 0,042 mg/l, and in lysimeter at GWL of 120 cm their concentration equals 0,178, 1,804, 27,00, 2,577, 0,007 and 0,002 mg/l respectively.

Consequently, chemical agents content in lysimeter with higher ground water level is 2-4 times higher than their content in lysimeter with lower GWL. In such a case even

small difference of GWL (only 20 cm) causes substantial differences in the content of macro- and microelements.
The content of almost all chemical elements in sod-podzol soil is almost 1,5 times higher (as for Potassium – in 5 times), than in dark grey forest soil. The reason of such phenomenon is consists in the difference of biological-physiological properties of the plants: stronger rye's root system penetrates the soil much deeper and consumes much more nourishing elements than potato does.
Potato harvest under different experimental condition was, in total, quite high (2.22 – 2,26 kg/m^2, in other words, 21.1 – 22,6 t/hectare). Consequently, conditions of the potato growing in lysimeters were close to the optimal ones.

Conclusions

1. Under conditions of droughty vegetative period, soil feeding with moisture from ground water prevails infiltration of all options during the whole investigated period. At the high ground water level (GWL) (70 and 95 cm from the soil surface) moisture feeding has taken place during all May, June and major part of July. Precipitation moisture infiltration for options of 70 and 95 GWL amounts just a negligible value.
2. Feeding volumes directly depend on GWL. Amounts of feeding and moisture infiltration at different average GWL were equal: at GWL 70 cm – 86 and 17 mm respectively, at GWL 95 cm – 97 and 45 mm; at GWL 120 cm – 28 and 34 mm, and at GWL 145 cm – 13 and 51 mm. Generally at GWL lowering the soil feeding with moisture from ground water decreases these values and infiltration – increases them.
3. GWL significantly influences the chemical agents content in interstitial water. With GWL rise the concentration of chemical agents in interstitial water significantly increases. Calcium content for options for GWL of 120 and 100 cm amounts to 107,7 and 26,9 mg/l respectively. Chemical agents content at high GWL is 2-4 times higher than at lower GWL.

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The use of municipal sewage sludge to fertilize the soil - technological possibilities and legal regulations in Poland

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Key words: sewage sludge, compost, post-ferment, management, fertilization, legal conditions, risks, environmental

Introduction

Sewage sludge is a byproduct of municipal wastewater treatment. It is estimated that municipal sludge comprises 2-5% of sewage fowing in the wastewater treatment plant. Utilization of sewage sludge is regulated by the Polish and EU laws [1, 2, 7, 8, 9]. In 2013, Poland generated 540.3 thousand tons of sewage sludge dry matter [4]. A real amount of sewage sludge requiring disposal reaches an amount of 219.8 thousand tons more, which are accumulated on landfill areas on the wastewater treatment plants from the past years [4]. Due to predictions, in the year 2018, the amount of sewage sludge is to reach 726 thousand tons of dry matter [4]. According to the valid regulations, the processing of municipal sewage sludge should be performed in accordance with regulations defining the waste disposal principles [9]. From 1 January 2016, the disposal of sludge which has not been properly processed is forbidden [9]. Under the regulations, sending sewage sludge to the landfill is allowed only for sludge which has the calorific value lower than 6.0 MJ/kg d.m., contains less than 5% of total organic carbon, and its loss on ignition is not higher than 8% d.m. Municipal sewage sludge usually, includes total organic carbon in amount of more than 5%. Currently, the predominant method for the disposal of this sludge is its storage and agricultural application. Due to the implementation of Council Directive 99/31/EC on the waste landfill, prohibiting the non-hazardous waste admission in landfills, including sewage sludge, operators of wastewater treatment plant are therefore forced to change the existing ways of their development [1].

Agricultural reuse of sewage sludge

The Act on waste [9] specifies recovery methods that deal with using sewage sludge: in agriculture for the cultivation of all crops introduced to the market, including crops for feed production; for the cultivation of plants used for compost production; for the cultivation of plants not intended for consumption and for feed production; for the reclamation of sites, including reclamation of land for agricultural purposes and the land adjustment to the specified needs arising from waste management plans, spatial development plans or decisions concerning development and land use conditions. In accordance with the Act on waste [9] the use of sewage sludge is possible only if it is stabilized and properly prepared for the aim and method of its use, particularly through biological, chemical processing and heat treatment or other process that decreases susceptibility of sewage sludge to putrefying process and that eliminates a risk to the environment and human health. In accordance with the Regulation of the Minister of Environment of 6 February 2015 on sewage sludge, it can be used in liquid, greasy or earthy form [7]. The Regulation sets forth the conditions for its use in the liquid form by introducing to the ground through the injection method or the spraying method, including hydro-seeding, while in the greasy and earthy form – through even distribution on the ground surface and through immediate mixing with the ground. The responsibility for the correct usage of sludge for the above-mentioned purposes bears the sludge producer, who is also obliged to perform the appropriate tests before using the sludge. The land on which the waste is being used should also undergo the tests.

Most of municipal sewage sludge produced in Poland could be used in nature. This applies primarily sludge produced in the areas of provinces where dominated by agri-food industry, which results that the sewage sludge do not contain large amounts of heavy metals and other dangerous industrial pollutants. The rationale seems to be the use of biowaste in agriculture as a fertilizer, but in this case puts out the most demanding requirements in terms of physical, chemical, biological and sanitary properties, and chemical and physical properties of soils.

21.6% of sewage sludge is used as a valuable fertilizer to agricultural and natural purposes, which puts Poland at the bottom of the list of European countries in relation to utilization of such sludge as a valuable source of biogenic elements. 131 thousand tons of dry solid is applied in agriculture, 111.2 thousand tons of dry solid is applied in land reclamation (including land for agricultural purposes) and 377 thousand tons of dry solid is applied in cultivation of plants intended for compost production [4].

Although the agricultural-natural use of sludge seems to be the cheapest and the most profitable solution, in Poland operate only 30 composting plants that process the waste from purification plants in a technical scale and yet only 17 of them have a permit on the distribution of compost as an organic fertiliser.

A positive aspect for sewage sludge agricultural use is the higher content of biogenic compounds compared to natural fertilisers and substances necessary for plant growth. Contents of biogenic compounds affects the possibility of sludge utilization in agriculture. Due to the fact that sewage sludge has humus compounds, trace elements, as well as other substances necessary for plant growth, they may be treated as valuable fertilizer [6].

On the other hand, however, it is a source of micropollutants, both mineral and organic. The reuse of sludge on the agricultural lands is limited by the high levels of the heavy metals, polycyclic aromatic hydrocarbons, tetrachlorodibenzodioxin, polychlorinated biphenyl and pathogenic organisms contamination [5]. Content of heavy metals dependent on the participation of industrial sewage in the total volume of municipal sewage, subjected to treatment. The high concentration value of heavy metals is an important factor that restricts the natural and agricultural use of sludge (Table 1). The most undesirable heavy metals that are toxic for living organisms in sewage sludge includes: cadmium, chromium, lead, nickel and mercury. They show (with the exception of nickel) a major susceptibility to biocumulation [3].

Moreover, the Regulation [7] pays attention to the permissible content of the chosen biological indicators, among which are Salmonella bacteria and invasive eggs of nematodes belonging to three types: *Ascaris, Trichuris* and *Toxocara* (ATT indicator). Under the Regulation [7] the sewage sludge can be used in agriculture and for the reclamation of land for agricultural purposes if Salmonella bacteria haven't been isolated in 100 g of the tested sludge, whereas the number of alive bacteria in 1 kg of dry organic matter is 0. In case of using the sludge for other purposes – ATT indicator should not exceed 300 eggs of intestinal parasites of *Ascaris sp*., *Trichuris sp*., *Toxocara sp.*

Table 1

Permissible content of heavy metals in municipal sewage sludge, in accordance with the ordinance of the Regulation of the Minister of Environment of 6 February 2015

Metal	Content of heavy metals, mg/kg dry waste residue, not greater than:		
	in the application of municipal sewage sludge:		
	in agriculture, and for the reclamation of lands for agricultural purposes	for the reclamation of lands for non-agricultural purposes	when adjusting lands for specific needs arising from the waste management plans, land development plans or decisions on the conditions developing and managing a premises, for the cultivation of crops intended for the production of compost, for the cultivation of crops not intended for human consumption and the production of animal feed
Cadmium (Cd)	20	25	50
Copper (Cu)	1000	1200	2000
Nickel (Ni)	300	400	500
Lead (Pb)	750	1000	1500
Zinc (Zn)	2500	3500	5000
Mercury (Hg)	16	20	25
Chrome (Cr)	500	1000	2500

Conclusion

The fast approaching year 2016 (a ban on landfill of sewage sludge) should see the ongoing efforts to standardize the sludge management in Poland. Legal and technological restrictions impose a necessity to look for new methods and possibilities of rational use of sewage sludge. The economic aspect related to acquiring EU funds for the development of the present infrastructure will be of great importance. It is estimated that the costs connected with the sludge processing and further management of sludge constitute from 20 to 60 % of all expenses related to the sewage treatment plant operation. One of the best methods of recycling the sewage sludge is the use of sludge in agriculture. The application of sewage sludge into the soil on the one hand will enable to refill the organic matter in the soil and on the other hand it will provide valuable nutrients that are essential for proper development and growth of plants. Agricultural use of sewage sludge is subject to the greatest requirements in terms of its physical, chemical and sanitary characteristics. Often, due to the excessive content of heavy metals and the presence of pathogens the use of sewage sludge in agriculture is not permissible. Therefore, the reclamation of degraded land soil seems to be a real and reasonable use of sewage sludge.

In the near future it is necessary to recognize the sewage sludge as a source of renewable energy. Presently, in Poland operate 11 plants that deal with thermal processing of sewage sludge. Seven of these plants use the fluidized bed technology.

Because the legislation will effectively block storage and agriculture reuse of sewage sludge, therefore effective methods of thermal sewage sludge utilization can be developed. But in Poland only 10.6% of sewage sludge undergoes thermal treatment by incineration or co-incineration with other waste, of which sewage sludge comprises only a slight amount [4].

Sewage sludge is also a fuel, the combustion of which brings a number of benefits for energy. By use combustion, the high amount of sludge is reduced to a small quantity of ash and heavy metals are retained in the ash. Based on current trends, local conditions and regulations of the EU, it is expected that Poland will increase the amount of sludge sent to composting and combustion [1,2,6].

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Environmental assessment of pollution of heavy metals soil Baku

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Introduction

Among anthropogenic sources of pollution in the cities of vehicles takes second place after the industry, as supplies natural environment huge masses of dust, soot, exhaust gases, oils, and hundreds of other substances, most of which relates to the toxicant. Particularly acute negative impact of road transport in large cities. Significant role in the contamination of soil roadside territories play heavy metals (zinc, copper, nickel, lead).

Toxicity HM appears to inhibit the growth and development of microorganisms and plants, causing serious damage to the health of humans and animals (Shvedova, 2004). In particular, the HM causes malfunction of the central nervous system, changes in blood impair the function of the lungs, kidneys, liver and other organs. Long-term effects of HM can cause cancer, allergies, malnutrition, physical and neurological degenerative processes similar to Alzheimer's disease, Parkinson et al. (Kvesitadze et al., 2005, Illarionov, 2010). Analysis of diseases in children (0 to 14 years) showed the frequency of diseases of the endocrine system, diseases of the musculoskeletal system; metabolic and immunity; respiratory diseases; diseases of the nervous system and sense organs; Diseases of the genitourinary system.

In assessing the dynamics of child morbidity noted figures in the following groups:

- diseases of the musculoskeletal system;
- diseases of the circulatory system;
- diseases of the digestive system;
- diseases of the endocrine system.

Currently accumulated quite a significant amount of information on the use of biochemical and biological methods for assessing the ecological status of the soil, to change the composition of the microbial community and the related enzyme activity, a comparative assessment of their sensitivity (Manual for the integrated monitoring. Programme Phase, 1993; Ismailov, 1988; Minkin, 2005; Ilyushkina, 2007; Vodyanitsky, 2009 Najafova S. 2012).

The main source of lead pollution - road transport. Most (80-90%) emissions settles along highways on the surface of soil and vegetation. Since the exhaust gases on the surface of the soil gets over 250 thousand. Tons of lead per year. The content of lead in the soil generally ranges from 0.1 to 20 mg / kg. Lead adversely affect the biological activity in the soil, reduces the number of microorganisms. Lead dose of 100 mg / kg dry feed weight is considered lethal for animals.

The purpose of research - the study of the enzymatic activity of soil urbolandscapes metropolis Baku. The object of study - urban soils sampled in different functional areas of the city of Baku from depths of 0-10 cm. The collection and analysis of soil samples was carried out according to standard procedures (GOST 28168-89, 2008).

Soil indicators catalase activity were determined by standard methods (Khaziev, 1990 Workshop on Agricultural Chemistry, 2001).

Results and Discussion

We have studied the effects of heavy metals on the activity of soil enzymes and biological activity of urban soils in Sabail district of Baku. Taking into account that the lead is one of the priority pollutants of soil in the cities, we investigated the effect of lead on the biological properties of urban soils Baku.

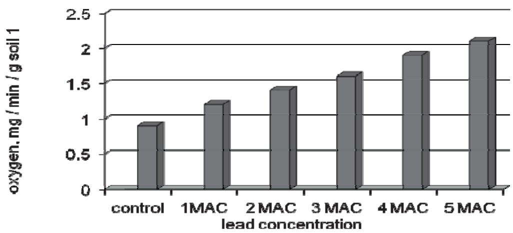

Fig. 1. Influence of lead pollution on catalase activity

Studies have shown that unpolluted lead carbonate heavy loam gray-brown soil enrichment catalase refers to the poor (0.6-1.1 ml of oxygen for 1 min/g of air-dry soil). With the increase of lead content in the soil, we studied concentration range, there is a regular increase in catalase activity (Fig. 1).

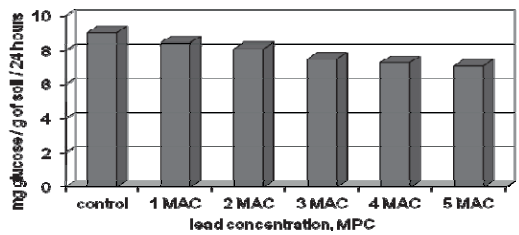

Fig. 2. Effect of lead pollution on invertase activity

Thus, compared with the control, the increase in catalase activity in lead content in the soil occurs already at a concentration of 1 MAC, which is greater than 33%. Exceeding the catalase activity of more than 2.0 times - at a concentration of toxicant in the soil 4 MAC. At a concentration of 5 MPC catalase activity increases 2.3 times.
Uncontaminated soil lead is, enrichment invertase, to the very rich (7.8 - 9.1 mg glucose/g-day). With the increase of lead content in the soil tends to decrease under the influence of invertase activity lead (Fig. 2). When the concentration of the pollutant in the soil from 3-5 MAC decrease in activity is about 22%.
Uncontaminated soil lead is, enrichment urease to very poor (3.1 - 3.7 mg ammonia /10 g per day). With the increase of lead content in the soil tendency to a slight increase of urease activity (Fig. 3). Thus, compared with the control, an increase of urease activity in the lead content in the soil 2-5 MAC is about 10%.

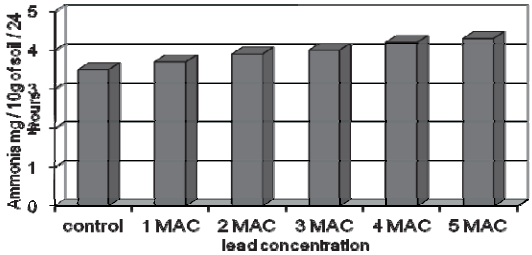

Fig. 3. Effect of lead pollution on the urease activity

Thus the studied parameters of the enzymatic activity, the greatest response to soil lead contamination found in the enzyme catalase. This allows the catalase activity of soil used as an indicator of pollution of urban soils Baku heavy metals, including lead.

Conclusions

In all the studied experimental plots of soil, the most polluted, catalase activity was higher than in the other soils of the experimental plots - Soil residential areas or roadside soils. This pattern is the same as in the spring and fall.

The results obtained allow us to judge about the changes catalase activity of soil under the influence of anthropogenic pressure, and showed that catalase activity may serve as a biological indicator of soil contamination by hydrocarbons.

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The possibility of using waste biogas plant ("Samorodovo") as an organic fertilizer on maize varieties Kubanskiy 141 MV

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Keywords: laboratory experiment, catalase activity, cellulolytic activity, *Heracléum sosnówskyi* M.

Introduction

Agricultural intensification has led to a significant concentration of animals on poultry farms and complexes. All this leads to the formation and accumulation of farms near large amounts of manure and litter.
These wastes represent a valuable organic fertilizer and everything needed for plants nutrients. But the manure and litter contain significant quantities microbes (including pathogenic to humans), helminth eggs capable long time to keep their viability and weed seeds. Therefore, the use of unprocessed manure is highly undesirable, it may lead to significant environmental degradation **[1]**. Need to find new ways of processing waste of livestock that would meet the following requirements: disinfection, ensuring long-term storage with maximum retention of nutrients, elimination of waste, polluting the environment. At the same time, it is important that they are economically justified. For the processing of manure you can apply biotechnology to obtain high quality products while preserving the environment **[2]**.
The most progressive method is anaerobic digestion (methanogenesis) or fermentation of liquid manure/litter. During this process killed pathogenic microorganisms, manure loses its odor and weed seeds – germination **[3]**. Biogas plants not only lower the class of danger of livestock waste and contribute to production of organic fertilizers that are easily absorbed by plants, but also allow to obtain electric and thermal energy **[4]**.
The objective was to study the possibility of using waste biogas plant as fertilizer. In accordance with the purpose of the following objectives:
1. To determine the effect of different doses of fertilizers "Samorodovo" on the growth and development of maize and the effect size of phytostimulation.
2. To determine the effect of different doses of fertilizers "Samorodovo" on cellulolytic and catalase activity of soils.

Materials and methods

The experiments were performed in the laboratory of Department of ecology of the Perm state agricultural Academy in 2015. Object of research – a liquid biofertilizer "Samorodovo". It is a product of biotechnological processing of quail droppings. Bioenergy plant constructed by the company "EnergoRezhim" (Perm) in the peasant economy of Vladimir Rashin (village Katishi Krasnokamsky district of the Perm region). The biofertilizer "Samorodovo" received at this facility. The farm contains 10 thousand quails.

The content of major nutrients in the fertilizer: ammonium nitrogen – 1.28 g/dm^3, total phosphorus – 1.92 g/dm^3, potassium general – 2.83 g/dm^3, the movable copper – 3.18 mg/dm^3, zinc movable – 14.6 mg/dm^3, a movable iron 12.1 mg/dm^3, manganese movable – 22.8 mg/dm^3.

The soil in the experiment was from the Agro-firm "Trud" (village of Troelga Kungur district, Perm region). The soil is sod-podzol heavy loam. As a test object used the seeds of corn variety Kubanskiy 141 MV.

Agrochemical analysis was performed according to standard procedures. Determination of catalase activity gasometrical method **[5]**. Determination of the phytotoxicity was carried the method of seedlings.

Options: 1) without making (control); 2) fertilizer "Samorodovo" 7.1 ml/kg; 3) fertilizer "Samorodovo" 11.7 ml/kg; 4) fertilizer "Samorodovo" 15.6 ml/kg. The experiment was conducted in four replications.

Results and discussion

Table 1 provides data that show that the most effective to stimulate the growth of corn was the dose of fertilizer "Samorodovo" to 15.6 ml/kg, and to increase the mass of the aerial part of maize at a dose of 11.7 ml/kg. Variant of experience with fertilizer "Samorodovo" in a dose of 11.7 ml/kg has the greatest effect phytostimulation compared with the control.

Table 1

Effect of different doses of fertilizers on the effect of photostimulation, height and mass of the aboveground parts of maize Kubanskiy 141 MV

Fertilizer	Dose of fertilizer, ml/kg	The height of the aerial part, mm	The mass of the aerial part, g	Phytostimulation, %
Control	without making	170.20	3.95	-
"Samorodovo"	7.1	280.85	9.61	+59.0
"Samorodovo"	11.7	281.75	9.86	+60.0
"Samorodovo"	15.6	310.35	9.38	+58.0
HCP_{05}	-	44.52	3.75	-

According to the data obtained (table 2), compared with control greatest effect on root length was provided by the fertilizer "Samorodova" in a dose of 7.1 ml/kg. More weight, but less root length showed the options with the application of the fertilizer in the doses of 11.7 ml/kg. the Greatest effect of photostimulation was observed in variant with application the dose of 11.7 ml/kg.

The effect of different doses of fertilizer "Samorodovo" on cellulolytic and catalase activity of soil. Highest cellulolytic activity in the experiment was observed with the application of the fertilizer "Samorodovo" in a dose of 11.7 ml/kg. Stimulation of activity cellulosebased of microorganisms can be caused by the presence in the

fertilizer compounds of copper, zinc, manganese and iron. Lowest cellulolytic activity was obtained when fertilizer application is "Samorodovo" in a dose of 7.1 ml/kg.
Study of catalase activity in soil showed that the highest activity was observed in the control variant. The lowest catalase activity in soil was observed in the variant with application of the fertilizer "Samorodovo" in a dose of 15.6 ml/kg.

Table 2

Effect of different doses of fertilizers on the effect of photostimulation, length and weight of roots of maize varieties Kubanskiy 141 MV

Fertilizer	Dose of fertilizer, ml/kg	Root length, mm	The mass of roots, g	Phytostimulation, %
Control	without making	67.98	2.40	-
"Samorodovo"	7.1	165.20	4.20	+42.8
"Samorodovo"	11.7	147.58	5.03	+52.3
"Samorodovo"	15.6	165.14	5.01	+52.1
HCP_{05}	-	31.61	3.30	-

Conclusion

Therefore, based on these data, studies on sod-podzolic loamy soil of Agrofirm "Trud" Troelga village of Kungur district, Perm region the best dose of biofertilizers "Samorodovo" for corn varieties Kubanskiy is 141 MV - 11.7 ml/kg.
Firm "EnergoRezhim" (Perm) plans to conduct research on the use of for operation of the biogas plant *Heracléum sosnówskyi* M.

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Optimization of the soddy-podzolic soil structural condition at different sysytems of its cultivation

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Keywords: composing, density, hardness, porosity, soddy-podzolic soil.

Introduction

Some favorable physical properties and the modes of soil are the basis and a necessary condition for realization of potential soil fertility for receiving high harvest of crops. Therefore, creation and maintenance of optimal composing of the arable soil layer by means of different cultivation systems is an up-to-date objective of modern intensive agriculture.

Results and Discussion

The use of different cultivation systems in a crop rotation has unequal influence on composing of the arable (0-20 cm) and subarable (20-30 cm) layers of the soddy-podzolic soil in barley crops. So, the higher level of density, porosity of aeration and hardness of the arable layer optimization is reached at the minimal cultivation system on depth of 10-12 cm, than at the moldboard system.
The optimal density of composing of the arable layer under barley is noted in the variant with the minimal cultivation, where it is 1,39 g/cm^3, that is 0,07 g/cm^3 less in comparison with ploughing (Tab. 1). Thus, considerable overstocking of the subarable layer (20-30 cm) up to 1,50 g/cm^3 is noted in the variant with the minimal cultivation. It is to assume that there is decompaction of the top layer at long-lasting use of surface cultivation, because of predominant intake of some plant residues and processes of humification.
In accordance with the results of our research, the porosity of aeration of the arable soil layer does not drop below the optimal values during the vegetative period of barley at the usage of the minimal cultivation at 10-12 cm, and ploughing at 20-22 cm.
However, reduction of cultivation intensity due to the methods of minimization stimulates significant increase in porosity of aeration of the arable layer, especially of the top layer (0-10 cm), where this indicator was 1,6 times higher in comparison with ploughing (Tab. 1). This increase happens due to formation of complete vertical holes, which are formed when moving of earthworms and extinction of a deeply penetrating root system of weedy (burr, stemrooted, etc.) plants.

The usage of ploughing for the depth of 20-22 cm leads to 1,5 times increase in hardness of the arable layer in comparison with the minimal cultivation for the depth of 10-12 cm.

Table 1

Influence of different cultivation methods on the agrophysical properties of soil

Cultivation of soil	Layer of soil, cm	Density, g/cm^3	Porosity, %	Hardness, kPa
Minimal	0-10	1,36	26,4	11,1
	10-20	1,42	25,5	16,1
	20-30	1,5	23,4	18,8
Moldboard	0-10	1,47	16,7	16,8
	10-20	1,44	21,2	19,2
	20-30	1,47	21,4	23,5

HCP_{05}= 1,05

It is explained by more intensive loosening of the top layer at the cultivation by the assembled unit "Pegasus" for the depth of 10-12 cm.

The analysis of the soil structural condition under the crops of barley shows that equal distribution of agronomically valuable units (10-0,25mm) is observed at the moldboard cultivation almost in all the studied layers (Tab. 2). Their insignificant increase is noted in the layer (10-20 cm), where it is 39,6%, and this increase is connected mainly with the fraction (3-1 mm), resistant to degradation.

Table 2

Influence of technologies of barley cultivation on the soil structural-aggregate state

Cultivation method	Dry screening, %					Moist screening, %
	Layer, cm	Fraction, %				
		>10 mm	10-0,25 mm	Fraction resistant to degradation 3-1 mm	<0,25 mm	>0,25 mm
Minimal	0--10	44,7	33,9	22,2	0,5	47,8
	10--20	55,6	29,2	19,9	0,3	47
	20--30	56,3	30	23,5	0,4	39,1
Moldboard	0--10	52,1	37,4	20,6	1,4	43,3
	10--20	50,7	39,6	28,3	2,2	49,5
	20--30	53,2	37,7	25,1	3,6	48,2

Thus, the number of water-stable units (>0,25mm) in the same layer increases to 49,5%. At the same time the maximum content of the agronomically valuable fraction and water-stable macrostructure is noted at the minimal cultivation mainly in the top layer (0-10 cm), and it is 33,9% and 47,8% respectively, that is 4,7% and 0,8% more than in the lower layer (10-20 cm).

It is caused by the fact that the reversing of soil and equal distribution of the organic substance at the ploughing promotes aggregation of the lower part of the arable layer, whereas at the minimum cultivation for the depth of 10-12 cm the top layer (0-10 cm) is more humus-enriched and better aggregated than the lower one (10-20 and 20-30 cm), mainly, due to accumulation of plant and root residues in this layer.

Water permeability of soil is closely connected with the structure, density and other indicators of the soil physical condition. The use of the minimal cultivation leads to the increase of soil water-permeability under the barley crops for 1,56 mm/min, or 37,4% of the arable layer, and for 1,07 mm/min, or 32,5% of the subarable layer, in comparison with the moldboard cultivation (Tab. 3).

Table 3

Soil water-permeability under the barley crops

Cultivation method	Layer of soil, cm		
	0--10	10--20	20--30
Minimal	3,67	4,68	3,29
Moldboard	3,15	2,08	2,22

HCP05= 2,16

It is connected with the fact that the conditions for active zoofauna development are created at the plowless cultivation. The zoofauna not only promotes biological loosening of the underlying soil layers, improving its structure, but also provides with permeability of the soil profile at the expense of the numerous passages reaching 1 m depth [3].

The usage of cultivation systems different in the way, depth and intensity in the experiment predetermines an unequal extent of optimization of separate physical factors of the soil fertility.

Table 4

Crop capacity of barley, t/ha

Cultivation system	Crop capacity
Minimal	4,92
Moldboard	3,95

HCP05= 0,21

Thus, the crop capacity of barley at the minimal cultivation is 4,92 t/ha, that is 19,7% more than at the ploughing (Tab. 4). It is explained by higher optimization of the soil structural condition at the minimal cultivation.

Approximation of soil aggregates wedging resistance on water content dependence

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Keywords: mathematical models, quantitative estimation, comparative analysis, soil properties

Introduction

The quantitative approach to the description of the dependences of soil properties is in great
demand in different fields of soil science. However, its use requires solving some general problems: (1) what function should be selected for the description of the soil characteristic, (2) it should be proved that the selected function is best in statistical and physical terms, and (3) the suitability of the parametric approach for assessing the phenomenon under consideration (the reliability of the differences in the characteristics among the soils, the experimental treatments, etc.) should be shown. The aim of this work is to substantiate the procedure for the use of the parametric approach in the description and comparison of the soil characteristics. The work considered the order of application of some functions for the description of the soil characteristics: (1) the selection and statistical substantiation of a mathematical model for describing the dependence of soil aggregates wedging resistance of the water content as important soil characteristics, (2) the use of approximation parameters for the comparative analysis of the soil objects, and (3) the testing of the usability of the approximation parameters for the study of the significance of the differences and the interrelations between the different soil characteristics.

Materials and Methods

The physical properties of chernozems were studied in the forest_steppe region of the zone of leached and ordinary chernozems in Aksakovo raion of Orenburg oblast. For comparison, an ordinary chernozem was taken from plots under a plowland (in black fallow at the moment of the study), a dead_cover forest, and herbaceous plants (meadow) located 35 m from each other (at 53°3′50.6″ N, 053°43′50.6″ E).
The wedging resistance as a characteristic of the mechanical stability of the aggregates depending on the moisture was determined with a Rebinder plastometer [9]. The soil aggregates were preliminary saturated with water for 24 h. For this purpose, a ceramic plate was put in a pan with water and covered with filter paper; no less than 30 aggregates were placed onto the paper. Then, the aggregates were transferred to the pan covered with a glass to prevent intensive evaporation and slowly dried to attain the equilibrium water content. In the course of the drying, the wedging resistance was determined with a Rebinder plastometer

simultaneously with the determination of the water content. The wedging resistance of the aggregates (*Pm*) nonlinearly increases with the decreasing water content (*W*). This type of nonlinearity is usually described by an exponential or power function. Hence, the following equations can be used: $Pm = b_1^{'} \cdot \exp(-b_2^{'} \cdot W)$ or $Pm = \left(\frac{W}{c_2}\right)^{-c_1}$ .Both these equations well describe the abrupt nonlinear decrease in the wedging resistance of the aggregates with the increasing water content. However, some methods can statistically estimate and select the function best describing the experimental data. For this purpose, the approximation by both functions should be performed; the numerical values of the approximation errors and the parameters with all the statistical characteristics (the standard error, the reliability estimate of each parameter, etc.) should be determined, and the obtained statistical data should be analyzed. If a parameter is found to be unreliable and
the standard errors are too high, the equation can be rejected and the equation with better statistical parameters can be used.

Results and Discussion

The analysis of the factual data for some soil objects showed the following:
(1) Exponential equations are best suitable for describing the dependence of the wedging resistance of the aggregates on the water content.
(2) The power equations best approximate the dependence of the wedging resistance of the
soil on the water content in the range from the liquid limit to the plastic limit.
Two things should be noted. First, an equation is frequently suitable for describing the experimental data only in a specific range, while another function is better in another range. This usually indicates that the studied dependence follows dissimilar physical mechanisms in different ranges. Therefore, it is very difficult o select a common equation with good statistics for a wide range of factor effects. Hence, the obtained equation should be used only within the studied range. The second point is related to the physical substantiation of the parameters determined in the course of the approximation. One frequently imparts some physical (chemical, biological, etc.) sense to the approximation parameters.

Conclusion

(1) The quantitative estimation of the soil characteristics and distributions, their comparative analysis, and their use in physically based forecasting simulation models require the mathematical description of the soil characteristics (the dependences of the property on the affecting factor) and the property distributions (the size distribution of the particles: the grain_size, micro_, and macroaggregate compositions, etc.). The assessment and comparative analysis are based on the approximation parameters of the specific data using the selected mathematical model, which can be statistically described and compared.

(2) The exponential equations $Pm = b_1' \cdot \exp(-b_2' \cdot W)$ are best suitable for describing the dependence of the wedging resistance of the aggregates on the water content, the power equations $Pm = \left(\frac{W}{c_2}\right)^{-c_1}$ best approximate the dependence of the wedging resistance of soil pastes on the water content in the range from the liquid limit to the plastic limit.

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Legal mechanisms seizure of agricultural land

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Keywords: land law, the criteria for a significant reduction in the fertility of land, failure to use the land, land with hillocks

The seizure of agricultural land is intended to make rational usage of the land and prevent the degradation of soil properties. Meanwhile, the legal mechanism of land seizure is not fully completed, but it is used in practice. The removal of agricultural land at the federal level is regulated by the Land Code, the Civil Code, the Federal Law №101 «On circulation of agricultural land."

In judicial practice the most common case - is seizure of agricultural land by the Civil code, article 284. As an example the appeal decision of the Tula court for the case №33-1582/2014. Within three years there were carried out unscheduled inspections by Kimovskii territorial department to inspect the land of ownership. There was found the overgrown with grass and the lack of economic activity[11]. Meanwhile 285 article provides the land seizure with violation of normal usage, in particular if it leads to degradation of soil fertility or environmental degradation [1].

Russian Federation Government Resolutions define the criteria for determination the decreasing soil fertility. But there are some questions to the texts of resolutions and to the prospects of their application.

The criteria of the decreasing soil fertility are approved by Government Resolution of Russian Federation № 612 from 22.07.2011[7].

These criteria don't include differences in structure and soil properties for different climatic zones. There is an opportunity to expand them, just include the criteria from the main list of chemical, physico-chemical and biological soil properties of land.

Obviously, the comparative analysis is necessary for the estimation of decreasing soil fertility, and it is possible only if we have initial fixed measurements.

It is hard to get data of old measurements. Last soil investigations were conducted in the late 80s and early 90s of last century, studies thereafter are sporadic. Author got information for 1992 from state farm "Quiet Don " while he was studying the questions of degradation of podzolized chernozems. After comparing these data with agrochemical passport we can say that the amount of movable potassium has not changed, but the amount of phosphorus has decreased.

The government resolution №736 from 19.07.2012 suggested the criteria of significant degradation of ecological situation. First criterion - is total index content of contaminats, which exceed the MPC. Second forbids the placement and waste production from 1 to 4th classes.

The government resolution from 23.04.2012 №369 sets rules of non-use lands in view of agrotechnical production or other activities in subjects of Russian Federation.

Wherein, method of determination of afforestation, waterlogging is missed at the legislative level, so we don't have an opportunity for expert studies [4].

Two fields 10*10 meters were selected on the unused land of Kurkinskii district in Tula region, after that we counted the amount of anthills. On the average we had 15 anthills on one field, their area is nearly 2% from the total area [8].

It is highly doubtful that such a large percent of the area can be exposed to large number of tussocks caused by activity of ants , moles and other animals [4].

Thus, it seems necessary:

1. Perfection of the regulatory base. Clarification and clear scientific justification for quantitative values of criteria for unused lands. The inclusion of additional criteria of soil properties. The development of methodical recommendations for land estimations with using the remote monitoring (satellite system GLONASS)
2. Collection and systematization of data from agrochemical and soil researches, which can be used as the initial information for comparative assessment.
3. Approval of a legal mechanism for agricultural land seizure due to significant decrease of soil fertility or ecological situation.

Solution for these questions will improve the legislation in land law

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The Gene Pool of Volgograd region soils

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Keywords: a structure, the fund of soil and genetic diversity, provincial peculiarities, black soils, chestnut soils.

About the Gene Pool. One of the common definitions for the term "gene pool" reads as follows: "The gene pool is a set of living species with their manifested and potential innate characters" (Reimers, 1990, p. 89). Initially, a soil is full of manifested and potential properties inherited from the parent rocks. Genetic diversity, provincial identity, age and evolution, individual characteristics, and morphological features are typical of any soil. Similarly to the Gene Pool of Living Organisms, we offer not only introduce a concept of "the Gene Pool of Soils", but to develop its content and structure (Okolelova A.A. et al., 2004, 2006).

Genesis of soils is investigated and discussed. "Genesis of soils is described by their origin, formation and development along with all the inherent peculiarities (structure, composition, properties and modern modes)" (Rode, 1975, p. 56). This global process is also evidence of the presence of naturally occurring Gene Pool of Soils or Fund of Soil and Genetic Diversity.

A.I. Klimentiev and V.B. Blokhin (1996) applied in their work the term "soil fund". The authors consider a soil as a living organism, define the morphology of a soil profile as "anatomy of a soil body", and establish "genetic unity" existing in the soil profile. "Every horizon of a soil profile "codes" the results of abiotic, biological and anthropological factors in its "memory" in a form of morphological characteristics and properties", write the scientists (p. 28). All components of a soil form the singularity of each taxonomic unit which evidences the presence of the Gene Pool of Soils existing in nature whether we take this fact into account or not. The soil diversity is a key to the formation of its basic properties: the ability to create conditions for the survival of living organisms.

The Gene Pool of Soils represents an integrated document gathering the information on soils of different land uses. Its creation will put on the leading position not a powerful competitor, but soils themselves (Okolelova A.A. et al., 2004, 2006).

According to the explanatory dictionaries, "anamnesis is a set of data on development of a disease, living conditions, past diseases, etc., collected for their use in the diagnosis, prognosis, treatment and prevention" (New Big Encyclopedic Dictionary, p. 45). Such definition can be applied to soils as well. The Gene Pool of Soils needs constant completing and updating information, because it is "a living document". Recording of even a cured disease (e.g., degradation or contamination) is required to determine the nature and subsequent type of soil use.

Since the Renaissance, the term “herbarium” has been understood as a collection of plants and a place where they have been stored. The Gene Pool of Soils or the Fund of Soil and Genetic Diversity is a single body and a document at the same time which includes the systematization of information about the kinds of exploitation and productivity of soils, a set of data about their condition required for diagnosis, prognosis, “treatment and prevention”.

A Structure of the Gene Pool of Soils. Methodology of any innovation includes a theory of the structure, logical organization, methods and means of activity. A theory of the structure is on the first place. A structure of the Fund of Soil And Genetic Diversity that consists of three sections is the most preferred; each section has to contain not only cadastral valuation, but also scientific and methodological recommendations for soil conservation and rational exploitation (Okolelova A.A. et al., 2004, 2006).

1. The soils of agriculturally used areas. It is appropriate to divide these soils to their productivity which is estimated by quality score attributed to soil: soils of high value, average and low productivity, and disturbed soils.

To the high value soils we propose to refer the soils with the quality score not exceeding the average of its land and estimation area; the soils with the score exceeding the half value in its administrative area, and the soils with potential fertility higher than in the given land and estimation area.

Economic activity related to soils with the average productivity has to be organized in a sparing mode of operation using effective melioration and prevention of negative processes development. They can serve as condensation nuclei for environmental well-being of ecosystems.

Provincial peculiarities of Volgograd Region soils restrict the land use; they are: heavy particle size distribution, low power capacity and content of humus, salination, formation of compacted layers in the soil profile (solonetz, clayed and lime horizons, a surface crust and a plow sole). Natural conditions of soil degradation in Volgograd Region are heterogeneity, much dissected relief in some cases and poor drainage in other ones, as well as shallow saline ground waters (Okolelova A.A. et al., 2004).

The above listed parameters of Volgograd Region soils compose their special phenotype. According to N.F. Reimers, “a phenotype is a set of internal and external structures and functions of individuals changing in the process of the individual development and formed on the basis of heredity (genotype) and influence of the environment” (1990, p. 549). Replace the word “individual” with the word “soil”. In the description concerned with the soil everything is true. “A set of internal and external structures changing in the process of the individual development” specifies the formation of a soil individual.

The soil heredity and its close relationship with the parent rocks are of no doubts. The impact of the environment is always present and, in each case, affects differently (Okolelova A.A. et al., 2004, 2006).

2. Soils alienated from ecosystems of non-agricultural purposes. According to the standards, they are divided to recultivated and non-recultivated ones. For non-agricultural purposes it is rational to recall from circulation firstly non-recultivated soils or, where these do not exist, low productivity soils. Here is why we propose to introduce the procedure for allocation of land for non-agricultural use. Based on the soil inventory, it is possible to develop a method of ranking areas for opportunities to recall them for technological facilities of various purposes. One of the basic elements used for the allocation procedure of the land of the non-agricultural operation should be the Gene Pool of Soils.

3. Soils of specially protected natural reservations (SPNR) including the soils listed in the Red Book of Soils. They are automatically shielded from the negative influence. It is also necessary to create the inventory for them. If the soil itself corresponds to the rank decent of its commandments, that only increases the value of the SPNR object.

Besides, we offer to include in the Red Book of Soils the standards of zonal soils that do not have obvious characters of degradation (black and chestnut soils), as also soils of the SPNR objects. The soil, regardless whether it inhabited with rare animals or not, whether it is grown with valuable species of flora or not, worth of careful treatment and preservation in the form in which it exists for centuries.

All three proposed sections of the Fund of Soil and Genetic Diversity are closely related. The valuable soils of agriculturally used areas are not recalled from circulation; they may be included in the Red Book of Soils.

The lands allocated to the temporary use will leave forever in their biographies information about the type and timing of its operating status, changes in “health”, and remain in the section of land set aside for non-agricultural use. A need to integrate information about the soils of each section seems to be obvious. The initial stage of the organization of the Gene Pool of Soils could be the introduction of passports of soil contours, similar to the ecological passports of soil objects.

The Gene Pool of Soils (an institution, service and a document) allows organizing and compiling all the soil differences in each region as well as determining their status. The Fund of Soil and Genetic Diversity, as a scientific and practical document, could be the basis for a regulatory and legal framework of soil conservation in the region.

The Gene Pool of Soils will give a possibility to reveal a degree of soil specialness, evaluate the significance of zonal soils in each region, to preserve and restore disturbed soils. The Fund of Soil and Genetic Diversity is needed as a foundation for creating a real ecological and economic value of such unique natural, almost non-renewable resource as a soil. It is a basic element of the management mechanism promoting biodiversity conservation of soil cover. Its formation enables to control the formation of soil resources regardless departmental affiliation. So, the term “gene pool” is applicable to soils.

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Sandy soils: genesis and evolution

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Keywords: Anthropogenic factors; Soil evolution; Coastline; Vegetation selection

Introduction

The coastal areas worldwide, become the subject of particular concern in the search for implementation of sustainable development projects because they are areas subject to natural environmental pressures and therefore fragile, since they treat interface between local media quite different characteristics.
Here we talk about a location, Aveiro Lagoon (Fig. 1 I), Portugal, in the Far Western Europe to 300 years ago still recorded the competition between the Atlantic Ocean and the sand trying to be deposited. In this particular case, in the case specifically of sandy coastlines, with no aggregate materials, any outside action causes, easily, the location of the imbalance. Plus these vulnerable natural characteristics, it is particularly worrying current and inadequate human pressure exerted on these areas already so fragile. So it is impossible for consolidation and soil formation for development or forest or agricultural.

Figure I: Aveiro Lagoon (Portugal)

This is an issue that involves much controversy in scientific circles and about which it is not intended here to take sides. But the truth is that the vast sowing held in the first half of the last century in Mira dunes ever had the desire to place cohabiting species typical of sandy shores - such as *Ammophila arenaria* (L.) Link and *Corema album* (L.) D. Don and exotic as the *Eucalyptus globulus* Labill., *Acacia melanoxylon* R. Br., the *Populus sp*. and *Alnus glutinosa* (L.) Gaertner - in order to withdraw therefrom the best advantage to the site and to obtain products for use populations (Rei, 1924). This project has been undertaken in the formula counting with a factor that nowadays disappeared (the use of woods by man) and this will be registered current imbalance in respect to the vegetal and the consequent evolution of soils.

Materials and Methods

The forests of Mira County were installed for the consolidation of afforestation and the establishment of coastal sands , constituting one of the most outstanding works of forestry of the twentieth century. Protecting farm houses and land of sand and salty winds, and contributing decisively to the appreciation of important coastal areas - formerly unproductive areas by controlling the local natural conditions , the woods become a supplier of goods to the population (PINHO, 2005) .
The work, as can be seen in Fig. 1 II, ranged from the creation of infra - structures (roads, divisional, sewerage systems), to the artificial regeneration, using essentially sowing maritime Pine (DIREÇÃO GERAL DOS SERVIÇOS FLORESTAIS, 1939).

Fig. 1 II- Seeding Dunes 1 - protective barrier: palisade to fix the dunes, 2 -Opening of gullies of sowing; 3 - Family workers in forest sowing
Source : Photos kindly provided by Mr. Nuno Rico

To meet the needs of transformation of loose sands in productive soils, it was necessary to establish a working method, which passed through the spatial planning. To this species were selected and suitable for hostile environments in which a favored the development of other , providing nutrients to inhospitable sands. The materials (substrates and seeds), was previously chosen among the best available, so that one could thus obtain positive results and thwart the will of nature. For this work we chose to use historical references which enabled them to make a reconstruction of what It has occurred over time.

Results and Discussion

The penisco (*Pinus pinaster* Aiton) it was sown with seeds of other plants silicícolas and fastest growing, such as *Ammophila arenaria* (L.) Link, *Ulex europaeus* L., *Ulex densus* Welw. ex Webb, *Ulex nanus* T. F. Forster ex Symons, *Cytisus pendulinus* L. fil., *Corema album* (L.) D. Don, *Myrica faya* Aiton, *Acacia longifólia* (Andrews) Willd. and *Acacia retinoides* Schlecht, in order to create shelter from the weather to small pine trees (DIREÇÃO GERAL DOS SERVIÇOS FLORESTAIS E AQUÍCOLAS, 1939).
In order to avail more funds or sheltered land and existing ditches margins, the following species have been planted: *Acacia cyanophylla* Lindley, *Acacia decurrens* Willd., *Acacia decurrens – var. dealbata, Acacia longifolia* (Andrews) Willd., *Acacia melanoxylon* R. Br., *Acacia mollissima* auct., non Willd., *Acacia pycnantha* Benth.,

Acacia retinodes Schlecht, *Alnus glutinosa* (L.) Gaertner, *Cupressus glauca* Lam., *Cupressus macrocarpa* Hartweg, *Eucalyptus globulus* Labill., *Fraxinus americana* L., *Populus alba* L. and *Populus nigra* L. (DIREÇÃO GERAL DOS SERVIÇOS FLORESTAIS E AQUÍCOLAS, 1939).

To achieve the goal of greening first proceeded to the construction of a protective barrier , and then under it or taking advantage of the natural defenses, sow penisco and other sandy seed plants and ultimately immobilizing the sands with a mulch. Opening planting furrows in parallel lines perpendicular to the direction of the prevailing wind followed. The seeds were distributed by gullies and covered with a light layer of sand. As it was sowing, the furrows were covered with weeds. The slatted was maintained (high) to fix the sands in sown area (REI, 1940).

Nowadays, soil Laguna already present of Aveiro low contents of organic matter in soil moisture, a slightly acidic pH, which allows them to fix vegetation which prevents the migration of sand into the interior. The installed vegetation already shows significant growth and renews itself, returning nutrients to the soil and enriching it (Fig. 1 III, OLIVEIRA, 2014)

Fig. 1 III – Different expressions of plant development of pine forest and soil

Conclusion

The idea that life becomes increasingly fragile with the interference of man on the environment has been widespread for the dissemination of concrete examples of environmental degradation. Exploration often these examples, getting so often forgotten those who contribute to this life strengthens. It happened with the constant concern of the Municipality of Mira in wanting to make life easier for people in the county, visible over time, and that intervention on the environment has always been guided by the search for improving the lives of these people. As the Dutch saying, here applied to Aveiro Lagoon: God made the earth and the Aveiro's man made Aveiro Lagoon (MIRANDA, 2005). This more specific case, were the Forest Service who did the hardest part of controlling nature. It means that changes have been made on the natural environment of the time; in the early twentieth coastal part of the municipality of Mira century it consisted of a sterile natural area of sand and marshes, which could not be availed by residents and even brought them destruction of land by then modulated, agricultural fields located inland. The control over the medium, effected by forest service was an unquestionable competence. Adapting to the needs of the time was precious, in the sense that gave the entire population solutions to their difficulties in controlling the natural environment because it gave him improved conditions of their farmland by the materials provided by the forest and also by the improvement in roads, the improvement of the hydrographic network conditions, agricultural organic fertilizer and food of the population. When thinking about new directions for Science any development/research has always reflected the ultimate goal, directly or indirectly, provide benefits for humans. Often scientific studies conducted for failing a proposal for application to a specific location, are often abandoned, regardless of its value. Science cannot be apart from society as being made by citizens, will always be a reflection of your needs. Also this work is the result of what is considered to be a necessity for society, because often the economic aspect does not allow detailed studies are effected for realization of certain projects through specific methods and tools, which can be costly and time consuming. This is essentially a nature work of natural history, but need to realize how we got to the current state of the soil. In the future, we intend to verify, using physical and chemical analysis, the importance of vegetation planted by humans had on the evolution of these coastal soils (this work is already underway).

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Characterization of Dissolved Organic Matter (DOM) in the Drainage Water of Hydroameliorated Agricultural Areas in Croatia

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Keywords: dissolved organic carbon, surface active substances, copper complexing capacity, dissolved sulfur fraction, drainage water.

This study provides the first investigation of dissolved organic carbon (DOC) and dissolved organic sulfur (DOS) in the drainage water of the experimental amelioration fields in the Sava River Valley (45º33'52''N/16º31'33''E), in Croatia. Soil was drained in four different drainpipe spacing variants (15 m, 20 m, 25 m and 30 m), set up in four replications (Fig. 1) (Šimunić et al., 2011). Dissolved organic matter (DOM) plays an important role in the carbon cycle of terrestrial ecosystems; it is

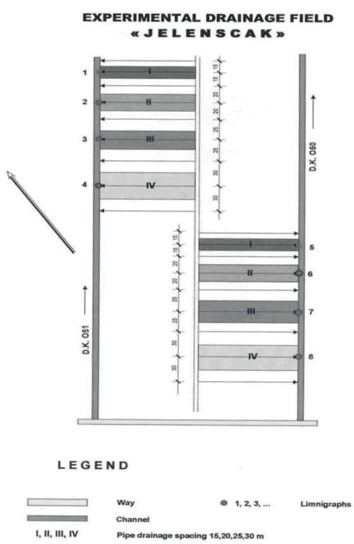

Fig. 1. Schematic illustration of the experimental amelioration field (Šimunić et al., 2011).

important for the transfer of organic C from terrestrial to aquatic systems (Neff and Asner, 2001). Dissolved organic carbon (DOC) are generally defined as compounds that can pass through a 0.45 µm or 0.7 µm filter. Dissolved organic sulfur (DOS) may in some cases constitute a significant part of the total flux of sulfur from terrestrial to aquatic environment (Wang et al., 2011).
In this work, electrochemical methods were applied for DOC characterization, including surface active substances (SAS), Cu complexing capacity (CuCC) and inorganic and organic reduced sulfur species (RSS) measurements. Paralell in all drainage water samples of hydroameliorated agricultural areas, DOC by high-temperature catalytic oxidation (HTCO) method was measured (Table 1).

Table 1

Data for drainage water of hydroameliorated agricultural areas. Data on the dates of sampling, pH, dissolved organic carbon (DOC), surface active substances (SAS), copper complexing capacity (CuCC), the corresponding log K, and organic and inorganic sulfur fraction

No.d.*	Date of sampling	pH	DOC (mgC L^{-1})	SAS (eq.Triton-X-100)	CuCC µM	log K	$S_{org.}$ (µM)	$S_{inorg.}$ (µM)
1	15.12.2014	7.40	5.173	0.367	0.477	7.71	n.m.***	n.m.
2	15.12.2014	7.60	3.953	0.272	0.104	-	n.m.	n.m.
1	19.02.2015	7.63	3.010	0.454	1.400	7.09	n.m.	n.m.
2	19.02.2015	7.67	9.928	0.417	0.113	-	0.092	0.185
3	19.02.2015	7.79	4.135	0.347	0.414	-	0.055	0.181
4	19.02.2015	7.86	1.065	0.105	0.103	8.04	0.129	0.228
1	26.05.2015	7.64	6.620	0.392	0.623	6.53	n.d.	n.d.
2	26.05.2015	7.35	8.008	0.416	n.d.**	-	n.d.	n.d.
3	26.05.2015	7.96	4.370	0.411	0.200	7.33	n.d.	n.d
4	26.05.2015	7.76	5.370	0.408	1.330	7.35	n.d.	n.d

*No. drainpipe. **not detected; ***not measured

Research on the DOC and SAS provides an important insight in the content, distribution, physico-chemical characteristics as well as dynamics of the complex mixture of DOM in the natural waters (Ćosović et al., 2007; Orlović-Leko et al., 2011). As shown in Table 1, DOC concentrations varied between 1.065 and 9.928 mgC L^{-1} with average value of 5.163 ± 2.529 mgC L^{-1}. These values are higher than those obtained in the surface freshwater systems in the region the Sava River, average DOC concentration was reported to be is 2.49 ± 0.66 mgC L^{-1} (Orlović-Leko et al., 2004). The large precipitation events are affecting the DOC fluxes by increasing DOC concentrations. Surface active substances are found to be important contributes to the amount of organic compounds (0.105-0.454 mg L^{-1} eq. of Triton-X-100, with average value of 0.359±0.102) in the drainage water samples. There is no significant correlation between DOC and SAS fractions (R=0.37); these results suggest that the SAS concentrations depend on the nature of the organic molecules. The capacity of organic ligands to complex metal ions was determined as additional parameter for qualititave and quantitative characterization of organic matter in drainage water, what is of special interest for understanding the pertaining physico-chemical processes (Plavšić, 2003). CuCC were in the range 0.103 and 1.400 μmol Cu^{2+} L^{-1} (Table1). The relative stability of the Cu complexes could be compared through the apparent stability constants (log Kapp) values. The determined log Kapp values for all samples are in the range 6.53-8.04. The stability constants determined for model humic and fulvic substances are in the range of 6.5–8.4 (Plavšić et al., 2006). The organic matter in the drainage water samples was mainly characterized as humic/fulvic type but the high precipitation event can influence in appearance of the strongly adsorbable/hydrophobic substances. Characterization of sulfur fraction was based on measurements of inorganic and organic reduced sulfur species (RSS) (Ciglenečki and Ćosović, 1997; Krznarić et al. 2001). Reduced SS comprise a group of compounds that contain sulfur in nominally-II and 0 oxidation states. The reduce SS concentration including inorganic and organic fractions was in the range between 0.236 and 0.357 μM. The organic sulfur fraction was lower (up to 36%) than inorganic fraction (up to76%).

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Main Nutrient Contents of Karayemiş (*Prunus laurocerasus l.)* in Different Growing Media

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Key words: Shoot dry weight, nitrogen, phosphorus, potassium

Introduction

Karayemiş, summer winter leaf evergreen, is a plant in the form of tall shrub or tree. This plant is used quite often on roadsides, in home gardens and parks in the Black Sea region. Its fruit are sold in the market and are consumed fresh by the people. It is not too selective in terms of soil requirements; and permeable sandy loam, grows well in soil rich in organic matter and plant nutrients. Karayemiş yield ranges between 20-110 kg per tree, and average yield is 50 kg (Kuleyin, 2005).
Karayemiş is reproduced with different propagation techniques, including seeds, root shoots, cuttings, dipping, vaccine and tissue culture. For the rooting of cuttings, perlite, pumice, river sand, peat and forest soils are used as rooting materials. Perlite is the most widely used in inorganic material in cutting propagation. It has good aeration and drainage, sterile and its chemical composition similar to soil mineral component. For this reason, plants can easily take water and nutrient from this media. Pumice is an important raw material for the plant in agriculture in terms of both cheap and properties. Hydroponic agriculture and rooting media are used alone or as mixtures in different proportions (Güngör and Tombul, 1997). Although animal and farm manure are used commonly in conventional agriculture, soil mixing the various organic and inorganic origin material have been used in today. Hazelnut husk is one of them. Hazelnut are the most important products grown in the Eastern Black Sea region, and leaves considerable waste after harvest (1/5 ratio dry husk of 1 kg of nuts) (Özenç and Çalışkan, 2001). Some physical and chemical characteristics of hazelnut husk have the value that can be evaluated in terms of its use as an organic material (Çalışkan et.al, 1996).
Purpose of this study was to assess the effects of different growing mediums composed of inorganic and organic substrates on some nutrient element contents of Karayemiş.

Materials and Methods

A greenhouse experiment with laurel (*Prunus laurocerasus L.*) variety carried out with different rooting mediums. Five rooting media as inorganic and organic were used: Perlite (PE), pumice (P), forest soil (FS), manure (M), hazelnut husk (HH), and

the experiment comprising the five media alone, six combinations at the 1:1 ratio. Perlite and pumice were bought from a commercial supplier, manure and forest soil were obtained from producers and land. Before the experiment, the some properties of media are determined and are given in Table 1.
For rooting, concrete production plots (1x1 m size, about 60 cm depth) were used and were filled with the media. Cutting taken from shoots next defoliation cut to be 25cm long and two eyes, were treated with NAA (Naphthalene Acetic Acid) and 2000 ppm by dipping method for 5sn, and then were planted into the eleven different media at interval 5x5 cm. Three replications for each media, each replications includes 10 pieces of cutting, the total was used 330 cutting. Cuttings were irrigated with misting system, which was established in the greenhouse considering the water retention capacity of the media. It was not applied any fertilization in production parcels from planting. The experiment was continued for 120 days and cuttings were removed form media. At the end of the experiment, root and leaves were dried and weighted, and then grinded for analyses.

Table 1

Some physical and chemical properties of media

Media	OM (%)	pH (1:3)	EC (1:3)	N (%)	P (%)	K (%)
PE (perlite)	0.00	6.95	0.00	0.139	0.128	0.094
P (pumice)	6.33	6.55	0.01	0.206	0.124	0.067
HH (hazelnut husk)	49.40	6.85	0.01	1.176	0.189	0.360
FS (forest soil)	28.07	6.00	0.00	0.273	0.192	0.178
M (manure)	57.93	6.50	0.04	1.142	0.281	0.458
PE:HH (perlite:hazelnut husk)	23.67	6.95	0.01	0.808	0.139	0.183
PE:FS (perlite:forest soil)	16.00	6.90	0.00	0.228	0.150	0.108
PE:M (perlite:manure)	26.00	6.80	0.01	0.730	0.200	0.296
P:HH (pumice:hazelnut husk)	24.80	6.85	0.00	0.557	0.156	0.225
P:FS (pumice:forest soil)	19.27	6.45	0.01	0.234	0.180	0.123
P:M (pumice:manure)	29.40	6.55	0.02	0.418	0.240	0.205

BD: Bulk Density; OM: Organic Matter; EC: Electrical Conductivity

Media was analyzed using the following methods: pH and EC according to Gabriels and Verdonck (1992), organic matter according to DIN 11542 (1978), total nitrogen according to kjeldahl method, total phosphorus and potassium according to spectrophotometric and fleyfotometric methods.
Variable was analyzed with one-way analysis of variance (One-way ANOVA). Statistical analysis was performed using a Minitab 16 software programmer and differences among the groups were separated by Tukey test at $p<0.01$.

Results and Discussion

The presence of organic materials in media supported plant growth and has been more effective on nutrient contents of karayemiş cuttings (Table 2). As seen in Table 2, inorganic mediums were positive effective in root growth, the highest root dry weight was found at the P:FS media (4.80 g), P (4.73 g) and P:HH media (3.83 g) followed. Because of leaf nutrition and shoot growth better in hazelnut husk media, leaf dry weight (8.36 g) increased in this media. Kocabaş and Kaplan (2007) reported that fertilizer applications were increased in dry weight of plants both rooting and growing period.

Table 2

Some nutrient contents of karayemiş cuttings in growing media

Media	Root				Leaf			
	RDW(g)	N (%)	P (%)	K (%)	LDW(g)	N (%)	P (%)	K (%)
PE	1.75cd	1.31b-d	0.13b-d	0.82b-d	5.12b-d	1.46bc	0.16a-c	0.84c-e
P	4.73a	0.70e	0.07e	0.45d	3.81c-e	1.64ab	0.16a.c	0.80de
HH	3.50a-c	1.60a	0.16a	1.62a	8.36a	1.61a-c	0.19a	2.26a
FS	2.85a-c	0.60e	0.06e	0.60cd	7.07ab	0.99d	0.15a-c	0.69e
PE:HH	3.81ab	1.37a-c	0.14a-c	1.07a-c	5.21b-d	1.77a	0.17a-c	1.43bc
PE:FS	2.32b-d	1.09d	0.11d	0.67b-d	5.94a-c	1.68ab	0.12c	0.66e
PE:M	0.79d	1.52ab	0.15ab	0.73b-d	1.89e	1.65ab	0.14bc	1.38b-d
P:HH	3.83ab	1.28cd	0.13cd	1.25ab	7.18ab	1.52a-c	0.12c	1.41b-d
P:FS	4.80a	0.79e	0.07e	0.51cd	6.82a-c	1.35c	0.13a-c	0.88c-e
P:M	2.49b-d	0.11cd	0.11cd	0.76b-d	2.47de	1.69ab	0.19ab	1.73ab

RDW: Root Dry Weight, LDW: Leaf Dry Weight

As a result of analysis of variance for characteristics, the difference between the average of at least two groups were statistically significant ($p<0.01$). Statistical differences were expressed as the letter representation next to the averages.

Similarly, the highest nitrogen content in root was found in hazelnut husk media (1.60%). The effect of media on these nutrient contents is directly proportional to nitrogen contents of materials (Table 1, Fig. 1 1). Significant of organic materials has been seen clearly in nutrition of rooted cuttings. Bates (2002) stated that 75% of the nitrogen was stored in the roots of grown grapes in field conditions. The highest nitrogen content in leaves (1.77%) was found in PE:HH media. This result is related to the presence of hazelnut husk. Media which is mixed organic and inorganic materials became prominent (Fig. 2).

Root and leaf phosphorus contents of karayemiş are the highest at hazelnut husk media (0.16% in roots, 0.19% in leaves). The presence of organic materials in the media provided an increase in phosphorus uptake (Table 2). Organic materials serve as a repository in the soil with macro and micro nutrient contents (Anonymous, 2012). Although the hazelnut husk compost is not rich in terms of phosphorus content, has been increased uptake with the roots of this element because it has suitable pH (Fig. 11, Fig. 12). Phosphorus is immobile element in its media, its receivability is significantly affected depend on physical and chemical properties of the media, especially pH. On the contrary, it is extremely mobile element in the plant, which is indicative of portability to the plant tissue. Uptaken phosphorus by roots, it can be easily transported to the plant's leaves (Kacar and Katkat, 2009).

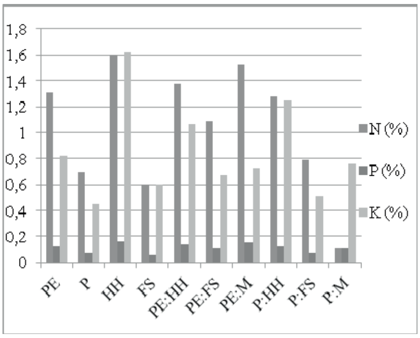

Fig. 1. N%, P% and K % contents of root

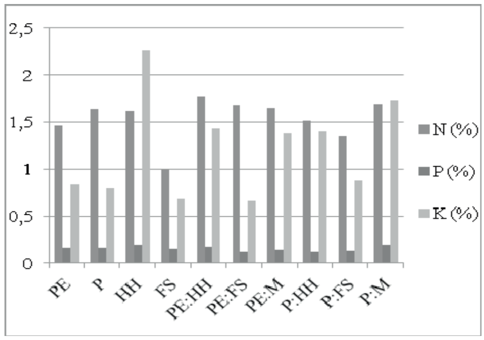

Fig. 2. N%, P% and K% contents of leaf

Similarly, root and leaves potassium contents of karayemiş is the highest at hazelnut husk media and media where it is mixed (1.62% in roots, 2.26% in leaves). This is the result of the husk have high potassium content (Fig. 11, Fig. 12). Kacar and Katkat (1998) reported that hazelnut husk has more and enough potassium and micro element contents. The high amounts of potassium have increased the content of potassium in different part of the plants by 25-32% (Ruhl, 1992).

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Effects of organic conditioners on K value of soils having different pH levels

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Key words: Soil conditioner, Soil erodibility factor, pH, Erosion

Introduction

Soil erosion is a major environmental threat to the sustainability of the World's agricultural production because of its negative effect on soil productivity (Pimentel et al., 1995). In Turkey, it is noticed that soils have erosion damage up to 78%. Many fields throughout the semi-arid lands exhibit characteristics of low soil productivity associated with erosion events. Therefore, it is very important to take effective measures to protect soil and water of agricultural fields in Turkey. Growers have several options for correcting or compensating for soil erosion and restoring productivity of these types of soils. The most common approach is to apply additional organic and chemical fertilizers to eroded areas to improve crop growth and reduce the potential of further erosion. However, large quantities of commercial fertilizer may not improve yields to the level of non-eroded soil (Talgre et al. 2012).

Use of soil amendments to increase aggregate stability of soils susceptible to erosion has been examined in the recent studies (Özdemir et al., 2004). One such practice is the incorporation of lime ($CaCO_3$) into the acid soil. Lime application improves soil structure in heavy-textured soil, so that water infiltration and the ability of roots to penetrate the soil are enhanced (Foley and Coopperhand, 2002).

The use of waste in agriculture, forestry and land reclamation has been increasingly identified as an important issue for soil fertility, conservation and residual disposal (Angin et.al, 2013). Using waste in agriculture helps not only dispose these materials economically, but also reduces negative effects on the environment and improve soil properties. The quality of soils can be improved with the addition of waste, which contains appropriate levels of organic matter. The addition of organic matter not only stabilises and improves the soil structure, but also improves the aeration of the soil. Many researchers have demonstrated that application of waste compost to soil improved the soil's physical and chemical properties (Albiach et al., 2001).

This study was carried out to determine the effects of rice husk compost, town waste compost and tobacco waste applications on soil erodibility parameter (K) in soils having different pH levels under laboratory and greenhouse conditions.

Materials and Methods

The soil samples (0–20 cm depth) used in the experiment was taken from Samsun, northern part of Turkey. The rice husk compost (RC), town waste compost (TW) and tobacco waste (TB) were obtained from different institutions. Soil samples were treated with four different levels (0, 2.5, 5.0, and 7.5%; w/w) of organic residues including the control treatments and each treatment was replicated two times in a split block design [(3x3x4)x2]. All of the pots were incubated at field capacity water content and 20^{o} C for 4 weeks. After incubation period, lettuce plants were grown in a greenhouse study. After harvesting the lettuce plants, soil samples have been rubbed by hand and sieved from 2 mm openings sieve. Some physical and chemical properties of soils were determined as fallows; soil organic matter content by a modified Walkley-Black method; soil texture by hydrometer methods; pH in 1:2.5 (V:W) soil:water suspension by pH meter; exchangeable Na by ammonia acetate extraction and cation exchange capacity according to Bower method (Nelson and Sommers, 1982). Soil erodibility factor (K) value was determined according to Blanco and Lal (2008). Statically analyses of results were done by SPSS computer program.

Results and Discussion

Soil Properties

Some physical and chemical soil properties are given in Table 1. Soil properties can be summarized as; moderately fine and fine in texture, moderate in organic matter content, low and medium in lime content, low and high in pH (Soil Survey Staff, 1993).

Table 1

Some physical and chemical properties of the soil

Parametreler	Soils		
	Tepecik(TP)	Kampüs(KP)	Çetinkaya(ÇT)
Clay (C), g kg^{-1}	394.0	402.2	149.5
Silt (Si), g kg^{-1}	340.6	256.3	394.1
Sand (S) g kg^{-1}	265.4	341.5	456.4
Organic matter (OM), %	2.40	1.13	1.31
pH (1:2.5)	5.60	7.00	8.33

Soil Erodibility Factor (K)

The effects of amendments on the soil erodibility (K) values depend on the type and level of amendment materials. These situations were given in Fig. 1. It was observed that the soil erodibility factor values of all soils decreased significantly depending on pH and amendment materials. When the reduces in mean erodibility factor caused by organic wastes over the control treatment was taken into account, it was found that all the wastes were more effective in neutral soil than the other soils.

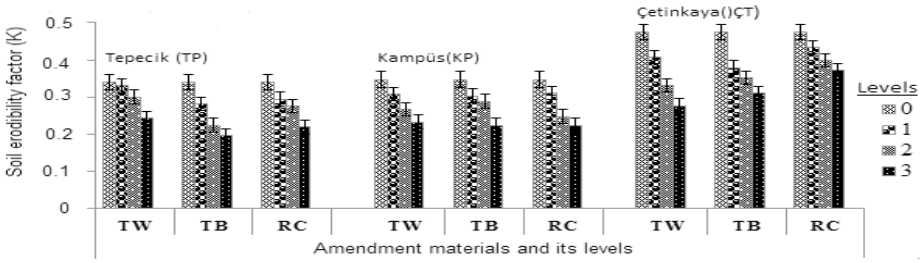

Fig. 1. The comparison of erodibility factor values as a function of soils pH

The effects of organic wastes on neutral, alkaline and acidic soils were RC > TW > TB (25%, 22%, 21%), and TW > TW > RC (27%, 26%, 13%) and TB > RC > TW (31%, 22%, 13%), respectively. According to the control treatments, K value was 0.35 for neutral soil while it was 0.34 and 0.46 for acid and alkaline soils, respectively (Fig. 1 1). The organic wastes added to soils with different pH levels decreased mean K levels of the soils to 23, 22 and 22% for neutral, alkaline and acid soils, respectively.

Also, decreases in the erodibility values (as a mean value) according to organic wastes were presented in Fig. 2.The erodibility values were different in each treatment. It is clearly seen that, rice husk compost application decreased the erodibility valuse lower than the other amendments.

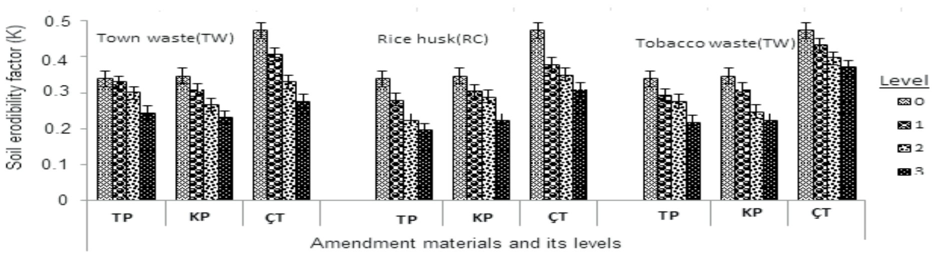

Fig. 2. Decreasing of soil erodibility factor values as a function organic wastes.

Variance analysis results on the K factor values were given in Table 2. As shown in this table; K values depending on the pH levels were significantly different at p<0.01.

The effect of amendment materials (TB, RC and TW) on the K values and their levels were statistically significant. On the other hand, K values according to soils were different at the end of the lettuce grown period. Mean of square values of the amendment materials (p<0.01) and their levels (p<0.01) were statistically significant. As shown in Table 2; also interactions between soil-amendment, soil -level, amendments-level, and soil -amendment level were significant (p<0.01). The compared means statistically are given in Table 3. The differences among the K values were significant at p<0.01.

Table 2

Variance analysis of the erodibility factor data

Sources	SS	DF	SM	SM
Soils (A)	.175	2	.088	1414.786***
Amendments (B)	.004	2	.002	34.917***
Amend. Levels (C)	.167	3	.056	896.169***
A-B	.016	4	.004	65.213***
A-C	.003	6	.000	7.144***
B-C	.002	12	.000	5.979***
A-B-C	.011	36	.001	14.344***
Error	.002	72	6.195E-005	
General	7.803			

*, p < 0.05; ** : p < 0.01; ***, p < 0.001

As shown in Table 3; the effects of amendment materials and amendment levels on K were different statistically. The results can be summarized as; amendment material treatments decreased the K values of different pH level soils. Effectiveness of the amendment materials varied depending on the type of the amendment material and the soil reaction. In conclusion, the effectiveness of the rice husk compost had considerably lower than the other amendment materials. The highest effect on the K was obtained with the highest dose of tobacco waste application in neutral pH soil.

Table 3

Mean values of soil, ammendments, and ammendments levels for the erodibility factor

Applications	0	1	2	3
Soils	0.2827a*	0.2898b	0.3908c	
Amendments		0.3234a (TW)	0.3107b (TB)	0.3292c (RC)
Amend Levels	0.3859d	0.3421c	0.2998b	0.2566a

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The Methodology Study for Determining Magnesium Fertilizer Requirements in Hazelnut (*Corylus avellana* L.) cultivation

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Keywords: *Corylus avellana* L., magnesium, fertilizer requirement, yield

Introduction

Magnesium (Mg) as a plant nutrient is required for formation of chlorophyll and the absence of this element leads to the inadequate photosynthesis. Magnesium is a central atom of the chlorophyll molecule and the most abundant free divalent cation in the plant cytosol, it is essential for the functioning of many enzymes, including ribonucleic acid (RNA) polymerases, adenosine triphosphates (ATP), protein kinases, phosphatases, glutathione synthase, and carboxylases (Marschner, 1995; Shaul, 2002). Magnesium is an essential basic cation required for the optimum growth and continuous photosynthesis. It is known that the 1.93% of the earth's crust is composed of magnesium. Magnesium is taken by plants as Mg^{2+}. Numerous factors are effected magnesium intake such as soil pH, low base saturation, climate, clay content, organic matter content, cation exchange capacity, excess nitrogen and potassium nutrient. In spite of the high amount of magnesium in soil, today there is often a deficiency of magnesium in several agricultural fields and especially hazelnut orchards. The probability of magnesium deficiency is high in the especially the low percent of the base saturation, cation exchange capacity of the sandy and acidic soil, the coarse-textured soil and heavy rain (Aktaş, 1994; Sağlam, 2001; Kacar and Katkat, 2010; Kacar, 2013).

Among the agricultural productions in our country, hazelnut (*Corylus avellana* L.) has a very important place both with the amount of production and the export value. The production amount of our country has important effects on world hazelnut trade and industry. High amount and high quality product is obtained, it is possible by the application of a good fertilizer program. The purpose of identifying the fertilization requirement for various plants, many studies carried out by benefiting from the plant and soil tests. Kacar and Katkat (2007) indicated that soil analysis methods were calibrated in different countries and regions in differential ways by different researchers and that fertilizer suggestion was made. Since relative index values can be provided with the chemical soil analysis methods, there occurs an obligation to calibrate these methods for certain plant, soil, climate and cultivation techniques. But then, fertilizer amounts which should be added to the soil are calculated according to the analysis values. Güçdemir (2006) stated that after finding out the correlation between the nutrient substance examined and the amounts of yield, the fertilizer amounts are calculated which increase the yield to the desired level.

This study objective were to determine of magnesium fertilizer requirements in Turkish hazelnut (*Corylus avellana* L.) cultivation and the calculation of fertilizer requirement values were formulated as being the first in hazelnut cultivation, and enough amount of magnesium fertilizer in practice was provided with only one calculation.

Materials and Methods

This research was conducted in 'Tombul' hazelnut orchards in Hazelnut Research Institute located in Giresun province. The trial was carried out according to the design of randomized complete blocks of magnesium nutrient elements with five different doses (0, 100, 150, 200 and 250 Kg ha^{-1} Mg) and three replications per treatment. According to the soil analysis result, the other fertilizers were given to each ocak as required. The experiment was established the average of 20-25 years old 'Tombul' hazelnut ocak with four branches based on planting system. Magnesium analysis of the trial soils were performed according to Anonymous (1982). Each hazelnut ocak was harvested separately in the first week of August depending on climate (Ayfer et al., 1986; Köksal 2002). Harvested hazelnuts were separated from husk and dried in natural conditions. Magnesium fertilizer requirement of hazelnut was determined according to the Mitcherlich equations modified by Bray (Kacar and Katkat, 2007).

$$\text{Log}\,(A-y) = \text{Log}A - c_1 b_1$$

$$\text{Log}\,(A-y) = \text{Log}A - c_1 b_1 - cx$$

A: The highest yield amount; y: The yield amount according to applying Mg fertilization doses; c_1: The impact value of magnesium in the soil; b_1: The contents of existing magnesium in the soil; c: The impact value of fertilizer applied to soil; x: The amounts of fertilizer to be applied to soil

Statistical analyses were performed by using analysis of variance in JMP statistical software. Differences at $p<0.05$ were considered to be significant. Difficulty in calculation was arranged by forming a regression equation between these variables. For obtaining 90% to 99% yield for certain levels of magnesium (10, 25, …750), the amounts of fertilizer was calculated. $Y = a + b_{yx}.X$ equations were constituted from the amounts of fertilizer calculated using the formula. All data obtained were the mean from the three years (Düzgüneş et al., 1983).

Results and Discussion

The orchards soil had a clay loam texture, low salinity and contained very little $CaCO_3$. Soil pH averaged 5.57, organic matter content 42.4 g kg^{-1}, available phosphorus content 70.68 mg kg^{-1}, available potassium and magnesium content 65.81 mg kg^{-1} and 39.37 mg kg^{-1}, respectively. The raising magnesium fertilization was significantly increased the yield of Tombul hazelnut (Table 1). Approximately

1187.09 kg ha^{-1} dry shelled hazelnut was obtained from 0 kg ha^{-1} application. The highest amount of yield was obtained 2275.57 kg ha^{-1} with 250 kg ha^{-1} Mg and 1463.11 kg ha^{-1} with 200 kg ha^{-1} Mg applications.

Calculation method related to proportional yield value of Mitscherlich modified by Bray was used, and the data obtained from trials using in the equation was formed Table 1. After being applied 0, 100, 150, 200 and 250 kg ha^{-1} magnesium in hazelnut orchards during three years, the impact values of magnesium in the soil and fertilizer were found. As seen in Table 1, the trial orchard soils had 200.60 kg ha^{-1}, 108.80 kg ha^{-1} and 85.10 kg ha^{-1} magnesium nutrient elements. The impact values of magnesium in the soil were calculated by $\log (A-y) = \log A - c_1 b_1$ equation and the mean $c_1=0.00266$ was found. The impact values of magnesium in the fertilizer were calculated by $\log (A-y) = \log A - c_1 b_1 - cx$ equation and the mean $c=0.00182$ was found.

These impact values of magnesium (c_1 and c) in the soil and fertilizer (Table 1) was substituted in the $\log (A - y) = \log A - c_1 b_1 - cx$ equations. The amounts of magnesium fertilizers were calculated to the existing magnesium content of soils. Then, these calculations were made separately for maximum yield from 90% to 99%. Table 2 was consisted of as results of these calculations. Similar calculations were made by Güçdemir (2006) and Kacar and Katkat (2007).

Table 1

The impact values of magnesium in the soil and in magnesium fertilizer

Treat.	Tombul hazelnut yields (Kg ha^{-1})					Magnesium in the soil (Kg ha^{-1})	Impact Values	
	0 (Control)	100 (Kg ha^{-1})	150 (Kg ha^{-1})	200 (Kg ha^{-1})	250 (Kg ha^{-1})		c_1	c
A	1330.53	1366.16	2055.03	1725.45	2275.57	200.60	0.00190	0.00135
B	1525.63	1293.68	1491.08	1135.12	3082.58	108.80	0.00273	0.00053
C	705.13	1086.65	1695.05	1528.77	1468.56	85.10	0.00334	0.00359
Mean							**0.00266**	**0.00182**

The difficulties in calculation were arranged by creating a regression equation between these variables. The formulation of $Y= a+b_{yx}X$ were created from calculated fertilizer amounts in order to achieve 90%, 92%, 94%, 96%, 98% and 99% of maximum hazelnut yield in certain magnesium values of soils (10, 25,….750). These regression equations were given in Table 3. Due to 100 % correlation between magnesium and the amounts of fertilizer, the hit rating (R^2) of estimates to be made using the resulting regression models was 100%. The constituted equations were found statistically significant ($p<0.001$).

In this methodology study, the required amounts of magnesium fertilizers were determined in hazelnut agriculture. The use of the results of this study, magnesium fertilizer recommendations can be done easily for hazelnut cultivation in practice and similar equations can be created for other plants.

Table 2

. The amount of magnesium nutrient should be used for the each maximum yield level

Magnesium contents of the soil (Kg ha^{-1})	The amounts of magnesium to be applied for different maximum yield level (Kg ha^{-1} Mg)					
	90%	92%	94%	96%	98%	99%
10	534.8	588.1	656.7	753.5	918.9	1084.3
25	512.9	566.2	634.8	731.5	897.0	1062.4
50	476.4	529.6	598.2	695.0	860.4	1025.8
75	439.8	493.1	561.7	658.5	823.9	989.3
100	403.3	456.5	525.2	621.9	787.4	952.7
125	366.8	420.0	488.6	585.4	750.8	916.2
150	330.2	383.5	452.1	548.8	714.3	879.7
175	293.7	346.9	415.5	512.3	677.7	843.1
200	257.1	310.4	379.0	475.8	641.2	806.6
225	220.6	273.8	342.5	439.2	604.7	770.1
250	184.1	237.3	305.9	402.7	568.1	733.5
275	147.5	200.8	269.4	366.2	531.6	697.0
300	111.0	164.2	232.9	329.6	495.1	660.4
325	74.5	127.7	196.3	293.1	458.5	623.9
350	37.9	91.2	159.8	256.5	422.0	587.4
375	1.4	54.6	123.2	220.0	385.4	550.8
400		18.1	86.7	183.5	348.9	514.3
425			50.2	146.9	312.4	477.7
450			13.6	110.4	275.8	441.2
475				73.8	239.3	404.7
500				37.3	202.7	368.1
525					166.2	331.6
550					129.7	295.1
575					93.1	258.5
600					56.6	222.0
625					20.1	185.4
650						148.9
675						112.4
700						75.8
725						39.3
750						2.7

Table 3

Regression equations for recommendation of magnesium fertilizer (**, P<0.001)

Max. Yield Level	n	b	Regression equation	Significance	R^2
90%	16	1.46**	90%= 549.4-1.46.X (Magnesium)	**	100%
92%	17	1.46**	92%= 602.7-1.46.X (Magnesium)	**	100%
94%	19	1.46**	94%= 671.3-1.46.X (Magnesium)	**	100%
96%	22	1.46**	96%= 768.1-1.46.X (Magnesium)	**	100%
98%	27	1.46**	98%= 933.5-1.46.X (Magnesium)	**	100%
99%	31	1.46**	99%= 1098.9-1.46.X (Magnesium)	**	100%

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The dynamics of mineralization of plant residues in mineral substrates of various composition

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Introduction

The process of mineralization of plant residues (PR) depends on many factors [1]. It is a complex and many-stage successive-parallel process, which includes biochemical decomposition of PR and part of newly formed organic material, stabilization of the decomposed products on its each step, humification of more stable pools of soil organic matter and partial mineralization of already stabilized humic substances. Thus, a continuous set of organic and organo-mineral compounds different by their resistance to decomposition by soil microorganisms are formed.

Mineralization of organic matter (OM) in soils depends on its availability to microorganisms (external factor) and their intrinsic resistance to the decomposition (internal factor). Most available soil organic compounds renovate during hours or day, most stable ones remain in soil during years or even millenniums [2].

For the quantitative description of the dynamics of mineralization in the systems studied, we used models, which imply the existence of two pools of organic matter different by their resistance to the decomposition, labile (LP) and resistant (RP). Such models include binomial exponential polynomial of the first order for their description [3, 4].

The work presents the analysis of the dynamics of mineralization of PR of maize and red clover in mineral substrates of various composition under controlled conditions.

Materials and Methods

In the experiments we used the aboveground mass of maize (*Zéa máys*) and red clover (*Trifolium praténse*), preliminary dried and milled to the sizes 3-5 mm. Mineral matrixes were as following: pure quartz sand and carbonate-free covering loam (the soil forming material of gray forest soil from the Experimental Field Station of the Institute of Physicochemical and Biological Problems in Soil Science Russian Academy of Sciences), the mixtures: sand + 15% bentonite and sand + 30% kaolinite. Mineral content of the loam was 59% quartz, 16% kaolin, 13% mica, 11% feldspar, and 2% smectite. The bentonite contained beidellite, montmorillonite, talk, some quartz, calcite, and mica. Different admixtures in kaolinite were less than 2%.

All mineral substrates were thoroughly mixed with the milled aboveground mass of maize and clover in the ratio 1:10, placed into glass volumes 200 cm^3, watered to 60%

of the water holding capacity (WHC). Soil microorganisms were inoculated into the substrates of each volume by adding of 1 ml of soil suspension (0.01 g of gray forest to each volume soil). After that, the substrates were incubated in biological thermostat at 20°C and 60% WHC. Duration of the experiments was 6-19 months. Sampling for the analyses was carried out after 5, 10, 20, 30, 60, 90, and 180 days from the beginning of the experiment for the clover set and after 7, 14, 20, 30, 60, 90, 180, 285 and 570 days - for the maize set. The experiment was run in three replicates. The content of organic carbon was determined by the Tyurin method. Carbon mineralization losses were estimated from the difference between the content of organic carbon in the beginning of the experiment (C_0) and that in the samples of each date. Biochemical composition of PR was determined.

Results and Discussion

Fig. 1 presents the relationships of the relative content of carbon in PR of maize and clover with the time.

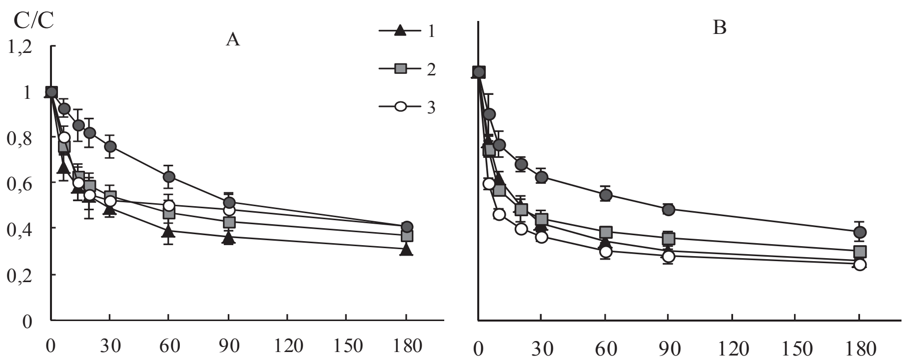

Fig. 1. The dynamics of mineralization of PR of maize (A) and clover (B) in the substrates studied: 1 – sand+30% kaolinite, 2 –sand+15% bentonite, 3 –sand, 4 – loam.

At the known initial content of $C_{org.}$ in the system (C=C_0 at t=0) the binomial exponential function is as following:

$$\frac{C_t}{C_0} = A \cdot e^{-k_1 t} + B \cdot e^{-k_2 t}, \qquad (1)$$

where C_t is the residual organic carbon maintained in the soil at the time point t, A – the share of labile matter, B – the share of the resistant matter ($B = 1 - A$).

The values of kinetic parameters calculated from equation (1) are presented in Table 1.

The analysis of the data obtained demonstrates that the kinetics of mineralization of PR of maize and clover is adequately described by the binomial exponential polynomial. With that the share of LP of organic carbon in clover biomass is higher (57-63%) than that in maize one (47-49%) that is connected with the peculiarities of biochemical composition of PR. In the loam substrate, the share of labile pool in clover biomass decreases to 39%, that is explained by higher ability of the loam to stabilize the products of clover decomposition.

The rate constants of decomposition of labile and resistant pools in all cases differ: $k_1 >> k_2$. The least rate of LP decomposition of maize is typical for the loam substrate, and maximal one – for the substrate with kaolinite. In the latter case $k_{1clover} >> k_{1maize.}$ Evidently, labile compounds of maize are stabilized by the loam stronger and are slower decomposed by microorganisms compared to the clover. The highest rate of RP decomposition of maize and clover is typical for the substrate with kaolinite. Hence, the kaolinite accelerates the decomposition process of PR of both cultures, and OM of the clover in a higher level.

Table 1

Kinetic parameters of transformation of organic matter in mineral substrates of different composition in the 6 month incubation experiment

Parameter	Bentonite	Kaolinite	Sand	Loam
		Maize		
A	0.484±0.012	0.490±0.019	0.483±0.024	0.468±0.030
B	0.516±0.012	0.510±0.019	0.517±0.024	0.532±0.030
$k_1 \cdot 10^{-1}$, day^{-1}	0.99±0.13	1.29±0.30	1.00±0.05	0.22±0.03
$k_2 \cdot 10^{-3}$, day^{-1}	2.02±0.27	3.16±0.53	1.16±0.18	1.61±0.25
T_1, day	10	8	10	46
T_2, year	1.4	0.9	2.4	1.7
		Clover		
A	0.567±0.015	0.600±0.011	0.632±0.018	0.385±0.013
B	0.433±0.015	0.400±0.011	0.368±0.018	0.615±0.013
$k_1 \cdot 10^{-1}$, day^{-1}	1.56±0.11	1.15±0.15	2.33±0.14	1.12±0.20
$k_2 \cdot 10^{-3}$, day^{-1}	2.58±0.40	3.19±0.32	3.11±0.40	3.10±0.28
T_1, day	6	9	4	9
T_2, year	1.1	0.9	0.9	0.9

The turnover period for the labile pool of clover (4-9 days) in all substrates and maize in sand and substrates with kaolinite and bentonite (8-10 days) is typical for the organic acids and simple saccharides. In the loam substrate, the turnover period for the LP of the maize is about 46 days due to stronger stabilization of the LP components. The turnover period of the stable pool of clover (0.95 year) is essentially less than that of maize (1.6 year) and generally corresponds to the turnover period of plant biomass. Calculation of the rate constants of decomposition of labile and resistant carbon pools at incubation during 19 months has shown that k_1 values of mineralization of PR of maize in sand substrate was 0.69 day^{-1} (T_1 = 15 days), in loam substrate – 0.032 day^{-1} (T_1 = 31 days). The values of k_2 were similar to both substrates and were 0.0015 day^{-1} (T_2 = 1.9 years) in sand and 0.0012 day^{-1} (T_2 = 2.3 years) in loam substrates and practically did not differ from the values obtained at incubation during 6 months. Concluding, the deceleration of the total rate of mineralization with time occurs mainly at the expenses of the labile pool.

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The infrared imagery for the analysis of morphological and physical properties of soils

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Keywords: radiometry, soil profile, horizons, temperature gradient.

Development of instrumental methods instead of expert assessments is an important area of research in soil science. We study possibility of radiometric method for the analysis of morphological and physical properties of soils. It is now widely used satellite remote sensing methods for the study of soils **[1, 2]**. There are a large number of satellite data, which are taken in the infrared region of the spectrum, for example, a series of satellites NOAA / AVHRR, TERRA / Modis. Terrestrial radiometric survey of soils provides additional correction information.

In this paper, we study the information content of survey carried out in the infrared spectrum for the analysis of morphological and physical properties of soils. In the studies was used portable radiometer – infrared imagery system FLIR Systems InfraCam. The use of soil survey in the thermal range makes possible to obtain data of the radiometric temperature distribution in soil profiles, and enables to detect functional horizons, on the basis classification by the temperature gradient. The studies were conducted in natural and anthropogenic forest ecosystems of forest-steppe zone of the Krasnoyarsk Region in Central Siberia.

The remote sensing analysis of thermal properties of forest soils performed using infrared image. Series of radiometric images were obtained for *Luvisols* and *Retisols* profiles. Initial data reflect all times of vegetation season from May to October.

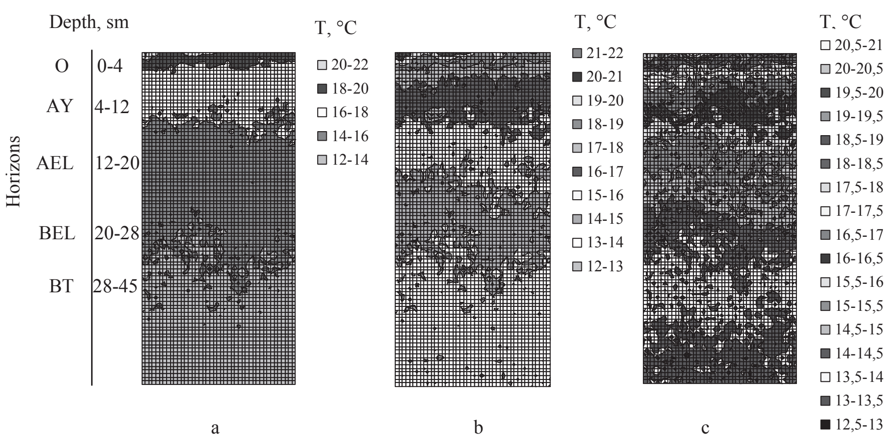

Fig.1. The radiometric images of *Luvisols* at the different temperature range ΔT°C (a – 2, b – 1, c – 0,5). Detail of the thermal field in the soil profile.

Radiometric image analysis provides additional information about the structure of the soil profile. Configuration of horizons is well displayed on the radiometric portrait of the soil profile, characteristics and width of the transition zone could be marked out as well, which is not always possible by means of expert analysis. Detail of the thermal field in the profile can varied while applying different temperature range during image classification procedure (fig.1). As the result, the structure of sub-horizons can be investigated.

On the basis radiometric images built soil portraits that are the images of the thermal fields in the soil profile. Depending on the degree of detailing in the image, i.e. depending on the values of ΔT°C, it is possible to identify the main soil horizons, or sub-horizons in the radiometric portrait. For example, can be distinguished each layer of litter or subarable horizon of abandoned agricultural soils.

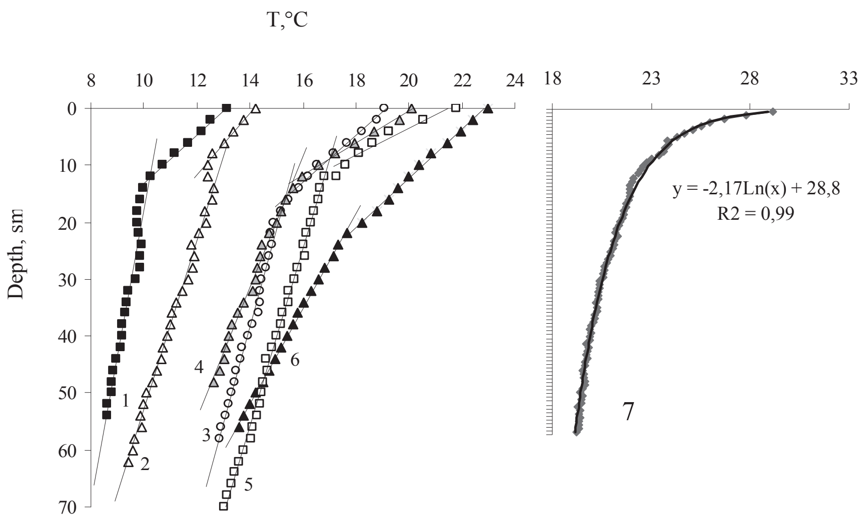

Fig.2. The temperature distribution curves for different soil profile (1,2 – *Retisols*, 3,4,5,6 – *Luvisols*, 7 – technogenic soil of industrial zone).

The temperature distribution curves for soil profile can be obtained as the graph of calibrated infrared image (fig.2). The temperature curves have the inflection point, which correspond to the lower boundary of the humus horizon. For natural soils the temperature gradient can be described by linear functions, separately for the upper humus horizons and lower mineral horizons reliably approximation R2 = 0,94 - 0,95. Temperature gradient can be described by logarithmic functions (R2 = 0,98 - 0,99) for abandoned agricultural soils and for technogenic soil of industrial zone as well.

Found that the radiometric temperature gradient along soil profile varies between 0,12 — 0,30 °C/cm in the upper humus horizons and between 0,05 — 0,3 °C/cm in the mineral layers. We suggest using a linear function with variable coefficients as model equation. It was recorded that the radiometric temperature gradient magnitude is defined by external conditions and soil type as well. Big jumps of the temperature gradient correspond to the boundaries of the soil horizons at the infrared image of the soil profile. Great amplitudes of the temperature gradient correspond to the horizons of natural soils and it does not observed in the profile of anthropogenic soils.

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Spatial disrtibution of exchangable Potassium in paddy soils of Central Gilan, Iran

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Key words: interpolation, inverse distance weighting, kriging, semivariogram.

Introduction

Proper management of soil nutrients is important for meeting the needs of ever increasing population of the word without deteriorating the environment. Surveys and maps illustrating the geographic distribution of soil nutrient availability would provide guidance for proper management of nutrients in soils, and are necessary for a better understanding of the nature and extent of nutrient deficiencies and toxicities in plants, livestock and humans (Liu et al. 2008). Mapping soil K availability is relevant because potassium is the second largest plant nutrient (Bernardi et al., 2002). Plant nutrient mapping has been used at the farm level as part of precision agriculture (Bernardi et al., 2002).
Soil agrochemical properties are affected from large amount of soil processes, which are working together but their activity and interaction vary both in time and space. Peck and Melsted (1973) suggest that existing of seasonal variability of soil test results are going to change because of factors affecting the nutrient uptake by plants and nutrient replenishment of soil solution (sorption, desorption, water transport, soil microbial activity, soil pH, CEC). Analysis and interpolation of spatial variability properties of soil is an important factor in site specific management (yasrebi et al. 2009).With increasing of sand percent, because of low exchangeable sites, large pores and high drainage, potassium leaching is high which decreases the concentration of soluble K (Jalali and Rowell, 1999).
Geostatisticcombined with geographic information system (GIS) have proven to be useful in the predicting the spatial distribution of soil properties that are very spatially dependent in fields having a limited number of soil samples. The interpolation technique that usually used is kriging (Cambardella et al, 1994). Spatial prediction technique, also known as spatial interpolation technique, differ from classical modeling approaches in that they incorporate information on the geographic position of the sample data points (Cressie, 1990).

Materials and Methods

This study was conducted at 2014 in Guilan province in north of Iran and bounded east longitude 51°0'-54°0' and north latitude 36°0'-37°0' with the total area of 576.11 km^2. Average annual precipitation is 881 mm. Soil sample were collected from 108 locations in 2- km regular grid. Some points, which fell on road, buildings and inaccessible, were not sampled. All soil samples were taken at depths of 0-30 cm then air dried and passed through 2 mm sieve then stored in plastic bags prior to chemical analysis. Electrical conductivity was determined in the saturation paste extract.

Cation exchange capacity (CEC) was determined using Na acetate (NaOAc) at a pH of 8.2 (Chapman, 1965). Available K was extracted with NH4OAC 1N and determined by flame atomic absorption spectrometry. Organic matter was determined using oxidation method (Walkly and Black, 1939) and soil particles (Clay, Sand and Silt) were determined with hydrometry method.

Results and Discussion

Descriptive statistics of soil parameters were listed in table 1. Distribution of soil properties tested with kolmogrov- smironove (K-S) statistic, and indicated that soil K, Sand and EC have non normal distribution. To avoid result distributions and low level of significance, log transformation performed on these parameters and the data of these parameters become fitted normal distribution.

Descriptive statistics of soil properties **Table 1**

Soil properties	unit	mean	median	range	S.D	Skewness	Kurtosis	CV(%)
available K	($mgkg^{-1}$)	105.49	103.11	40.68-237.17	41.91	1.61	4.37	39.73
CEC	($Cmolkg^{-1}$)	24.57	24.5	41-24.57	6.31	0.28*	-0.52	25.68
(OC)	(%)	2.32	2.28	.076-3.82	0.67	0.13*	-0.43	29.33
Clay	(%)	29.10	30	4-48	8.35	-0.13*	0.96	28.72
Silt	(%)	43.48	44	14-60	7.06	-1.16*	3.47	16.24
Sand	(%)	27.32	26	12-63	9.47	1.25	2.45	36.43
pH	$-log[H^+]$	6.31	6.29	4.33-7.52	0.68	-0.42*	-0.36	10.86
EC	dsm^{-1}	1.33	1.1	0.27-5.52	0.94	1.51	3.14	71.32

In order to identify the possible structure of different soil properties, semivariograms were calculated and the best models with highest R^2 (R square) and lowest RSS (residual some of square) that describe these spatial structures were identified. The semivariograms of available k and soil parameters were shown in figures 2 and the geostatistical model parameters were shown in table 3. The best fitted semivariogram models of available K were Gaussian and for soil sand, clay and OC were exponential.The range of K was 3.93 and the range of other soil parameter such as O.C, Sand and Clay and Sand were 33, 97, 73.9 km respectively. The nugget/sill ratio for available K and soil Sand, Clay and OC were 30.56, 45.09, 48.95 and 48.96 respectively and they had moderate spatial dependency and intrinsic factors such as (soil formation and parent material) and extrinsic factors such as (rainfall and fertilizers) affecting spatial dependency of these parameter. Wollenhaupt et al. (1994) relate soil available P, K and Mg to the properties with medium spatial variability.

Avalable K correlation coefficient CEC, and some of soil's physical and chemical properties are shown in table 2. Evaluation of multi varient linear regresion equation points out that ther is no relation between soil physical chemical and avalable K, (R^2=0.072). In order to identify the possible structure of different soil properties, semivariograms were calculated and the best models with highest R^2 (R square) and lowest RSS (residual some of square) that describe these spatial structures were identified. The semivariogram models and another analysis results of available k and soil parameters and the geostatistical model parameters were shown in table 3.

The effects of soil intrinsic factors such as parent material and sedimentation on soil's pH, extrinsic factors such as saturation and oxidation reduction conditions and fertilizing can also affect this variable's behavior.Spatial distribution mapping of physicochemical soil properties of the erea are shown in figs 4-9. The etea in discuss is wrought of four physiographic units including Mountains, Plateau and Upper Terraces, Piedmont Alluvial Plain and Low Lands. It's important note that the Land use of 1.3 and 1.5 Land units, has changed in to rice farm and the height of the erea reduces in west-east direction.

Correlation coefficient **Table 2**

	K(mg\k	CEC(Cmol/k	pH	OC(%)	EC(ds/	Clay(	Silt(%	Sand(
K (mg\kg)	1							
CEC(Cmol/k	0.122	1						
pH	0.41	0.309**	1					
OC (%)	0.157	0.354**	0.10	1				
EC(ds/m)	0.131	0.318**	-	0.086	1			
Clay (%)	-0.082	0.574**	0.14	0.145	0.191	1		
Silt (%)	0.24	-0.034	0.15	0.385*	-0.59	0.089	1	
Sand (%)	-0.21	-0.381**	0.26	0.34**	-0.102	-*	0.56*	1

Correlation significant at the 0.01 level.

The best fitted variogram models and their parameters **Table 3**

Variable	Model	C_0	$C+C_0$	A_0(m)	R^2	RSS	$C_0/C+C_0$	Spatial structure
K	Spherical	0.1	0.1	0.24	3900	0.95	2.764×10^{-4}	M
CEC	Exponential	18.2	18.2	40.6	6420	0.897	31	M
EC	Spherical	0.168	0.168	0.582	19450	0.977	4.184×10^{-3}	M
pH	Linear	0.386	0.386	-	-	0.384	0.0227	W
OC	Spherical	0.18	0.18	0.47	3200	0.849	5.28×10^{-3}	M
Clay	Spherical	34	34	63	3200	0.662	155	M
Silt	Spherical	14.7	14.7	51.5	4000	0.82	275	M
Sand	Spherical	0.02	0.02	0.1	2900	0.82	1.38×10^{-3}	S

The study of CEC and Clay spatial distribution maps point out that there is a reasonable compatibility between the quantities of these two. So that the eastern parts mostly consist of Pelateau and Upper Terraces and Piedmont Alluvial Plain with higher amounts of clay have bigger CEC rate. This is the result of difference in heights of eastern and western parts, the clay particles of higher areas accumulate in lower areas due to water flow and colluvial movements.
The quantity of Organic Carbon in north-eastern and central area is more than other parts. It's because of low heights on north-eastern parts and a consequent of partial drainage. In these conditions due to in complete soil aeration and oxygen deficiency the aerobic microorganisms activities the soil would reduced and the decomposition of organic materials slows down and results in their accumulation. The reason of high amunt of Organic Carbon in some part of central area is the change in land use from foret to paddy. Soil pH spatial distribution shows that its distribution is uniform, and the variable's CV is low (CV=10.86%).
The density of available K in eastern areas is lower than western parts (fig 1), while it was expected in areas with high CEC and Clay, the density of available K would be high; but there is no meaningful linear relation between available K and soil intrinsic properties like Clay and CEC (table 2).
The Organic Carbon percentage in eastern areas is high. Coatrary to soil high CEC; the bound strength between available K and Organic Carbon is low so the leaching of avalailable K liability is high. In western parts especially the areas coinciding Piedmont Alluvial Plain the density of K is medium to high, on the other hand in the most rice farms of the area despite the continual cultivation history Potassium Fertilizers are not used or slightly used non-uniform spatial distribution of Potassium is because if the fertilizing uniform in eastern half which has sufficient amount of K, not only there would be no increase in operation but also it will probably couse Potassium fixation in the soil that will result in production expenses growth and in long term it will cause a cotensation between soil and plant .

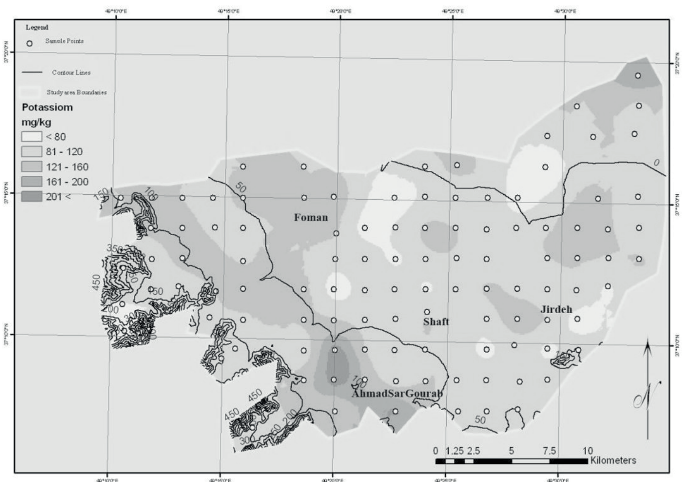

Fig 5. Map produced by; Ordinary Kriging of soil available Potassium

While in eastern half due to significant deficiency of Potassium there is a possibility that the amount of utilized Potassium fertilizers would not suffice the actual needs of the plant, meanwhile adequate management in fertilizing can increase the operation of crop and significant step towards unfailing agriculture.

Conclusion

One important point about sampling is adequate distance between samples. Not only this will increase the accuracy but also it is more economical convenient, the results of this research shows that choosing 2 km distance for basic properties of soil is suitable Potassium and Clay (table 2), Mineralogy studying is recommended. Based on results, the amount of available K in eastern half of the area in study is low. There is a possibility that this variation is influenced by different configurations of Potassium which brings out the need of more studies in this field. While examining plant's reaction to Potassium fertilizers it is also proposed to present necessary recommendations on consumption amount and the appropriate time of fertilizer exhibit to farmers.

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Biology of the Irrigated Soils under Fodder Crops in the Subtropical Region of Azerbaijan

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Key words: biological activity, enzymes, humus, microorganisms

Introduction

Biological characteristics are a key indicator of soil fertility… [1[1], 5[1]][3]. In this connection, the comparative study of the influence of the biological productivity of fodder crops on soil processes, particularly biological ones, is of great scientific and practical importance.

Working procedure. The purpose of the work is the study of biological properties of soils under fodder crops in Azerbaijan dry subtropics. The object of the research: Irragri Kastanozems - Gyanja-Gazakh area, Irragri Gleyic Calcisols - the Shirvan steppe , and Irragri Gypsic Calcisols - the Absheron peninsula. Irragri Kastanozems - the soils are often calcareous and slightly saline (0.11–0.60%). The salinization is of the chloride–sulfate type. The humus content in the upper 25 cm is 2.15–2.28%. Irragri Gleyic Calcisols-the soils are often calcareous and contain soluble salts (0.34–1.06%) in the upper 2 m. The salinization is of the chloride–sulfate type. The humus content in the upper cm is 2.00–2.10%. In irrigative Gypsic Calcisols soils saline soil (chloride-sulphate), reaction of the soil environment is weak alkaline (8.2-8.6), humus maintenance forms 1.6-1.8% [1[2],6]**.** The scheme of the experiment I.Barley --->Corn II. Rye --->Corn III. Lucerne IV. Sainfoin; V. Corn; VI. Corn+soya+sorghum+amaranth; VII. Barley +vetch+rape ---> Corn+soya+sorghum+amaranth ---> Barley+vetch; VIII. Rye+vetch+rape ---> Corn+soya+sorghum+amaranth ---> Barley+vetch. The experimental area under crops is $70m^2$, the fourfold replication. Agrotechnology – zonal. Microbiological and biochemical researches were conducted by the methods described in the book by K.Sh. Kazeev (2003) [4]. All the biodiagnostic analyses were conducted in a triple replication. The dispersive analysis of the received data- by SYSNAT (the computer program), the correlation- by STAT_ENG (probability level-95%).

Results and Discussion

Soil microflora. The number of microorganisms is the key indicator of the rate of the cycle of matter in the ecological system and the soil formation process [3]. The researches conducted from March till the end of September on all three types of soils showed some fluctuations of the number of microorganisms under the cultivated

3 "Biological properties enable to diagnose the onset of soil degradation processes, the character and the degree of man impact on soil covering …"

crops (table 1). In Irragri Kastanozems, under scheme VIII the total number of microorganisms in a spring-and-fall period was the highest-$16x10^6$ – $13x10^6$ colony forming units/ha in absolutely dry soil.

Table 1

The biological activity of the irrigated soils in dry subtropics under intermediate fodder crops

SCHEME	Depth, cm	Month	Urease,mg NH_3,1g/24 hs	Phosphataze, mg P_2O_5, 10g/1h	The total number of microorganisms in 1g of soil
Irragri Kastanozems					
I. Bbarley	0-10	May	3.03	2.10	$4 x 10^6$
Corn	0-10	July	2.87	1.90	$2x 10^6$
II. Rye	0-10	May	3.11	2.13	$4 x 10^6$
Corn	0-10	July	2.89	1.93	$2x 10^6$
III. Lucerne	0-10	May	5.17	3.67	$15 x 10^6$
VII.Barley+vetch+rape	0-10	May	4.51	3.73	$15x10^6$
Corn+soya+sorghum+amaranth	0-10	July	3.90	3.03	$11x10^6$
Barley+vetch	0-10	September	3.97	3.27	$12x 10^6$
VIII. Rye+vetch+rape	0-10	May	4.94	3.97	$16 x 10^6$
Corn+soya+sorghum+amaranth	0-10	July	3.96	3.14	$11 x 10^6$
Barley+vetch	0-10	October	4.00	3.37	$13 x 10^6$
Irragri Gleyic Calcisols					
I. Bbarley	0-10	May	2.77	1.90	$3x 10^6$
Corn	0-10	July	2.34	1.78	$3 x 10^5$
II. Rye	0-10	May	2.87	2.00	$3 x 10^6$
Corn	0-10	July	2.39	1.83	$2x 10^6$
III. Lucerne	0-10	May	4.97	3.20	$14 x 10^6$
VII.Barley+vetch+rape	0-10	May	4.21	2.79	$14 x10^6$
Corn+soya+sorghum+amaranth	0-10	July	3.77	2.36	$10x10^6$
Barley+vetch	0-10	September	3.23	2.29	$12x10^6$
VIII. Rye+vetch+rape	0-10	May	4.84	3.39	$15 x 10^6$
Corn+soya+sorghum+amaranth	0-10	July	3.86	2.86	$10 x 10^6$
Barley+vetch	0-10	October	3.59	2.78	$12 x 10^6$
Irragri Gypsic Calcisols					
I. Bbarley	0-10	May	2.20	1.59	$2x 10^6$
Corn	0-10	July	2.00	1.48	$3 x 10^5$
II. Rye	0-10	May	2.47	1.64	$3 x 10^6$
Corn	0-10	July	2.09	1.53	$3 x 10^5$
III. Lucerne	0-10	May	4.66	3.10	$13x 10^6$
VII.Barley+vetch+rape	0-10	May	3.97	2.68	$13x10^6$
Corn+soya+sorghum+amaranth	0-10	July	3.55	2.16	$9x10^6$
Barley+vetch	0-10	September	3.00	2.33	$11 x10^6$
VIII. Rye+vetch+rape	0-10	May	4.57	3.19	$14 x 10^6$
Corn+soya+sorghum+amaranth	0-10	July	3.68	2.68	$9 x 10^6$
Barley+vetch	0-10	October	3.28	2.49	$11x 10^6$

That is 40-50% higher than in the scheme rye --->corn and 25-37% higher than in the soil under lucern and sainfoin. In Irragri Gleyic Calcisols, the total number of microorganisms under scheme VIII was 15 x 106 --> 10 x 106 ---> 12 x 106 colony forming units/ha in absolutely dry soil, which was 23-35% lower than in Irragri Kastanozems. The other schemes had the same picture. The high biogenity under corn+soya compared to the sowing of pure corn can be explained by the effect of the previous mixture rye+vetch+rape. In Irragri Gypsic Calcisolsthe, we observed the highest activity of the microorganims under the scheme VIII; the lowest activity- under schemes I, II and IV. The researches revealed that by the quality and the quantity of microorganisms, the irrigated soils of the moderate-dry (Irragri Kastanozems) and arid (Irragri Gypsic Calcisols) zones differed from the soils of the heavily arid zone (Irragri Gleyic Calcisols). By the intensity of the process of mineralization in the soils under the examined crops, the irrigated soils can be put in the following sequence: Irragri Gleyic Calcisols (0.39-0.60) --->Irragri Gypsic Calcisols (0.29-0.40)---> Irragri Kastanozems (0.17-0.26).

Enzymatic activity of soils. Enzymatic activity characterizes the intensity and the direction of soil biochemical processes [2].

Urease participates in hydrolysis of nitrogen-bearing organic residues and is important for the nitrogen cycle. In connection with a big number of rhizospheric microorganisms and their high biochemical functions in Irragri Kastanozems in spring the highest urease activity is observed in variants III, IV,VII and VIII; it is relatively low under pure rye and barley sowings. In summer in the soil in schemes VII and VIII under pure corn sowing the urease activity decreases (to 2.87-3.03 mg NH_3) compared to spring variants. But in the soil under lucerne and sainfoin the increase in urease activity is observed by 0.10 – 0.35 mg NH_3 than in spring. In autumn (as compared to in summer) in the soil under lucerne and sainfoin the decrease in urease activity is observed by 0.12 – 0.38 mg NH_3. The analogous coincidence under the above-mentioned schemes was observed in Irragri Gleyic Calcisols and Irragri Gypsic Calcisols. But these showings were slightly lower than in Irragri Kastanozems.

Phosphotase activity as compared with urease, renders the dependence on the type of the cultivated crops. High phosphotase activity in Irragri Kastanozems - under mixed grass crop (3.73-3.97 mg P_2O_5 in 10g of soil for 1h) owes rape (in spring roots going 1.3-1.5 m deep in soil raise nutrient substances to the upper soil layer and they are able to secrete mustard oils rich in sulfur decomposing phosohate forms difficult for vegetation). The analogous data were received in the soil under mixed grass crops in Irragri Gleyic Calcisols and Irragri Gypsic Calcisols, but they were lower than in Irragri Kastanozems.

Correlation analysis. The quantity of the correlative connection between ferment activity and the number of microorganisms while cultivating fodder crops varies greatly (from 0.30 to 0.69) but it is statistically authentic.

Conclusion

The study of the biological activity Irragri Kastanozems, Irragri Gleyic Calcisols, and Irragri Gypsic Calcisols in Azerbaijan dry subtropics under fodder crops confirmed their subjection to common geographical laws.

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Specificity of soil forming processes and properties of upland soils in the south-east of the Bolshezemelskaya tundra

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Key words: cryoturbated gleezems, cryomethamorphic gleezems, meso-micromorphology, inherit signs.

Introduction

In recent decades, soil science has successfully developed ideas about soil-memory as a set of properties inherited and accumulated from previous periods of soil formation. Sources of soil and genetic information are fragments of buried horizons, humus pedorelicts, cutan complex, soil new formations frequently diagnosed only in micromorphology. Not many works are devoted to the study of these soil memory carriers. Reflection in mineral soils of present-day tundra of past changes in climate and vegetation is ambiguous. Connection between profile differentiation and the former forest stage is questioned. Thus, the solution to the problems of formation, evolution of loamy tundra soils requires detailed studies using modern methods and approaches.

Materials and Methods

The objects were cryomethamorphic (Epistagni-Endogleyic Luvisol), and cryoturbated (Turbi-Histic Gleysols) gleezems, formed on the cover silty loamy soils underlaid by moraine loams in automorphic landscapes gently steeply sloping hilly plains of Bolshezemelskaya tundra southeast with dwarf birch-shrub vegetation and large isolated “islands” form of permafrost at the depth of 0.9 to 2-5 m.
The integrated approach to the study of soil includes the use of the following methods: 1) a detailed mezomorphological analysis of the profile structure components; 2) micromorphological method of diagnosis of clay-humic formations, pedorelicts, clay cutans as of the most resistant to the time and cryopedometamorphism; 3) the separation of current and inherited properties, assessment of their transformation at cryopedogenesis; 4) determination of lithochemical indexes, allowing to reconstruct the paleogeographic situation of soil formation according to the relation rates between elements[2].

Results and Discussion

I. *Cryomethamorphic gleezems*. Subparallel micro schistosity, lense-shaped and thin-platy aggregates in cryomethamorphic gleezems being the result of modern cryogenesis (pressure of ice schliers) in the upper horizons change to the concentric structure of ooid aggregates (the result of paleocryogenesis) in the lower horizons.

As the analysis of the chemical composition of the structural components of soil has shown (Table.1), relative SiO2 accumulation occurs in intraped mass of horizon Bg(G), and the reduction of its content in the lower horizons. Distinct eluvial-illuvial distribution of R2O3 in intraped mass of soil is revealed. With regard to the total forms of R2O3 in skeletans, the profile picture of the distribution is reversed: the accumulation in the horizon Bg (G), reduction in the horizon of CRM. Obviously, this is due to the various redox processes in these parts of the profile or noticeable participation of Al-Fe-humus illuviation. Thus, intraped mass, locked by cutans from desalination and preserving properties, clearly reflects the eluvial-illuvial profile differentiation, saved, obviously, from the mid-Holocene soil formation.
Oxalate- and dithionite soluble forms of iron in a composition of skeletans accumulate in the upper part of profile (horizon Bg(G)) on the surface of the aggregates, as well as in interped gaps and innerped interstices, i.e. on migration paths of chemical compounds. As part of the intraped mass profile distribution of these elements is similar. Profile differentiation of C skeletan, in both virgin and reclaimed soils, similar to the differentiation of Fe_o and Fe_d in these components, may be associated with the formation of organo-mineral complexes and reflects the process of Al-Fe-humus illuviation or a stage of an integrated macroprocess - Al-Fe –humus differentiation of soil [3].

Table 1 Total chemical composition of cryomethamorphic gleezem structural components, % of ignited sample

Horizon	Depth, cm	Structural component	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	MnO	K_2O	P_2O_5	TiO_2
Bg(G)	13-22	Skeletans	76.86	14.18	3.46	0.59	1.77	0.03	1.71	0.37	0.97
		Intraped mass	75.47	15.01	3.88	0.64	1.86	0.04	1.65	0.36	1.02
- « -	22-38	Skeletans	76.27	13.78	3.78	0.71	2.45	0.04	1.96	<0.1	0.92
		Intraped mass	75.50	14.50	3.54	0.67	2.93	0.04	1.83	–	0.54
CRM1	38-60	Skeletans	79.74	11.82	2.80	1.06	1.72	0.04	1.91	–	0.85
		Intraped mass	73.60	14.47	5.17	1.04	2.56	0.09	1.98	–	1.00
CRM2	60-100	Skeletans	80.84	11.43	2.40	0.93	1.62	0.04	1.91	–	0.77
		Intraped mass	73.84	15.08	4.39	0.95	2.82	0.07	1.91	–	0.89
BC	100-140	Skeletans	78.71	12.34	3.09	0.88	2.23	0.04	1.87	–	0.79
		Intraped mass	72.35	15.18	4.98	0.91	3.47	0.10	1.99	–	0.97

Note: «–» – has not been revealed

Concretionary new formations are also one of the sources of information about the formation and development of soil. Maximum content of concretions of irregular oval form in cryomethamorphic gleezem in noticed in the horizon (Bg (G)). The highest values of the coefficients of accumulation of total forms in concretions are observed for Mn, Fe.

The intensity of the impact of current soil-forming processes is limited at the depth of 40 cm. Deeper lying horizons belong to the previously formed soil which preserved relic properties, and that is confirmed by reveal of lithochemical indexes. In a less weathered part (up to 40 cm) values of CIA are 71-72, whereas in the lower part, where the processes of weathering and soil forming proceeded more active, values of CIA are higher – 76-79.

Humus pedorelicts and clay cutans (fragments) in the lower part of the profile indicate relict texture differentiation of soil, probably in the Late-atlantic period of Holocene, and cryogenic structural metamorphism with the formation of a horizon CRM and the destruction of the cutan complex are the result of a sharp cold snap in the Subboreal period.

Based on the research polygenetic feature of cryomethamorphic gleezems is shown.

1) Formation of the upper part of the profile is the result of a current cryogenesis (specific cryogenic organization due to bonding of the particles during rotation, and the pressure of ice schliers and the segregation-coagulation conditioning) as well as of soil processes of a tundra phase of soil forming (gleying, Al-Fe-humus illuviation, biochemical transformation and interprofile migration of mobile organic acids).

2) Lower horizons belong to the previously formed soil preserving the relict properties (fragments of clay cutans, pedorelicts) and reflecting a higher degree of maturity and weathering, according to the results of indicating-geochemical analysis.

3) Analysis of the intraped mass preserving properties under the protection of sandy-silty cutans reflects eluvial-illuvial differentiation inherited from the Taiga stage of soil formation.

4) The following diagnostic criteria of soil polygenetic features of Cryolithozone are offered: a) the structural organization of soil and differentiation of a cutan complex; b) signs of cryogenesis; c) modern and inherited pedogenesis processes, d) humus pedorelicts, fragments of clay cutans, f) the intensity of lithomatrix transformation.

II. *Cryoturbated gleezems.* In the soils formed on flat drained surfaces of the relief gleying is one of the leading automophic soil-forming processes [3]. Profile of cryoturbated gleezem unified in a dry condition, very tight, not aggregated. Spotting (ocher zones) testifies to the oxidation of Fe. Rare whitish spots of skeletans and filling of tube interstices by them characterize cryogenic sorting of skeleton grains. Curved dark brown pieces enriched with organic substance at the depth of 40-60 cm, are the result of cryoturbation.

A slight differentiation in total content of Fe (its minimum is in horizon G1) and deep penetration of organic substance are noticed: accumulation C in horizon B@ (1.31%), a sharp decrease (by 2-3 times) in the underlying mineral horizons and concentration in the curved dark brown fragments of permafrost (1.32%). The latter are distinguished from the mineral thickness by higher content of humic acids and decrease of the amount of insoluble residue. By total content of Al differentiation does not occur.

In the soil there is a small number of concretions due to prolonged overmoisturizing, making the process of their formation difficult. Heterogeneity of being in the same horizons concretions of different density and color is observed. The largest number is

found in suprapermafrost horizon. Concretionary new formations are characterized by the highest coefficient Mn accumulation, from 47 to 63 by the profile.
Forming in the process of underlayer transformation organic compounds form granular aggregate layer at the boundary with the mineral thickness, and dark brown spots on its surface (horizon B@). Granular aggregates in this part of profile are the result of cryogenic processes, while dark brown spots, accumulation of iron-humus compounds directly under the organic horizons are the result of Al-Fe-humus illuviation. At the same time there are ochre areas in the root holes, reflecting the processes of cryogenic ferrugination or chemogenic differentiation of Fe oxide as a result of redox processes: mobilization of divalent Fe and its accumulation in the oxidation barrier near the freezing front at the top of the profile. A similar phenomenon was first noticed by B.N. Gorodkov [1], and related to soil forming processes by V.D. Tonkonogov [3].
The main features of cryoturbated gleezems are: 1) the prevalence in the soil of long periods reductive conditions and gleying, as evidenced by the small number of concretions, unification of upper part structure; 2) maximum intensity in these soils of cryoturbations, along with which take place redistribution, sorting of components and cryocoagulating aggregation of organic substance on the border with the mineral thickness; 3) a weak development and change soil thickness by pedogenic processes: Al-Fe-humus illuviation, chemogenic differentiation of Fe oxides, slow migration of functioning products; 4) forming of B@ horizon under organogenic layer, as well as in the soils without diagnostic horizon G, indicating activation of pedogenic processes (Al-Fe -humus illuviation) in the course of evolution in the upper part of gleezems; 5) preservation of inherited features: fragments of clay cutans, humus pedorelicts.
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The research of urban soils sealed with artificial surfacing

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Introduction

Soils sealing in some parts of the cities may reach 90-95%. That is urban soils study is impossible without taking into consideration of sealed soils, determining their condition and role in soil cover of urban area. The peculiarities of soil functioning under the solid road surfacing are revealed not only in the variation of water-air conditions, soil morphological properties and section, but also in the changes of its biologic activity and intensity of biogenic processes. Thus the necessity to study sealed soils ecologic condition and the intensity of their biologic processes appears.

Materials and Methods

The research was conducted in Vladimir city. Research objects were urban soils sealed with artificial surfacing, urban plots of various economic utilization. Sample areas were laid in residential area, namely on the outhouses and yard areas and also on the auto roads areas, the sealed with asphalt concrete and bitumen. Due to the disturbed profile of the "sealed" soils, as a result of anthropogenic activity, sampling was done not by the levels, but from the fixed depth in all sampling areas. Soil samples were taken at the depth of 20 cm, 30-40 cm, 40-60 cm and also 60-90 for certain plots. Original soils subjected to sealing are grey forest light- and moderate loamy soils.
The researched soils biologic activity has been assessed according to the specimen composition of *Azotobacter* (nitrogen-free Ashby medium, method of soil nubbins), and urease enzyme activity at the background of active acidity variation index (Aristovskaya express-method) [1,3]. Soil sampling was done in compliance with State Standard GOST17.4.4.02.84. In the soil of the sealed areas heavy metals content was detected by roentgen fluorescent method. Petroleums total mass fraction was detected by fluorimetric method; soil actual acidity was measured potentialmetrically using a multi-purpose ionmeter "Expert-001".

Results and Discussion

"Sealed" soils are considerably more solidified as compared to the soils of the open non-sealed areas. Increased sand content in the upper soil thickness has been detected, resulted from the sand layer made during the road surfacing construction.
During the research actual acidity of "sealed" soils has been measured (table 1), considerable reduction of "sealed" soils actual acidity in comparison with both natural grey forest soils of the Vladimir region and areas with open non-sealed soils in Vladimir city has been determined. Background values of pH water in the surface layers of the Vladimir region soil are changing within the limits of 5.4-6.0, whereas

the measuring results of actual acidity for the sealed soils in Vladimir can be characterized as weak alkali or even moderate alkali soils (pHwater=7.76-8.84). Almost everywhere actual soil acidity down the profile tends to increase thus indicating anthropogenic reasons of upper levels alkalization.

Table 1

Actual acidity and petroleums content in the sealed soils of Vladimir city

Sampling location	Sampling depth, cm	Petroleums total mass fraction in soil, mg/g	pH	Sampling location	Sampling depth, cm	Petroleums total mass fraction in soil, mg/g	pH
Studencheskaya str.	20	0.88±0.31	8.13	Egorova str.	20	0.56±0.2	8.22
	30-40	0.36±0.13	7.84		30-40	0.82±0.29	7.91
	40-60	0.07±0.03	7.81		40-60	0.82±0.29	7.9
Kuybisheva str.	20	0.91±0.32	8.62	Zhukovskogo str.	20	0.58±0.2	7.92
	30-40	0.74±0.26	8.32		30-40	0.41±0.14	7.81
	40-60	0.48±0.17	8.23		40-60	0.11±0.05	7.81
	60-90	0.08±0.04	7.80		60-90	0.06±0.03	7.42
Lakina str. Motorway impact area	0-10	0.95±0.33	7.68	Forest (control)	0-10	0.018±0.008	6.04
	10-20	0.71±0.25	7.32		10-20	0.016±0.007	5.90

Measuring results of petroleums total mass fraction revealed that the “sealed” soils are characterized with uneven distribution of petroleums along the profile (table 1). The major amount of petroleums was concentrated in the upper soil layer being in the closest contact with the outer artificial surfacing. Probably, it is explained by the fact that exactly the upper soil layer is more liable to the risk of heavy petroleums penetration including tar and bitumen, used in road construction.

“Sealed” soils samples have been studied regarding heavy metals content of all 3 hazard classes (Zn, Cu, Ni, Pb, Cr, As, Sr, V, Co, Mn, Ti, Fe), but detailed analysis has been carried out only for the metals, which background content values and MPC in soils are determined. In urban soils, covered with artificial surfacing and facilities, heavy metals positive balance is created, consequently, background content exceeding and upper concentration limit assessment becomes typical for certain elements (table 2). Heavy metals accumulation intensity in the sealed soils diminish as Pb>Cu>Zn>Cr>Co>Ni>Mn. The priority contaminant among heavy metals belongs to lead. The MPC exeedance of this element in 1.04 – 1.57, the background level in 2.9 – 5 times has been detected. Separate indicators of sealed soils biological activity have been studied during the research, as soil microbiota reaction on negative impacts complex allows to characterize up-to-date soil cover condition. Many researchers consider *Azotobacter chroococcum* bacteria to be the indicators of urbanogenesis. In the researched samples the rate of soil nubbins biofouling by azotobakter bakteria at different depth comprised 100%. *Azotobacter chroococcum* exhibits considerably lower sensitivity towards contamination in comparison with other soil bacteria, thus permitting to take an ecological niche, released due to the decrease of total bacteria amount in the sealed soils. Azotobacter high activity is stipulated by the limited oxygen access, created during soil sealing, as *Azotobacter chroococcum* is better developed at a certain shortage of oxygen. Constant presence of azotobacter in the sealed soils can be also connected with the ability to form cysts. Thus it can be assumed that *Azotobacter chroococcum* dominates in microbe pool of the contaminated poorly aerated soils.

Table 2

Heavy metals content in the sealed soils of Vladimir city

	Lead	Manganese	Zink	Copper	Cobalt	Chromium	Nickel
Background level of the element in soil, mg/kg	14,9	609,0	47,3	-	4,6	84,8	35,7
Concentration limit upper value, mg/kg	46,8	1147,0	71,9	17	16,7	101,8	113,5
Excess (%) from total sample amount to the upper limit value	90,6	0	25	84	3,1	18,8	0

Many scientists consider urease activity to be a diagnostic criterion of soil ecologic condition. According to the urease enzyme activity rate we can judge about total soil-biochemical surrounding, this index serves as a reliable indicator of environment conditions [2]. In the researched sealed soils urease activity was not revealed, vapor pH over the soil of all samples remained 6 during the whole experiment. Probably poor aeration of the sealed soil, the lack of necessary microelements and organic substances suppress enzyme function thus testifying of the sealed soil condition conservation and the lack of self-purifying processes in soils.
Consequently morphological and physical-chemical properties of the sealed soils considerably differ from natural grey forest and turf-podzol soils of the Vladimir region and from open urban non-sealed soils in Vladimir. Biological activity of sealed soils is low, variation in microbiological environment of the researched soils revealed as the change of microorganisms composition has been detected.

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Effects of gyttja on some soil quality parameters

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Key words: gyttja, organic matter, soil, quality

Introduction

Agricultural production in the arid and semiarid regions of the world is limited by poor soils characteristics. The maintenance of soil quality or enhancement of the soil properties has a critical importance for sustainable agricultural production. Soil quality has been defined as the capacity of soil to function as a vital living system, within ecosystem and land use boundaries, sustain biological productivity, to promote the quality of air and water environments, and to maintain plant, animal and human health' (Doran and Safley, 1997).Generally, soil quality indicators soil organic matter, topsoil-depth, infiltration, aggregation, pH, electrical conductivity, suspected pollutants and soil respiration (Arshad and Martin, 2002).Moreover, soil microbial biomass and soil enzymatic activity can be also use as an indicator of microbial activity (Fernandes et al., 2005). One of the most important soil quality indicators is soil organic matter content (SOM), and its typically used as a measure of soil quality. Soil organic matters affect soil physical, chemical and biological properties. Improving factors, affecting plant production, is possible by increasing organic matter content of a soil. Additions of organic materials help to reduce soil pH and Na, and improve water infiltration rates (Gupta et al., 1988). A number of studies have indicated the beneficial effects of organic matter on improving soil physical and chemical characteristics (Tisdall and Oades, 1982). Romig et al. (995), reported that soil organic matter serves as a primary indicator of soil quality and health. Gyttja application to the soilsincreased SOM content,and statistically significant the positive correlations werefound between the amount of SOM and enzyme activities (Tamer and Karaca, 2006).

The majorities of the soils (65 %) in Turkey have low and very lower organic matter contents (Eyupoglu, 1999). Therefore, the applications to the soils of the organic materials as farmyards, leonardite and gyttjawere recommended to increase soil quality. Gyttja which low-cost and locally available natural materials is a mixture organic and inorganic materials as calcareous and clay, its content of organic matter generally varied from 40 to 50 % by weight, and located on lignite deposits. The gyttja which is not used in the coal-fired power plant due to its low quality must be removed for the lignite layer can be taken for mining. Approximately reserve of the gyttja is 1.8 billion tons in the Afsin–Elbistan coal-fired power plants (A-B units) in Turkey. It was estimated that gyttja reserves approximately 3.5-4 billion tons with new planning C-D units (Saltali, 2015). The aims of the present study are to determine the effects of gyttja on some soil quality parameters.

Material and Methods

The soil samples were taken from classified areas as haploxecrept (Soil Survey Staff. 2003). The pH of the soil was 7.80, EC 667 was µS/cm, the SOM content was 2.54 % by weight, CEC was 44 Cmolkg^{-1}, $CaCO_3$ content was 10 %, clay was 51%, silt was 19%, sand was 30%.

Gyttja samples were obtained from the Afsin–Elbistan coal-fired power plants in K.Maras, Eastern Turkey. The pH of the gyttja was 7.10, EC 860 was µS/cm, the SOM content was 42.1 % by weight, $CaCO_3$ content was38.8 %, total N content 0.24 %.

The experiment was conducted at pots as a completely randomized plot design. Doses of the gyttja 0, 40, 80 and 160 (g/pot) added to each pot containing 4 kg soils, and soil samples were incubated ten months in 2014.The incubation was carried out in a laboratory conditions. Soil moisture was adjusted to 50 % of the water content at field capacity. Water losses were compensated by the addition of distilled water during incubation. Soil properties were measured after ten month of incubation. Soil pH and EC were measured in a 1:2.5 soil/water mixture, SOM by a modified Walkley–Black method, , cation exchange capacity (CEC) by ammonium acetate methods, and soil texture by hydrometer method. Hydraulic conductivity was measured with disturbed soil samples (Klute and Dırksen, 1986). Total N content in the gyttja was determined by Kjeldahl method (Chapman and Pratt, 1961). Humic acids contents of the gyttja were measured according toTSE methods (Anonymous, 2003). Basal respiration (BSR) at field capacity (CO2 production at 22◦ C without addition of glucose) was measured, as reported by Anderson (1982), soil microbial biomass carbon (Cmic) was determined by using the Substrate-Induced Respiration method (Anderson and Domsch, 1978), Catalase activity (CA) was measured by the volumetric method (Beck, 1971), Dehydrogenase activity (DHA) was determined by using the classical TTC method (Pepper et al.,1995). Effectiveness of subject on variables was evaluated by ANOVA test. In addition, comparison of mean values was performed by Duncan test. SPSS computer package was used for these analyses.

Results and Discussion

Applying of the gyttja to the soils had noticeable effects on some soil quality indicators (Table 1).

The mean pH and EC values of the soils in all application rates were not statistically changed the compared with the control soils (Table 1).It was showed that gyttja applications have not unfavourable effect on soil quality parameter such as the soil EC.The soil organic matter (OM) contents increased with the increasing application of gyttja rates, the increases were statistically significant (Table 1). Soil organic matter contents increased 15, 47 and 119 % in the soils for 40, 80 and 160 gpot^{-1} at the rates of gyttja compared with control pot, respectively. Arshad and Martin (2002), suggested that a 15 % increase or decrease over the average value for organic matter may be considered as a critical limit. The majorities of the soils (65 %) in Turkey have low (1-2 %) and very lower (<1 %) organic matter contents (Eyupoglu, 1999). Since, gyttja could be a good source to increase soil organic matter content in arid and semiarid region in Turkey. Romig et al. (995), reported that soil organic matter serves as a primary indicator of soil quality and health. Soil organic matters affect soil physical, chemical and biological properties. Improving factors, affecting plant production, is possible by increasing organic matter content of a soil. Therefore, the applications to the soils of the gyttja as the organic materials could be recommended to increase soil quality.

Some quality indicators of experimental soils **Table 1**

	Gyttja rates (g/pots containing 4 kg soil)				
	0	40	80	160	P
pH (1:2.5)	7.80	7.87	7.90	7.85	ns
EC μS/cm	667	674	670	655	ns
O.M. (%)	2.49b	2.86b	3.64b	5.46a	***
$CaCO_3$ (%)	10b	11.3a	11a	11.8a	*
CEC (cmolkg^{-1})	44a	47b	47.8b	47.6b	**
BSR (mg CO_2 g^{-1})	12.7d	15.2c	21.5b	26.6a	***
Cmic(mg CO_2-C g^{-1})	208d	256c	289b	346a	***
CA (ml O_2 g^{-1})	71d	80c	89b	109a	***
DHA (g TPF g^{-1})	23d	27c	35b	45.6a	***
Cmic/Corg	1.4a	1.5a	1.4a	1.09b	**
H. Conduc.(cm/hour)	1.4c	1.6c	2.7b	3.9a	***

DHA ;Dehydrogenase activity, CA; Catalase activity, BSR; Basal respiration, Cmic; microbial biomass carbon , ns: not significant. $\alpha = 0.05$.

The soil CEC is one of the important soil properties, and soils with high CEC is potentially fertile. The CEC increased in all treatments compared with control soil at the end of the incubation. The CEC values of the control and all treatments soils were found in statically different groups, but the CEC values of all treatments soils were found at the same group according to Duncan groups. These can be attributed to the large contents of organic materials in gyttja because organic colloids have more charge than mineral colloids. The same CEC values of the all treatments soils maybe due to short incubation time for gyttja decomposition.

Microbial activities are bound to the living cell, like basal respiration and enzymatic activities, and the microbial activities can be considered as connected with living conditions of microorganisms (FlieЯbach et al., 2007). One of the soil quality indicators is soil basal respiration (BSR) which expressed as mg C-CO_2released kg soil h^{-1} (Fernandes et al., 2005). In this present research, the BSR values were significantly affected by the gyttja applying, and the BSR values varied from 12.7 at control to 26.6 (mg CO_2 g^{-1} dry soil 24h^{-1}) at the higher application rate (Table 1). The BSR values increased with increasing application rates of gyttja, and BSR values were found 20, 69 and 106% higher as compared to control treatment. The higher BSR values in gyttja treatments soils may be due to stimulating effect of organic matter and nutrients on soil microorganisms (Fernandes et al., 2005). FlieЯbach et al.

(2007) reported that highest basal respiration was measured in systems received organic fertilizers, and lowest values were found in the control treatment not adding organic fertilizers.
Microbial biomass carbon (Cmic) also increased with increasing the gyttja doses in the experimental soils (Table 1). The smallest Cmic value was obtained in the control which was statically different from treatments that received gyttja applications. The enhance in the Cmic values could be attributed to the an increase organic materials which favored the soil microorganisms and activity (Fernandes et al., 2005).
Increased applied gyttja doses also increased the catalase activity (CA) and dehydrogenase activity (DHA) in the experimental soils. The values obtained demonstrated that there were significant differences in the CA and DHA values between soil with and without the addition gyttja doses (Table 1). When compared with the control, the highest gyttja dose showed increased 53% and 98% in CA and DHA values, respectively. Karaca et al., (2006) reported that the increasing values of biomass C and some enzyme activities was due to the the inputs of organic matter by gyttja.

The obtained values demonstrated that there were significant differences in soil hydraulic conductivity (HC) compared to the control and applied gyttja doses (Table 1). This may be attributed to reduce of swelling, aggregate breakdown, and soil particle dispersion.

Conclusion

According to the data obtained, the applying of gyttja to soils in low organic matter content improved both some physical, and biochemical indicators of soil quality. Generally, the improvements were proportional to the applying doses of the gyttja. Therefore, gyttja can be recommended to agricultural soils in low organic matter content to improve some soil quality indicators.

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Characteristics of soils in the Northern Urals

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Introduction

Stationary studies of soils, soil-forming processes and their dynamics are conducted rarely in Russian natural reserves nowadays, and studies of soil cover are only conducted in 20% of reserves [1]. Studies of the Urals soils started later than in other mountains. In the Perm region, the unique biocenoses of Northern Urals are presented in the "Vishera" state natural reserve. The diversity and genetic characteristics of the soils of the Northern Urals have not been studied within the reserve before.
The purpose of the research is to study morphological and genetic features and classify soils of the Homgi Nël mountain within the western North Urals macroslope. The morphological appearance of each soil is unique which may be due to both geomorphological conditions and plant communities.

Materials and Methods

The object of the research are mountain soils in the "Vishera" natural reserve, the fourth largest reserve in Europe located in the extreme north-east of the Perm region in the river Vishera headwaters. It's territory is situated within mountains with 800–1200 meters level difference embracing fragments of central backbones of the Urals. We conducted the pedological survey at an altitude of 920 (mountain tundra belt) to 458 (mountain forest belt) meters. Using catenary method, we made 8 cross sections and took soil samples at the Homgi Nël mountain (1301 m), Molebny Kamen range, Northern Urals. Based on morphological features, the soils were classified using substantively-genetic soil classification [2] and WRB [3].

Results and Discussion

Old plains of subaerial denudation raised to different altitude are the characteristic feature of Northern Urals relief hence there are flat-topped and dome-shaped ranges and mountain groups. Northern Urals are characterized by the absence of contemporary glaciation and the presence of high-altitude zones: cold goltsy desert, mountain tundra, subgoltsy belt (birch crooked forest, parkland spruce-fir forest, meadows), mountain forest belt (dark coniferous spruce-fir taiga, light coniferous pine forests).
Mountain tundra zone (850-1200 m) is represented by different types of open treeless communities: herb and moss, suffruticous, rocky and lichen tundra, and thickets of dwarf birch trees in different combinations. Mountain tundra intersperses with deposits of stones representing goltsy desert. The vegetation is poor in species composition and is represented by mosses and alpine flora. At an altitude above 1200 m, among large-block stone hollows there is the uppermost high-altitude zone of the Ural mountains – cold stony desert, or goltsy. The vegetation is represented by

colored crustose lichens growing on the rocks. Thus, treeless spaces are characterized by high-contrast microclimate conditions, creating different combinations of weathering and soil formation conditions.

In rough environment of mountain tundra, shallow soils are formed (8-9…30-31 cm); their structure allows diagnosing primary soil formation process, where the combination of soil-forming agents leads to the formation of *soddy forest ferrous-humic-illuvial soils* (*Entic Podzols, Umbrepts*) and *infantile soils* (*Cambisolss*). The soil profile is not fully developed, but clearly differentiated into genetic horizons by color and content of specific components. For example, in section 8-14, there is clearly visible organic oligotrophic peat crust, under which illuvial-ferruginous horizon with signs of gley is formed, and under it there is a gley horizon of bluish color with rusty spots of iron compounds. Thus, illuvial accumulation of iron-humus compounds forming specific chemogenic alfehumic horizon is morphologically evident which diagnoses *alfehumic* soils, particularly *soddy forest ferrous-humic-illuvial gley soils* (O-BFg-Gox). Long frost weathering and a short warm season contribute to long-term water saturation and chemogenic reduction of iron compounds. There are transitional (g – gleysolic soil in alfeguhumic horizon) and process (*ox*) signs except diagnostic horizons. In addition, there are *infantile soils* (*Cambisols*) in mountain tundra (goltsy) belt represented in infantile humus horizon, thickness of which is less than 5 cm, on solid bedrock (O-W-R). Such soils are formed in places of fine soil accumulation between deposits of stones.

In the sub-goltsy belt, soil cross sections were made in areas of different sub-belts differing in the predominant vegetation: mesophilic subgoltsy meadows sub-belt (cross section 6-14), mountain crooked forest sub-belt (cross section 5-14), subgoltsy light forest belt (cross section 4-14). The relief here is unhomogeneous and diverse and includes slopes of different angle, well-marked microrelief, and biogenic forms of relief. There are swampy areas, deposits of stones, creeks and streams crossing the area. On a mesophilic mixed herbs reedgrass meadow with elements of short-grass St.-John's-wort meadow among parkland light and crooked forest *mountain meadow gray-humic* (O-AYel-AYm-AY-CLM, *Umbrisols*) soil has formed. It has a stretched humus profile with gradually changing color from gray-brown to black and well defined solid structure. The grey humus horizon has transient signs of eluviation (*el*) and metamorfization (*m*) expressed in the presence of clarified material in the form of mineral grains dispersed in the mass of the horizon and in the presence of nuciform lumpy structure, respectively. In bilberry birch and scrub forest in mountain crooked forest sub-belt on a cleve, the *lithic soddy forest ferrous-humic-illuvial soils (O-AYe,g-BH-BF-CLM, Entic Podzols, Leptosols)* with alfehumic horizon and truncated profile (less than 30 cm) are formed; they have a sod horizon with transient signs of podzolity. This feature diagnoses the *podzolic* subtype. In light parkland forest with tallgrass meadows on gentle slopes, there is an iron-metamorphic horizon in soil profile occupying more than a half of the profile and diagnosing *brown forest ferralitic* (O-AY-BFMgr-BFM-CLM, *Stagnosols*) soil type. The *gr* process sign is evident in *BFM* diagnostic horizon.

In mountain forest belt, cross sections were made on test areas with different slope angle and ground cover in the spruce-fir taiga. Relief varies in this belt and has well marked biological forms. Wetlands can be found on poorly drained slopes. At an altitude of 400-600 m there is a sub-belt of mountain spruce-fir forests with an admixture of birch, mountain ash and cedar. The forest is light and bushy (height up to 15 m). Fir-spruce taiga gradually turns into a spruce-fir along with the mountain altitude. Percent of birch (up to 30 %) and cedar (10-30 %) rises sharply. Lightness of mountain forests causes development of dense grass cover. On drained slopes there are large ferns spruce-fir forests, and on wet slopes and areas with temporary watercourses light tallgrass taiga and moist shavegrass spruce forests developed.

Under the spruce-fir forests the soils of thickness of 20...75 cm are formed. On the slopes of angle more than 5° low thickness *lithic immature soils* (*Leptosols*) and *brown forest* (*Cambisols*) soils are formed. Profile-forming processes are overlapped by horizon-forming ones appearing in transient (*g, ao, m*) and process (*hi*) signs (O-AYao-AYm-R; O-AYao,g-AYg,hi-R). On more gentle slopes in the lower part of mountain forest belt under fir-spruce taiga the *soddy-podzolic ferrous illuvial (Umbric Ferralic Gleyic Albeluvisols*) soil with signs of gley has formed. The profile is quite thick as for mountain area (75 cm) and clearly differentiated into genetic horizons (O-AY-Eg-BTf,g-BTf-CLM). To conclude, on the Homgi-Nёl mountain of the Northern Urals there are soils of both primary and postlitogenic soil forming (Table 1).

The classification position of soils on the mountain Homgi-Nёl **Table 1**

Taxonomic unit			
Trunk (soil forming)	Department	Type	Subtype
Primary	Infantile soils	Petrozem	Humus
Postlithogenic	Lithic soils	Gray-humic	Metamorphosed
			Gley
			Humic-infiltrated
	Ferralitic-metamorphic	Brown forest ferralitic	Iron-granular
	Mountain meadow	Gray-humic	eluvial
			Metamorphosed
	Al-Fe-Humus soils	Forest ferrous-humic-illuvial gley	Oxidation-gley
		Soddy forest ferrous-humic-illuvial	Podzolized
	Texture-differentiated soils	Soddy-podzolic	Ferrous illuvial

Conclusion

Based on the morphogenetic characteristics we have defined the classification position of soils of Northern Urals, namely identified ranges and defined types and subtypes of soils within them, as so as clan (unsaturated, carbonate-free); defined soil type by humus horizon thickness (small); by depth and location of gleying (surface gleyed); by degree of saturation with bases (highly unsaturated and unsaturated). By grain size distribution, the classes are from medium clayey to clayey, and by the degree of gritty consistency — medium and high-consistent.

Basic morphogenetic soil characteristics are: rubbility, truncated profile, distinct horizontation, gleyzation, ferrugination, and podzolization. So, the diversity of soil forming conditions causes diversity of soil cover.

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Ecology of soil surface in Kazakhstan, problems and solutions

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Globalization of economy, intensification of post-industrial and existing productions in many countries and, as a consequence, climate change associated with global warming become a reason of violation of dynamic development in biosphere processes and create a special concern on deterioration of natural environment.

By the occupied area which is 272.5 mln. ha, and a variety of natural and resource potential, Kazakhstan is one of the largest countries in the world. It includes ten natural and agricultural zones, while the share of four zones: steppe, dry steppe, semi-desert and desert account for 87.4% of the total area, share of pastures - 84.8%, arable land - 9.8%, hayfields and waste lands - 2.3%.

Unlike soils in other countries, soil surface of the Republic of Kazakhstan has a low resistance to anthropogenic loads, and is more susceptible to degradation and desertification. Every year the intensive processes of degradation, salinization, pollution and deterioration of soil and environmental conditions which become more threatening are observed. As a result of negative anthropogenic impact and general aridity of the republic territory, major changes have occurred towards the reduction of productivity of arable land.

The share of agricultural lands in the structure of agricultural lands of the republic is 38.5%, of which more than 70% of arable lands is located in Akmola, Kostanai and North Kazakhstan regions and more than 60% of irrigated arable lands– in Almaty and South Kazakhstan regions, and the largest areas of grasslands – in Karaganda (18.8%) and Aktobe regions (14.1%).

Over the past 60 years humus concentration in soil has declined in non-irrigated area by one third of its original concentration, and in terms of irrigation - by 60%. Sharp decline in supply of agricultural fertilizers has a certain influence on it. Today, compared to 1985, a period of intensive use of fertilizers in Kazakhstan, the volume of mineral fertilizers per 1 ha of arable land has decreased 15 times and organic - 25 times less and that has contributed to destabilization of soil fertility to a certain extent. Currently, the annual removal of nutrients from soil with crop yields exceeds hundreds times their income with fertilizers. There is the imbalance between humus formation and decomposition processes, which resulted in the decrease of the share of agronomically valuable water-resistant aggregates (0.25 mm) by 10-28% depending on soil type. Density of arable and sub-arable horizons has increased by 0,01-0,23 g

/cm^3, and in some cases has already reached critical values – 1.40-1.50 g /cm^3. Quantity of absorbed calcium cations has reduced in soil, resulting in reduction of soil buffer capacity. This was accompanied by deterioration of aggregate composition and soil density. The loss of humus on eroded soils was 24% lower than on non-eroded soils. The annual loss of humus in land cultivation in Kazakhstan is 0.5-1.4 t/ha. Process of dehumification has been registered in all arable soils in which humus concentration has decreased by 20-30%. Long-term researches have found that on black soils and dark chestnut soils of Northern Kazakhstan the dehumification processes and reduction of productivity of arable land are progressing. In Eastern and Central Kazakhstan not only soil fertility decline has been observed, but also a catastrophic scale of soil contamination.

The territory of the Aral Sea region is subject to irreversible desertification, soils on the area of 59.6 mln. ha are affected by salinity, intensive development of salt and dust streams that are spread, according to space shooting at a distance of 500 km, and their deposition has been determined on the area of about 25 mln. ha.

On gray soils, brown and gray-brown soils of southern Kazakhstan the decrease in soil fertility is accompanied by intense processes of salinity and degradation. Technogenic pollution of soils as a result of economic activities of industrial and oil companies is a big problem. The total area of oil-contaminated areas in the country is more than 200 thous. ha. Every year the areas of disturbed lands increase, and currently they occupy 184 693.0 ha.

Influence of anthropogenic factors affect almost all natural landscapes.

In this regard, one of the main objectives today is introduction of not only waste or fallow lands into agricultural use, but also disturbed and contaminated lands. Therefore it is necessary to pay special attention to restoration of degraded, disturbed, contaminated and deserted lands.

For addressing environmental problems it is needed to conduct researches on evaluation of soil and ecological functions of natural and technogenic terrain that allow to identify the territories with various degree of stability of soil and vegetation cover and determine their restoration capabilities.

Currently, U.U.Uspanov Kazakh Research Institute of Soil Science and Agrichemistry is involved in the following researches: patterns of soil and soil surface formation in Kazakhstan and its rational use; development of scientific bases of fertility reproduction and soil protection in terms of anthropogenesis, activities, methods and techniques of soil fertility reproduction; increase of agricultural crop productivity; assessment and regulation of soil functions in terms of anthropogenesis.

Scientists of the Institute have justified scientific approaches to rational soil fertility management and conservation. Evaluation of current soil-reclamation, soil environmental status of soils in the republic using earth remote sensing methods (RS), geographic information system (GIS technologies) is conducted by phases according to soil and climatic zones.

Based on field soil researches, satellite imagery and GIS technologies the electronic versions of soil maps of Semirechye (Almaty region), Zhambyl, South Kazakhstan region; current Syr Darya River delta and dried bed of the Aral Sea (1: 500000) have been done. More than 400 monographs, recommendations, collections on fundamental geographic and genetic research, rational use of soil fertility and soil surface conservation have been published.

Scientifically justified methods of detoxification of contaminated soils and methods of improvement of humus status and soil biological activity by using soil biotechnology methods and soil fertility reproduction technologies based on new biomineral and bio-organic fertilizers and small-volume preparations-adaptogens are developed.

Special scientifically justified approach taking into account natural- climatic conditions, development and introduction of new innovative technologies is needed to increase the productivity of arable land and soil fertility in each specific region.

Thus, regulation of soil fertility and rational use of soil resources should be aimed at preventing all forms of soil surface degradation and increase of arable land productivity, providing Food and agro-ecological security of the country.

Impact of different depth soil treatments on content of water-stable aggregates in sod-podzolic soil

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Keywords: water erosion, water-stable structure, soil protecting treatments on different depth

Introduction

First and most important result of soil treatment is redistribution of the mechanical aggregatesa long the soil profile that ischanging the physical parameters of the soil that defines the effect of soil treatment on erosion process.
Content of water-stable aggregates - the main factor determining the soil resistance to the erosion process.

Results and discussion

The research of regularity in spatial and temporal variation of the content of water-stable structure was carried out on dissected relief under long-term implementing the soil saving treatments of different intensity. The soil cover was characterized with the wide dissemination of erosion process and consisted of low- and middle washed off sod-podzolic soils.
Soil treatment produced the direct impact on the content of water-stable aggregates in the soil root layer. While implementing the annual plowing the tendency of decreasing in the content of agronomically valuable structure during the researched period was defined. The deterioration in structural and aggregate composition under traditional plowing was determined with depletion of organic matter in treated soil level due to annual mixing with podzolic level. The content of water-stable structure in soil while rotated crops cultivation under moldboard plowing (minimum and flat treatment) on both researched slopes were slightly higher in comparison with the traditional plowing.
So, on a slope of 2-5^{0}the maximum content of water-stable aggregates in the soil root layer was 46, 1%, that was by 8, 5% higher in comparison with control variant. On a slope of 5-7^{0}the tendency of distribution was the similar and differed only by not significant decrease in the content of water-stable aggregates along whole slope that characterized the slope as less resistant to erosion (Tab.1).
In the research period of 15 years the main tendency on increasing the content of water-stable aggregates in layer of 0-40 cm was revealed (Fig. 1).
The peaks of the graphs on the content of water-stable aggregates are associated with the cultivation of perennial grasses.

At the cartogram on spatial distribution of water-stable aggregates their spatial differentiation in connection with the elements of relief is presented (Fig. 2). In the upper parts of both slopes the low content (in average) of water-stable aggregates is defined that determines the development of denudation processes under the influence of gravitation forces (slope washing off). Increasing in content of water-stable aggregates in accumulative part of slope was defined. Increasing the water stability of soil was observed from top to foot of the slopes. Soil saving treatments in conditions of terrain with difficult relief contributed to the differentiation of certain quality parameters on the structure of arable and subarable layers.

Table 1

Impact of erosion saving soil treatments on the water stability of the soil under rotated crops cultivation (layer of 0-40 cm) (content of water-stable aggregates, %)

Soiltreatment	Crops				
	Oat	Barley	Winter wheat	Perennial grasses of the 1st year cultivation	Perennial grasses of the 2nd year cultivation
Slopeof5-7^0					
1. Plowing (controlvariant)	40,9	32,5	33,6	38,6	44,5
2.Plowing + slotting	41,6	36,0	35,0	40,0	45,9
3.Flattreatment + slotting	44,4	36,8	38,8	39,6	44,9
4.Flat treatment + rotortreatment	43,4	37,1	36,1	43,4	48,6
5.Minimum treatment + slotting	43,5	40,2	37,8	43,2	46,4
6. Minimum treatment	41,0	37,3	38,2	40,5	44,6
Slopeof2-5^0					
1.Plowing (controlvariant)	41,7	39,2	37,8	44,0	48,4
2.Plowing + slotting	41,7	36,6	39,2	40,7	48,2
3.Flattreatment + slotting	38,6	33,9	39,8	41,9	46,9
4.Flat treatment + rotortreatment	39,8	36,6	41,5	44,3	53,7
5.Minimum treatment + slotting	42,0	42,2	42,5	47,7	55,5
6. Minimum treatment	44,4	43,9	40,0	48,1	54,7
LSD_{05}A - 2,3; LSD_{05}B - 3,8					

Table 2

Statistical analysis of the content of water-stable aggregates (%) in the soil of experimental plot

Parameter	Beginning ofvegetationperiod		End ofvegetationperiod	
	Layer, cm			
	0-20	20-40	0-20	20-40
Minimum value	27,1	24,3	31,9	26,8
Median value	43,4	35,8	49,4	39,7
Maximumvalue	53,3	44,6	63,9	52,2
Standard deviation	6,02	5,57	7,27	6,09

During the vegetation season the increase of agronomically valuable aggregates on both slopes under all variants of soil treatment was observed that related to changes of other soil agrophysical parameters.

Statistical data processing defined the spatial variability of the content of water-stable aggregates, resulting in high value of range (Tab. 2). Relating to the mean values the content of water-stable aggregates in the soil of experimental plot is increased.

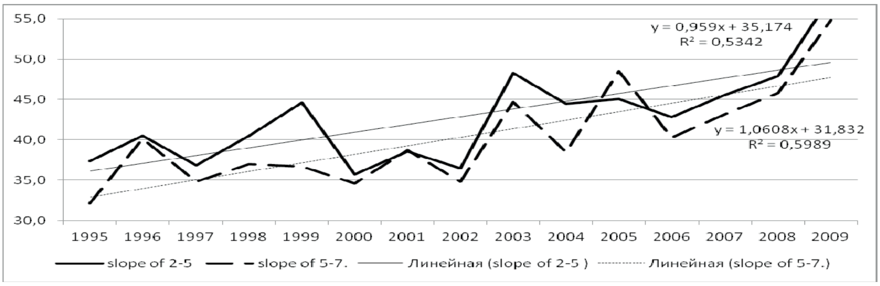

Fig. 1. Dynamics in the content of water-stable aggregates, %

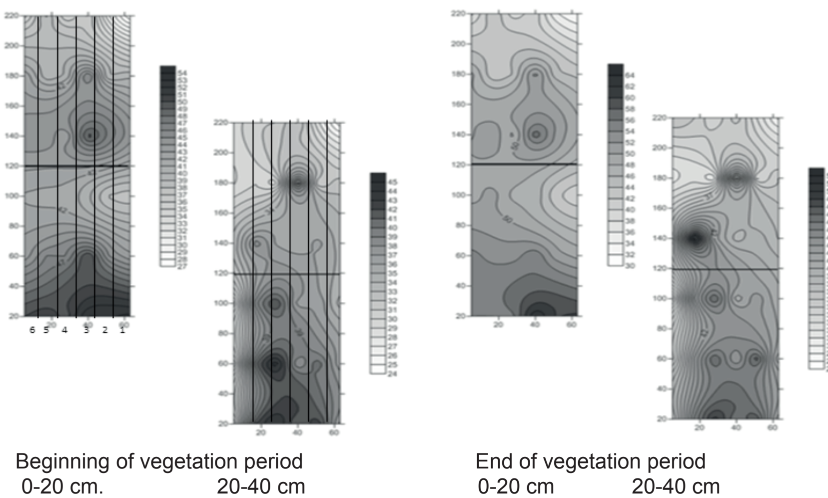

Fig. 2. Cartograms on spatial distribution of water-stable aggregates

The tendency on reducing the content of water-stable aggregates in a layer of 20-40 cm on both slopes under minimum treatment was defined; flat treatment along with rotor treatment contributed to more equal distribution of the above aggregates.

Conclusions

Thus, the water off processes on slopes are connected with washing off and destruction of slopes with small temporary water streams that leads to anisotropy of the qualitative characteristic of the soil structure.

Amplitude and damping depth in soil solarization under different applications

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Key words*:* Amplitude, Damping depth, Soil temperature, Soil solarization

Introduction

Currently, for the control of soil pathogens and pets soils are fumigated by some of the fumigation materials (methyl bromide) that are globally prohibited for their high toxicity and detrimental effects on the stratospheric ozone layer (Katan, 2000). More ecological treatments are no sought. Alternative sustainable techniques, such as milder chemicals, soil solarization (Stapleton, 2000), crop rotation and bio-control agents have been envisaged, alone or in combination.
Soil solarization is based on the exploitation of the solar energy for heating wet soil mulched with transparent PE sheets to 40-55 °C in the upper soil layer. The effectiveness of soil solarization depends on soil color and structure, soil moisture, air temperature, length of day and intensity of sunlight (Souza, 1994). Thermal killing is the major factor involved in the pest control process, but chemical and biological mechanisms are also involved. Synergistic effects of some organic materials applied with solarization have also been observed in some studies (Harender 2004; Komariah *et al*. 2011). Its high synergistic effect in its use in combination with various organic amendments against root-knot nematodes in greenhouse vegetable crops is more effective when compared to single treatments (Oka *et al*. 2007).
Soil temperature is the most important, as it is the main cause of microorganism death. Temperature fluctuations in the surface of the soil reaches into the soil by thermal conduction. However, the temperature amplitude in the soil decreases with soil depth due to the limited diffusion. Damping depth (*d*) is a characteristic depth at which the temperature amplitude decrease to the fraction 1/e=0.37 of the soil surface amplitude. d is related to the thermal properties of the soil and the frequency of the temperature fluctuation (Hillel, 1982). The thermal properties of the soil (conductivity. diffusivity and heat capacity) govern the penetration of the daily and annual temperature waves in to the soil (Monteith and Unsworth, 1990). When the thermal diffusion coefficient is high; daily and yearly temperatures are more effect toward soil depth, and retardation time is decreases in deeper soil layers or *d* is increase. The effect of increasing the temperature of the deep layer will undermine their ability to escape to the upper layers of soil pests and pathogens. Thus, soil solarization becomes more effective.

Knowing amplitude and damping depth is the key for lethal killing depth and increasing effectiveness of solarization practice. In this study, we determined the effect of solarization under applications of CO2, basaltic tuff (BT), organic matter (OM) and a different color plastic cover (DCPE) on amplitude and damping depth.

Materials and Methods

The study was carried out under greenhouse and open-air conditions at the Çukurova University, Faculty of Agriculture Farm. for 32 days, starting from 17th of July 2009. The research area located in Adana/Turkey (36°59’ N. 35°18’ E) at an elevation of 20 m above the sea level and under the influence of the Mediterranean climate. The soil properties of the study area are given in Table 1.To determine the effects of solarization and applications on soil temperature, the daily soil (5. 20 and 30 cm) temperatures were recorded during the trial period. The variants and the applications within the experiment are given Table 2.

Table 1

Some features of the experiment area of soils

Organic matter (%)	pH (1:1 H2O)	Salt (%)	Lime (%)	Clay	Silt (%)	Sand	Texture class
1.7	7.7	0.055	38.5	44.2	36.7	19.1	C

During the study soil temperatures, maximum and minimum temperatures in mentioned depths (5, 20 and 30 cm) and in greenhouse ambient temperature were monitored. Thermal properties, temperature, amplitude and damping depth were calculated (Gülser and Ekberli, 2002). Variance analysis was performed on the data obtained from the study by the IBM-SPSS Statistic 20 software package and interpreted with Duncan’s test.

Table 2

Applications in the experiment

Treatments	Descriptions
CO_2	+0.5 kg m^{-2} CO_2 (dry ice org as state) applications
BT	+Basatic tuff= 5 kg m^{-2} (<5 mm) application
PE	Normal solarization
OM	+ Organic matter (OM) (1.5 kg m^{-2}) application
OM+CO_2	+ 0.25 kg m^{-2} CO2 + 0.75 kg m^{-2} OM application
DCPE	Different color and size cover material (UV+IR) application
Control	Control (no solarization and any other application)

The experiment was carried out at 2 m × 2 m plots that were prepared in the greenhouse and open-air conditions with 7 different applications. Solarization applied fields were plowed and seed-beds were prepared. The application materials were applied to the plots and a drip system was installed for irrigation. Each plot was covered by 100 µm PE materials – clean plastic sheets used for solarization and plastic cover edges were embedded in the soil to prevent heat and water loss of soil for a depth of 10 to 25 cm.

The climate data for the research periods were taken on the climate monitoring station (Davis-Vantage PRO2 Plus) located in the University Farm. Soil temperature average values recorded daily and every 15 min. By PT-100 temperature sensors in 5. 20 and 30 cm depth. During solarization process, soil water content was measured wit TDR (6050X3K1 Mini Trase Kit) and Tensiometer devices which was previously calibrated.

Results and Discussion

Soil temperature: According to statistical assessment of study results, it was determined that apart from the most effective OM, DCPE and OM+CO_2, other subjects can be used for solarization as well. Soil temperatures significantly affected by the applications ($p<0.05$).The maximum and minimum daily temperatures ranging from 54-26.7 and 50.4-24.2 °C in greenhouse and open-area, respectively (Table 3.). The highest average maximum soil temperatures was obtained from 52.2 °C (PE) in greenhouse whereas 47.7 °C with (DCPE) in open-area solarization.

Table 3

Effect of applications on soil temperature (°C)

	Applications	CO2	BT	PE	OM	OM+CO2	DCPE	Control
Greenhouse	The highest	51.5	49.9	54	53.7	53.8	52.8	44.8
	Max. mean	49.3 b	47.4 c	52.2 a	51.9 a	51.7 a	51.2 a	42.7 d
Open-area	The highest	49.1	47.0	45.9	49.5	49.2	50.4	36.3
	Max. mean	47.6 a	44.3 b	44.5 b	47.6 a	47.3 a	47.7 a	34.8 c

Comparison of applications in terms of max. mean temperature values by Duncan test ($\alpha = 0.05$)

Amplitudes: Amplitude values in the open-area were between 3.9 and 7.9 °C at the 5 cm and in deeper soil layers (20 and 30 cm) were 1.5-2.6 and 0.9-1.4 °C whereas these values were respectively 4.8–7.6. 1.8–2.7 and 1–1.4 °C in greenhouse conditions (Table 4.). In both solarization conditions, the average temperature values and temperature fluctuations at the soil deeper layers were to be low that has a substantial effect on decrease of amplitude. According to the applications, amplitude values in all depths were higher than control plots. The amplitudes of OM, OM+CO_2 and DCP at 5 cm depth were high, while BT application has a lower amplitude. Here, it is understood to be difference between max. and min. temperatures in BT was lower than other applications. The minimum temperature during the night hours not too fall under this arrangement reduces the resistance shown against thermal sensitivity. The highest average amplitude values in both solarization areas appears to be under OM+CO_2 application. Organic additives contribute to heat and temperature increase which occurs as a result of fermentation during the period when they stay in soil (Komariah *et al*. 2011) and increased amplitude values.

Damping depth: Damping depth values varied between 13.1 and 16.9 cm in open-area and 14cm-18.9 cm in greenhouse conditions (Table 5.). The most successful application has been basaltic tuff (BT) in both conditions. Which can be explained by the fact that the high porosity having a structure of basaltic tuff to increase water holding capacity in the soil with its latent heat to build up and to add positive effect on heat conduction within deeper depts. The lowest damping depth were obtained from control subjects. All applications made have succeeded in transfer of heat to deeper depths, and increased the destruction (killing) depth. Generally, damping depths in greenhouse were founded to be higher depend on the climatic conditions inside the greenhouse (interior temperatures, no wind conditions, Etc.).

Table 4

Amlitudes (±SE °C) throught complete 32 days of solarization period

Applications	Open-air solarization				Greenhouse solarization			
	5 cm	20 cm	30 cm	Mean	5 cm	20 cm	30 cm	Mean
CO2	7.8±0.1	2.3±0.0	1.3±0.0	3,80	6.4±0.1	2.2±0.1	1.3±0.0	3,30
BT	5.2±0.2	2.1±0.0	1.1±0.0	2,80	4.8±0.1	1.8±0.1	1.3±0.0	2,63
PE	6.2±0.1	2.2±0.0	1.3±0.0	3,23	7.6±0.1	2.2±0.1	1.3±0.0	3,70
OM	7.8±0.1	2.0±0.0	1.4±0.0	3,73	7.5±0.1	2.0±0.1	1.3±0.0	3,60
OM+CO2	7.9±0.1	2.6±0.0	1.4±0.0	**3,97**	7.3±0.1	2.5±0.1	1.4±0.0	**3,73**
DCPE	7.9±0.2	2.5±0.0	1.3±0.0	3,90	6.9±0.1	2.7±0.1	1.4±0.0	3,67
Control	3.9±0.1	1.5±0.0	0.9±0.0	2,10	5.9±0.1	1.9±0.1	1.0±0.0	2,93

Table 5

Effect of application on damping depts

Applications	Open-air solarization		Greenhouse solarization	
	[1]$Sd_{30\ cm}$ (cm)	[2]$\bar{D}_{5\text{-}30cm}$ ($cm^2\ h^{-1}$)	$Sd_{30\ cm}$ (cm)	$\bar{D}_{5\text{-}30cm}$ ($cm^2\ h^{-1}$)
CO2	13,7	24,6	15,6	32.0
BT	**16,9**	38,2	**18,9**	47.0
PE	15,6	32.0	14.0	25,8
OM	14,3	27,1	14,1	26,1
OM+CO2	14,3	27,1	14,9	28,9
DCPE	13,8	25.0	15,7	32,4
Control	13,1	23,2	14.0	25,9

[1] Damping depth, [2] Thermal diffusivity

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Modern soil physical methods and instruments of granulometric composition, rheological characteristics and properties of the solid phase surface soils investigation

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Keywords: laser difraction, rheology, contact angle, soil organic matter

Introduction

In soil science are used modern instruments and methods that have, in contrast to the traditional ones, other physical fundamentals, principles and methods of sample preparation. In particular, one of the most common of the fundamental properties of natural and man-made bodies of dispersed samples,- particle size distribution, - currently measured by traditional sedimentimetric (pipette method, hydrometer, etc) methods and new ones (laser diffraction method). These new methods have another physical fundamentals, the specifics of preparation of samples for analysis, which should be considered in the analysis, interpretation of results. Furthermore, the content and composition of soil organic matter, modifying altering amphiphilic properties the solid phase of soil, are very important. This article focuses on the value of the content of soil organic matter in the study of particle size distribution, rheology and surface properties (contact angle) of the solid phase of soil. The objectives of the study is to investigate the influence of soil organic matter on (1) the particle size distribution obtained by the pipette and laser diffraction, (2) the rheology and (3) the contact angle.
Grain size distribution (granulometric composition) of soil. All sedimentometric methods (pipettes, hydrometer) are based on the Stokes equation. By using these methods, we do not get the real radius and use the so-called hydraulic (or effective, Stokes) radius of the particles, ie, particle radius corresponding to the determined rate of fall. This is a major assumption in the analysis of particle size as the particles can have very different density (compare, - mineral on average, 2.65, and organic – 1.3 g / cm^3), the various properties of the surface (hydrophobic and hydrophilic) and other characteristics, questioning the proximity their actual and hydraulic radius. This just proves the need to compare sedimentometric and laser diffraction methods. Last method registers real particle radius on the deflection of the laser beam and subsequent decryption of the diffraction pattern. Thus, in many sources [1,2] draws attention to the sharp decrease (4-6 times) content of the clay fraction and an increase (1.5-2) 10-1mkm number of particles using laser diffraction. Similar results were obtained by other authors [3, 5].

Moreover, the greatest differences are observed in the heavy, containing a high percentage of organic matter soils. At the same time, the total content of fractions >0.01 mm as physical clay fraction may be close, which is very important for classification purposes because it is the content of physical clay used for the separation of soil particle size distribution in the classification Kachynski [2]. This fact leads to an optimistic conclusion that the common classification for the purposes of both methods yield similar results, but for a detailed analysis of the size distribution pofraktsionnogo should be noted that the laser diffractometer gives significantly reduced content in a fraction of the sludge.

The rheological characteristics of the soil. Modern devices can significantly increase the accuracy of measuring rheological parameters and their number. Rheometers are highly sensitive instruments for measuring the interparticle interactions. Applicability rheometer to study the microstructure is shown in a large number of studies.

To study the viscoelastic properties of chernozems, we used the method of amplitude sweep with the measurement system of parallel plateau modular rheometer MCR-302 (Anton-Paar, Austria). We investigated samples of typical chernozem Central Black Soil reserve the Kursk region, selected from the area reserved nekosimoy steppes and long steam. Soil samples were analyzed in a paste state of the soil (after daily capillary wetting). Identified the following rheological parameters: 1) G '- the elastic modulus (storage modulus) as a component of the viscoelastic behavior, 2) G "- the viscous modulus (loss modulus) as a component of the viscoelastic behavior, 3) LVE_range - linear viscoelastic range (the stability limits paste to the soil structure destruction), 4) G '= G "- breaking point structure (point equal moduli of elasticity and viscosity). The modulus of elasticity and the linear viscoelastic range of virgin soil is much higher than those in soils exposed to constant plowing (G 'steppe - 106 Pa and G' couple - 105 Pa at zero deformation range of linear viscoelastic virgin soil extends up to 0.1% deformation, steam is much less - up to 0.02% strain). The destruction of the structure (point equality modules) for the virgin soil deformation occurs at 20% for the soil a long couple - at 8% strain. These data suggest a significant difference in the rheological behavior of the studied soils. Our research confirmed that rheometers are highly sensitive instruments for measuring the interparticle interactions, which certainly puts them in the front ranks of the application in soil science to study the microstructure of the soil. Apparently, it was the rheological characteristics of the devices and may be signaling by research indicating the initial change in the structure of the soil, in the strength of the structural relationships that are difficult to be identified by classical methods, but is very sensitive and accurate register of rheological tests.

Contact (contact) angle (ASC). Many processes occurring in the soil, including the infiltration and preferential flow of runoff depends on the wettability of the solid phase of water, numerically characterized by the contact angle of wetting or contact angle (CA).

The main factor for the formation of hydrophobic-hydrophilic properties of the soil is organic matter (OM) of the soil. When the content of TOC> 2% was a direct linear relationship between sorghum. and contact angle. In the range 0 <Corg. <1% of the extreme variability of the observed value of the contact angle of 0 ° to 90 ° [4].

Determination of ASC we conducted by static sedentary drops on digital protractor (System Analysis drop shape, DSA100, Krüss, Germany) equipped with a video camera and software.

To investigate the influence of metabolites of bacteria on the ASC has been done the following experiment. Kaolinite and montmorillonite were incubated for 2 months at 25 ° C with a pure culture of Bacillus circulans in culturing medium silicate bacteria. When the concentration of water-soluble products of bacterial metabolism reached a constant level, clay minerals were separated by centrifugation, washed several times with distilled water and dried.

Analytical studies showed a significant change in specific surface desorption from 11 to 6 m^2/g for kolinite and 49/29 to14 for montmorrilonite), CA changes from 31 to 54^0 and from 48 to 68^0 of clay minerals after incubation experiment.

Conclusions

Laser diffraction particle size distribution for the study, determination of rheological characteristics and the contact angle of the solid phase surface are new, progresive, intensive but poorly understood methods of studying the properties of soils. On the one hand, they are extremely attractive in its capabilities, but on the other - require a lot of methodological work to establish and identify the boundaries of their applicability, the optimal range, and measurement conditions. And, most importantly, the necessary standardization of the procedures for determining the above properties.

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Transformation of the soil and land resources in Priyeniseyskaya Siberia in the backgound of the global climate change

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Keywords: soils, fertility of soils, climatic trend, agriculture

Soil and land resources are the environmental elements, which are the most involved into human activity, with constantly increasing economic load on them. The most important point is that land resources provide living and activity for the present and future human generations.

According to the Soil Map of Russia, scale 1: 2 500 000 [1], the total area of Krasnoyarsk Krai is 233.97 million ha (13,7% of the territory of Russian Federation). 224.14 million ha (95,8% of the area of the region) are represented by soils. The areas of soils and non-soil units were defined by using the data from scientific monographs and the United State Register of Soil Resources of Russia, which was made in 2013 by the Dokuchaev Soil Institute [2–4].

Non-soil units occupy 9.83 million ha (4.2%), including 5.85 million ha occupied by stone-strewn areas; 0.47, loose deposits; 1.87, glaciers; and 1.64, water.

The soil cover composition is as follows (% of the total area of the Krai): tundra and taiga podburs (17.2), arctic and arctotundra soils (12.8), cryozems, cryopales, cryopeaty and pale solis (10.0), tundra gley soils (7.7), taiga gley soils (6.1), sod-podzols (5.6), brownzems (5.6), sod-calcareous and humus-calcareous soils (5.0), podzols (4.5), alluvial soils (3.4), gray forest soils (3.0), peat boggy soils (2.5), granuzems (2.4), sod-brownzems (2.3), chernozems (about 2.0). On their aggregate, these soils make up more than 90.0% of the region territory and 94.2% of the soil-covered area. The rest soil types (humus-carbonate tundra soils, peat-podzolic-gleyic soils, mountain primitive soils) have percentages varying from 1.0 to 1.6%.

In the soil cover structure, nearly 35% is occupied by mountain soils, and the area of forest soils is 108.86 million ha (48.5%) of the soil cover area.

Krasnoyarsk Krai is one of the largest food producers in eastearn Russia. The region holds the 2nd place in the Siberian Federal District in terms of agricultural production. The fraction of agricultural (agrarian and industrial) complex of the Krai, including agriculture and the agricultural production rework, is 8.9% of gross regional product. Climatic risks continuously threaten the stability of agricultural production volumes and cause the high costs for producers.

According to the integrated quality assessment of agriculturally used soils (carried out in 2013), Krasnoyarsk Krai refers to "the most unfavorable" regions [5]. The soils unsuitable for agrarian production make up 81%. The area of the most fertile and therefore the most productive soils in agriculture - chernozems, seems to be insignificant (about 1.9%) in comparison with the total area. However, the factual area of these soils is about 4.44 million ha; this is the huge area making the Krai one of the leading producers of food and marketable grain in Siberia. The area of the humus-carbonate and gray forest soils, which are also suitable for profitable agricultural activities, occupy the area as large as four times more.

The scheme of planetary climate changes as a result of variations in greenhouse gases concentrations in the atmosphere, first of all those in CO2, is the most reasonable, explaining the climate changes in the best way. The data on modern climate observation and simulation show that the climate in the territory of Russia is more sensitive to global warming, than climates of many other regions of the world. According to Roshydromet (Russian Hydrometeorological Service), warming in the last 100 years (1907–2006) made up 1.29 °C for the entire territory of Russia, at average global warming, according to the Intergovernmental Panel on Climate Change (IPCC) being 0.74 °C [6]. According to the general summary of the IPCC report, ground air temperature in the period of 1976–2006 over the territory of Russia increased by 1.33 °C (fig. 1).

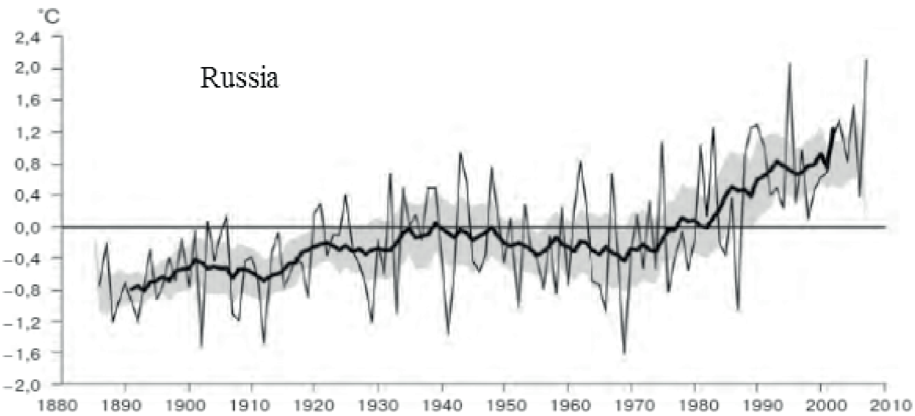

Fig. 1. Variations in average annual air temperature, average over the territory of Russia, in deviations from average values for 1961–1990/ (the thin line denotes temperatures observed at stations; thick line indicates the smoothed variations in air temperature [6])

In the Priyeniseysky (Near-Yenisey) region, gradual increase in average air temperature was noticed, and, in addition, mainly positive anomalies of air temperature were observed in the last 20 years [7]. The linear trend estimated on the time series from 1936 for 2009 yielded +0,18 °C/10 years; for the 30-year interval of 1980–2009, it yielded +0,51 °C/10 years (tab.). It means that the increase in near-surface air temperature during the last three decades is more intensive than during the longer period since 1936 until 2009.

Quantitative estimates of linear trends indicate warming in all areas of the Krai. Distribution of values of linear trend coefficient shows that temperature increases the most intensively in Tuva and in northeast Taimyr Peninsula. The respective values of linear trend coefficients are 0.64 and 0.51 °C/10 years. Air temperature increase in northern regions of Krasnoyarsk Krai and in the west of Evenkia occurs about twice as slow (0.29 °C/10 years) as in the regions mentioned above. For the last 50 years, an increase in the annual rainfall was reported: precipitation grew by more than 30–50 mm/year in the steppe and forest-steppe zones, and also in the zone of mountain taiga dark-coniferous forests and in the middle taiga zone.

The most probable forecast of climate change for the period until 2050 assumes global climate warming by 0.6–0.7 and further by ~1.7 °C, with the accompanying increase in precipitation by 30–50mm/year. On the basis of expert estimates, it is possible to predict the northward shift of natural zones. In the coastal territories, sea level rise is possible (supposedly by 15–20 cm); in its order, this will expand areas of swamped lands and hydromorphic soils. In cryolithozone, degradation of permafrost in the tundra and taiga zones will continue to expand the areas of boggy soils. At the same time, resulting from disappearance of screen effect of permafrost, drying of some soils is possible. During the summer period, water content will decrease within the uppermost one-meter-thick layer of tundra and sod-podzolics soils, whereas in chernozems and gray forest soils water content will remain the same. The area the steppe-altered sites will increase. In southern parts of the region, in the central Minusinsk Depression, and in steppes of Khakassia and Tuva, intensified drying of soils is forecasted.

Table 1

Rates of increase in annual temperatures (a linear trend) for climatic zones of the Priyeniseysky region [7]

Region	Linear trend of 1980-2009	
	Annual temperature increase, ^{0}C/10 years	Trend of contribution to dispersion, %
Central Siberia	0,51	23
Krasnoyarsk Krai	0,50	22
Taimyr	0,51	22
Evenkia	0,34	15
Northern areas	0,29	9
Central areas	0,41	17
Southern areas	0,48	24
Khakassia	0,37	12
Tuva	0,64	34

The climate warming accompanied by increase in summer and winter precipitation, winters getting softer, and vegetation period getting longer (which is favorable to sequential change of phenological phases cultural plants), seems to have favorable effect on development of marketable agriculture of the region, especially in the forest-steppe zone. In flatland taiga areas, at improved climatic parameters, soil conditions will be the limiting factor for agricultural activity. In steppe landscapes, development of irrigating infrastructure will be required.

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The impact of varied fertilisation on the concentration of nickel and chrome in soil and organs of willow trees (*Salix viminalis*)

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Key words: sewage sludge, fertilization, heavy metals, *Salix viminalis*

Introduction

The prime objectives of the Energy Policy of Poland up to the year 2030 also include the protection of forests from excessive exploitation for the purpose of obtaining biomass, a balanced use of agricultural areas for those purposes related to renewable energy sources, in order to avoid creating a negative form of competition between renewable energy and agriculture.
The willow has the capacity for the accumulation of heavy metals as well as nitrogen and phosphorus compounds. The particular use of this plant is related to the fast growth of biomass and the intensive ion exchange between the roots and soil, which is a consequence of it [9]. The main determinants of the yield include water, the soil conditions, the species and variety, as well as the appropriate fertilisation. Willow plantations may be fertilised with mineral fertilisers and sewage sludge [2,3,4,8].
The doses of the sewage sludge to be used for the purpose of fertilisation, depend also on their heavy metal concentration. However, for plant growth it is not the total concentration, but their easily soluble forms [10]. Also, the intensity of the application of sewage sludge – on a one-off basis or gradually - is important. Heavy metals in raw sewage sludge occur in the dissolved form, that is, the form which is more accessible to the plants than after absorption by the soil [2,9]. Heavy metals include both, plant micronutrients and toxic elements[1,5].

Materials and Methods

The object of studies is the mechanical-biological sewage treatment plant in Sulechów which is designed to receive household and industrial sewage from 26500 PT. The dehydrated sewage sludge – after sanitation with lime – was dosed on a one-off basis into the soil before the establishment of the crops.
The sewage sludge was tested on a regular basis at the Laboratory of Water, Sewage and Waste of the Institute of Environment Engineering at the University of Zielona Góra. Pursuant to the Regulation of the Minister of Environment of 13 July 2010 on municipal sewage sludge [7], the analyses of sewage sludge samples confirm their usefulness for agriculture and for the land reclamation.
On the basis of the soil characteristics, according to the programme [6], the doses of sewage sludge have been established at levels of 88 to 94 tons of dry mass/ha. The planting density amounted to 33 400 pieces per 1 ha. The cuttings of the common

osier of Scandinavian varieties, from clones obtained in Marzęcin (Ulv and York varieties), were 40 cm long.
The whole area of cultivation of the willow was divided into three sections: with an addition of sewage sludge, with an addition of mineral fertilisers in the form of potassium salt at a dose of 0.12 t KCl/ha and superphosphate at a dose of 0.08 t P_2O_5/ha and the control section.
The plant samples were collected during the first three years of cultivation. The collection consisted of the careful digging up of the entire plant, cleaning of the root of any deposited soil and dividing of the plant into the root, stem and foliage. The air-dried samples – the stem and the root were treated into the form of chips, and the leaves were ground in to mortar. The analysed index (content of nickel and chrome) was determined by means of the reference method (atomic absorption spectrometry after mineralization in aqua regia).

Results and Discussion

The study concerning the uptake of trace elements by the plants as a consequence of the introduction of sewage sludge into the soils are inconclusive. On the other hand, an effect of fertilisation on the uptake and the content of chrome and nickel in the above-ground parts of the plants is noted [5].
In the biomass of the plants from the non-fertilised (control) plantation, the content of chrome was the highest (Figs. 1-2), and the highest average concentration of this metal was observed in the soil fertilised with sewage sludge (Table 1). The lowest average content of nickel in the soil was obtained in the samples coming from control plantation and the highest average concentration of this metal was observed in the soil fertilised with sewage sludge.

Table 1

Effect of fertilization on the average content of chrome and nickel in the soil.

Combination of fertilisers	Year of cultivation	Form marked in 1 M HCl	
		mg Cr / kg	mg Ni / kg
Control	I	4.5	0.0
	II	2.9	1.5
	III	2.7	3.5
Sewage sludge	I	5.0	3.3
	II	3.9	5.9
	III	4.9	4.5
Mineral fertiliser	I	4.5	0.2
	II	4.9	1.0
	III	2.3	3.5

The tendencies to take up chrome by the plants were related to the used fertilisers. In the biomass of the plants fertilised with mineral fertilisers, a lowest mean content of chrome was observed (by about 45%) in relation to the plants grown with the addition of sewage sludge (Figs 1-2).

The samples of biomass from the non-fertilised plantation were characterised by the lowest content of nickel, that is, higher by about 33% than in the case of the plantation containing mineral fertilisers (Figs 1-2).

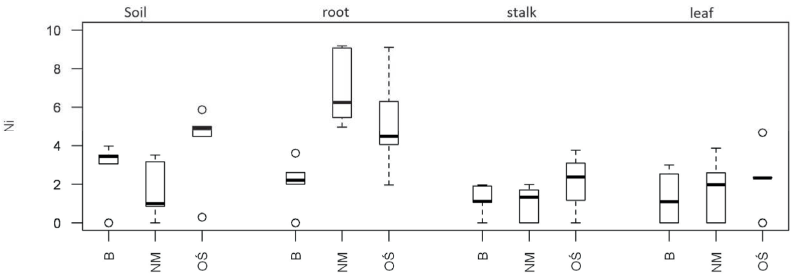

Fig. 1. Box plots of the contents of nickel in soil and biomass samples. B – without fertilization, OS – sewage sludge, NM – mineral fertilization

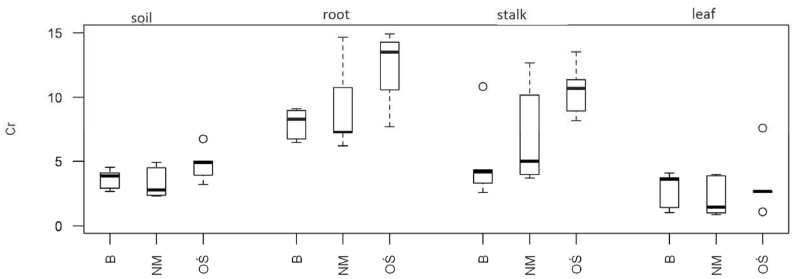

Fig. 2. Box plots of the contents of chrome in soil and biomass samples. B – without fertilization, OS – sewage sludge, NM – mineral fertilization

The results of the statistical analysis (Fig.2) show a significant effect fertilization method on the content of chromium in soil and biomass willow (p.value = 0.0012). The highest concentrations of chromium present in the root of the willow. The results of the statistical analysis show significant differences in the average nickel content (Fig. 1 1), depending on the nature of the sample (p.value = 0.000). With boxed charts show that the largest concentration of nickel is present in the roots. Two-way analysis of variance shows that there is no significant difference in Ni content, depending on the method of fertilization.

Regardless of the plant species, its roots constitute the main barrier that limits the movement of metals to sprouts, leaves and fruit. The content of metals in the plants decreases in the following order:

root > leaves > sprouts > underground organs collecting nutrients > fruit > seeds [1].

The results of the conducted studies (Figs. 1-2) show that during the three years of cultivation – irrespective of the type of fertilisation – the roots of *Salix viminalis* were characterised by the highest content of chrome and nickel, and the smallest amount of these metals was accumulated in the stem and leaves of the willow.

The use of sewage sludge into energy willow plantations as organic recycling recommended for use in the Polish law, does not affect the physico-chemical properties of soils and plants and is an effective way to the final deposit of sewage sludge in the environment.

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Soil formation processes on the dried bed of the Aral Sea

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Introduction

As a result of the Aral Sea shrinkage, the unique freshwater body has given place to a huge bitter-saline lake with an area 3.5 times less, volume 6 times less and water salinity 10 times larger than in 1960, and the saline desert at the interface between three sand deserts with an area of more than 5 million ha.
The exposed ground is illustrative of arid salt-accumulation, where specific type of soil - coastal solonchak - is formed and differs from zonal soil in their specific features. Those features consist of dynamic soil formation processes both in space and time. Exactly these features enable the soil cover on the dried bed of the Aral Sea to pass century-old development cycle over a short time [**1**] [**2**]. The studies of genetic properties of newly formed soil have just started and are expected to be continued in the future. The conducted monitoring of the exposed bed cover and the great amount of field and laboratory data from 9 expeditions undertaken during 2005-2011 will serve as a basis for further research. The speed of processes passing in Aral make us to capture the current state, otherwise we could miss an opportunity of studying such unique process of the formation of desert soil in place of the dried parent material. As is well-known, the classical Dokuchaev’s soil science highlights 5 main soil-formation factors: climate; relief; parent material; vegetation; and, age. In our case, the age factor is very important.

Materials and Methods

In 2005-2011, SIC ICWC organized 9 expeditions to the dried bed of the Aral Sea. The expeditions were undertaken in spring and autumn, the seasons most suitable in terms of weather for prolonged field visits to this region. Each expedition lasted about one month. The first four expeditions were conducted under the Project “Comprehensive remote sensing and ground based studies of the dried Aral Sea bed” with the support of GTZ, Germany. Based on the results of these studies, a book [**3**] was published in 2006. The monitoring of the dried seabed was continued in 2006-2011.
Recent expeditions were held jointly with the Germany Center of Earth Studies, Potsdam within the framework of the CAWA Project “Central Asian Water”. The expeditions were comprehensive, i.e. the group of researchers included environmentalists, soil scientists, hydrologists, and GIS experts.
Soil samples were taken by genetic horizons. The following characteristics were determined in the lab: texture; chemistry of water extract; and, nutrients. The microbiological composition was determined in the soil biology department of the Lomonosov Moscow State University, while intensity of microbiological processes

was analyzed in the Institute of Microbiology at the Uzbek Academy of Sciences. The methods of microbiological studies are described in the section of results.

Results and Discussion

The collected huge material allowed making comprehensive analysis of changes that take place on the dried seabed: environmental situation; natural and artificially planted vegetation; hydrogeological conditions; and soil cover.
This paper gives some results of monitoring regarding trends of soil cover, particularly of its salt composition.
Depending on geomorphological and soil conditions, the dried seabed is clearly divided into an eastern part related to Akpetki island system and a western plain part between Ustyurt plateau and Kokdarya (Muinak part), including specific area between Ustyurt plateau and Ajibai bay.
We believe that coastal solonchaks of the dried Aral Sea bed shall be considered as **intrazonal soils**. However, they have clear local zonality. According to classical soil-formation science, genetic soil types have horizontal zonality and, in mountains, vertical zonality. Zonality is clearly traced in the area under study. Akpetki island system is characterized by a change of soil cover in the direction from drying lakes to upper continental land. For plain part, the change in soil cover is taking place due to drying up and increase of horizontal strip of the dried area. Since the dried area is a former seabed, which had different depths, there is vertical zonality determined by the nature of bottom sediments. The temporal factor of soil-formation is particularly expressive in these conditions.
Probably, it should be considered that soil formation process starts from the moment of the seabed emergence from under water. Since drying-out of the bed was gradual as the sea recessed, there is differing age of process of initial soil formation.
Every year, up to 2 thousand km^2 is exposed as a result of drying process.
Depending on year's water availability, drying is more or less intensive. After the humid year 1999, the drying process covered only 1.2 thousand km^2. Maximal drying was observed in 2001, 2002 – 1.9-2.4 thousand km^2, as a result of drought.
This process is irreversible, and the balance between drying and flooding is always positive. As was noted earlier, a typical short duration of processes and certain regularity of changes in the land cover in time indicate to importance of age as a factor of soil formation in our case.
The initial stage of soil cover formation on all types of the Aral Sea coast is the same. It is related to intensive salinization of grounds emerging from under water as well as to formation of marshy and coastal solonchak. Under the influence of changing hydrogeological conditions and arid climate, the soil is transformed progressively from hydromorphic to automorphic type. In case of light lithological composition, soil development usually ends with the formation of aeolian erosive-accumulative relief. In case of heavy texture, mature desert soils of solonchak type appear, which can further become takyr soils, while shor solonchak is usually developed in closed sinks and lagoons [**1**].
Under these conditions, the soil evolution will follow the same scheme as it takes at present: excessively hydromorphic soils (marsh) → moderate hydromorphic solonchak → semi-hydromorphic solonchak → semi-automorphic solonchak →

automorphic solonchak. Under conditions of Akpetki, where there is no periodical wetting of coastal strip, marsh does not exist.

During the last stages of the soil evolution, solonchak processes caused by hydromorphic conditions fade out, and the influence of arid-zonal factor increases many times, thus making further soil development run as desert type process.

Automorphic and semi-automorphic soils, especially their crust-puffed types, become a source of dust and salt.

With the lapse of time, the soil salt profile changes on the exposed bed. This is one of the main genetic features of solonchak types on the dried seabed.

Microbiological soil analysis[4]

The origination of life in the soil of the dried bed starts long before the occurrence of external characteristics. This process can be traced only by studying the microbiological composition of soil. This way, it is possible to answer a question when, after drying up of the sea, the bottom sediments are transformed into the soil and when one can consider the bottom cover as the soil?

One can also assess contribution of artificial plantations or self-growing to soil formation. Research in this direction, was conducted in order to determine the microbiological composition of soil for horizons of one typical profile of solonchak.

Given work used the traditional **plating method** of inoculation of medium.

As a result of plating, bacteria genuses were identified and approximate percentage in each medium was estimated.

One of the most advanced methods for identifying, studying and quantifying microorganisms in their natural habitat is the luminescence microscopy in incident light.

As the main method for preliminary processing of samples for the microbiological analysis, an ultrasonic dispersion using low-frequency disperser UZDN-1 was applied (22 kHz, 0.44 A, 2 min).

The total quantity of microorganisms was estimated through the luminescence microscopy.

The following conclusions may be made from this work:

1) Actinomycetes are not developed in given soil layers and horizons.
2) Maximum quantity and biomass of bacteria was observed in layer 1 (0-1cm), layer 4 (37-44cm) and layer 5 (44-61cm).
3) Maximum quantity and biomass of fungus mycelium is observed in the two upper layers: 1-(0-1); 2-(1-12cm).
4) Fungi mycelium is developed only in the two upper layers.
5) Population of fungi spores is the same in all the soil layers and amounts to $2*10^6$ M kl/g of the soil.

These results can be considered as unique. They characterize the soil bacterial community of the dried bed of the Aral Sea. In order to improve methodology, one may apply molecular-genetic research methods in order to identify and refine DNA of

[4] The microbiological analysis was made at the soil biology department of the Lomonosov Moscow State University and at the Institute of Microbiology at the Uzbek Academy of Sciences.

certain genus of bacteria, make sequencing, and by getting a sequence of nucleotides with probability of 99%, we can evaluate accuracy of the plating method.

New methods can be developed through given research in order to assess diversity of microorganisms in the soil, which contribute to occurrence of life on the dried bed of the Aral Sea. Perhaps, it is advisable to assess bacterial diversity per each soil horizon. And it is important to choose media more thoroughly for identifying bacterial genuses.

The received results show that solonchak of the dried seabed is mainly comprised of the following microorganisms: 56% of Pseudomonas, which is responsible for mineralization of easily accessible organic compounds; and, 24% of Bacillus, which keeps further process of deeper mineralization of organic matters.

Final stages of mineralization are maintained by oligotrophic plants that can exist on poor organic medium.

We have studied quantity of major taxonomic and ecological-trophic groups of soil microorganisms on the Aral Sea bed that take part in the cycle of nitrogen, phosphorus and other macro- and microelements - ammonifiers; nitrifiers of 1st and 2nd phase; nitrogen fixers; denitrifiers; oligo-nitrophils; phosphorus mobilizing, cellulose-fermenting aerobes and anaerobes; micromycetes (microscopic fungi) and actinomycetes. Soil sections were cut along the line from the sea to mainland.

Fig. 1 shows the composition of microorganisms in the upper soil layer located in the place of 20-year drying process.

In the soil sample of the profile 810 (0-5 cm) no beneficial groups of soil microorganisms were found, except for cellulose-fermenting aerobes (10^8 ufc/g of soil), anaerobes (10^6 ufc/g of soil), and actinomycetes (10^3 ufc/g of soil) (Fig.1).

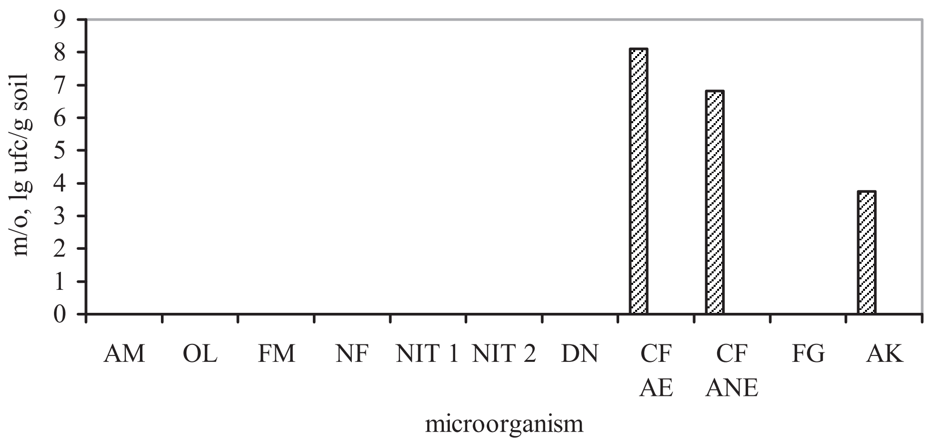

Fig. 1. Population of microbal community in soil samples № 810 (AM- ammonifiers, OL-oligo-nitrophils, FM- phosphorus mobilizing, NT-nitrifiers, DN-denitrifiers, CF AE- cellulose-fermenting aerobes, CF ANE- cellulose-fermenting anaerobes,FG-Fungi, AK- actinomycetes)

Denitrifiers were found in the sample of soil profile 815 (0-20 cm) cut on the dried seabed near the original coast. This indicates to losses of nitrogen from the soil. Presence of fungi and actinomycetes is illustrative of destruction processes regarding complex polymer compounds in the soil.

Decomposition of nitrogen-bearing organic matters took place (Fig.2) in all samples from the profile № 815. This is evidenced by presence of ammonifiers and cellulose-fermenting microorganisms.

One can conclude from the obtained results that the decomposition processes driven by cellulose-fermenting bacteria take place in all samples, irrespective of sampling location. Presence of ammonifiers in the samples implies nitrogen and phosphorus cycling, i.e. the initial process of fertility formation.

In order to study full composition of microorganisms, it is planned to repeat sampling in the section line from the sea, approaching maximally the water's edge. The results of this will be analyzed in context of duration of the drying process and the degree of self-overgrowing.

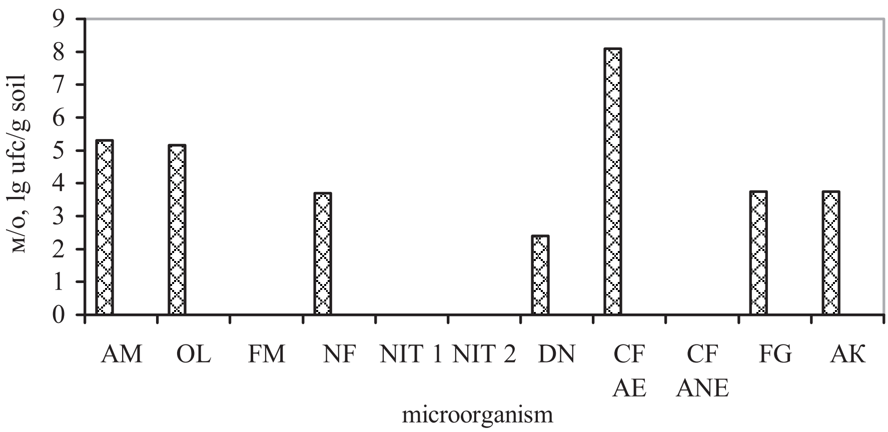

Fig. 2. Population of microbal community in soil samples of the section 815 (AM-ammonifiers, OL-oligo-nitrophils, FM- phosphorus mobilizing, NT- nitrifiers, DN-denitrifiers, CF AE- cellulose-fermenting aerobes, CF ANE- cellulose-fermenting anaerobes,FG-Fungi, AK- actinomycetes)

Conclusion

The research showed that unique processes that are of great scientific interest take place on the dried bed of the Aral Sea. These processes develop long before their visual display. The need to study these processes is evident. Regular monitoring of the environmental situation in Prearalie is important since this area is a risk zone for health of the people. At the same time, studying such properties of the dried seabed cover as salt composition and microbiological composition allows tracing formation of initial soil on sea sediments followed by desert-type soil formation. The research of soil cover development will help to understand the kernel of desertification process as a whole.

Benzo[a]pyrene content in soil-plant system of technogenic territories: analysis and estimation

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Keywords: benzo[a]pyrene, soil-plant system, model experiment, subcritical water extraction method

Introduction

Polycyclic aromatic hydrocarbons (PAHs), including benzo[a]pyrene (BaP), are priority pollutants of environment, carcirogenic and mutagenic compounds (Wenzl et al., 2006). Their presence in soils, plants and water is connected with the increased level of the technological pressure. PAHs accumulation on a soil surface in the form of the polluting substances first of all are involved in processes of distribution in the soil-plant system and migrations on a soil profile. Ability of certain of PAHs to accumulation in plants and migration in the soil depends mainly on sorption properties of a soil matrix, and also on physical and chemical properties of PAHs molecules (first of all, the water solubilities) and abilities to transition to soil solution (Tsibardt and Gennadiyev, 2013). The main reper compound of PAHs pollution of environmental objects is BaP possess high carcinogenicity and a mutagenicity. Its background contents in plants and the majority of mineral soils fluctuates within 0,1-5 mkg/kg whereas for some chernozems and peaty soils are characterized by more high level of BAP - 15–20 mkg/kg. That is caused by the increasing contents of highly condensed organic substances and specific structure of soil microflora. The complex of interaction of soils and plants is important object for control of BaP environmental pollution (Yakovleva et. al., 2012).

Materials and Methods

Sampling of soil (carbonate heavy loamy chernozem, virgin, the 0-5 cm topsoil) was carried out in the Persianovskaya steppe of the Rostov region (South of Russian Federation) located far from possible contamination sources. This soil revealed the following physical and chemical properties: organic carbon ($C_{org)}$ = 3.4%; pH =7.3; cation exchange capacity (CEC) = 37.1 mmol(+)/100g; $CaCO_3$ =0.1%; the content of physical clay =53.1% and clay =32.4%.
The new method of PAHs subcritical water extraction based on use of properties of subcritical water was used for extraction of PAHs from soil and plant samples (Sushkova et al, 2014). As a plant sample for developing the method of subcritical

water extraction was used the whole plants of the barley which were grown up in the control background soil in the conditions described below.

Conditions of carrying out vegetative experiment. Researches were conducted in the conditions of vegetative experiment which was put on May 15, 2011. The 2 kg soil was sifted through a sieve with a 1 mm diameter and placed on vegetative vessels with a capacity of 4 l. BaP solution in an acetonitrile was flowed on a surface of the soil at the rate of concentration 20, 200, 400 and 800 mkg/kg (1, 10, 20 and 40 maximum permissible concentration respectively). The initial soil was used as a control, and also the soil with a pure acetonitrile was used as a background. The frequency of experience were triple.

The soil in vessels were incubated in the conditions close to natural, on an experimental platform of Southern Federal University, within 26 months. The watering was made with the distilled water as required for maintenance of optimum humidity. Through 1 and 2 years after the beginning of incubation vessels were sowed with test culture. As test culture was used spring barley (Hordeum sativum distichum) "Odesskii-100". Before barley crops (i.e. in 13 and 24 months) the soil in vessels was mixed and selected an average sample on the analysis. In initial samples of the soil the maintenance of BaP and other PAHs were measured. In the incubated soil in the specified terms were determined the maintenance of BaP by the HPLC method with preliminary sample preparation of soil by subcritical water extraction method. The barley plants sampled from vessels, cleared of soil particles, dried up, weighed, pounded, sifted through a sieve 1 mm diameter and used average test on the BaP analysis. The maintenance of BaP in plant samples were determined by subcritical water extraction method.

On the basis of the received results the constants of speed of BaP decomposition in the soil (To,-1) were measured on the equation of K =-Ln (Ct/Ciskh)/t, where Chisk - inintial BaP concentration in soil and Ct-concentration of BaP in the soil in a timepoint of t (g). The period of semi-decomposition of BaP in the soil was counted on a formula T50=0,693/K. Besides, coefficients of BaP bioaccumulation in barley plants were counted on a formula Kp=Cp/Cs, where Cp and Cs – concentration of BaP in plants and in the soil before landing of plants, respectively. On the basis of the received results there were established the coefficients of correlation and coefficients of the equation of linear dependence of K, T50 and Kr of initial BaP concentration in the chernozem soil by using of the Sigma-Plot software. Statistical processing of results were carried out by Microsoft Excel software.

Results and Discussion

Studying of degradation and redistribution of BaP in the soil-plant system in the conditions of vegetative experiment

The background maintenance of priority PAHs in the initial soil are the following: biphenyl – 1,95; Anthracene – 1,79; fluoranthene – 34,9; acenaphthylene – 10,9, pyrene 40,2 and BAP – 24,3 mkg/kg. For BaP background level in the soil of the studied soils is nearly its maximum permissible concentration (20 mkg/kg).

Results of definition of the BaP quantitative maintenance in plants of barley and soils of model experiment, and also extent of its degradation in the soil through 1 and 2

years are given in tab. 1. In initially polluted soils there was found from 84% (at 1 maximum concentration limit) to 99% (at 10 maximum concentration limits) from the added concentration of BaP. After 1 year of incubation the concentration of BaP in the soil decreased by 8-33%, and for the 2nd year incubation it decreased for 5-16% or totally for 15-38% - for 2 years. The extent of BaP destruction was increased in proportion to increase in its initial concentration in the soil from 1 to 40 maximum permissible concentration. Adding of one solvent (control with an acetonitrile) in background variant only slightly influenced on the initial maintenance of a pollutant in the soil and extent of BaP transformation. The influence of solvent on the BaP maintenance in plants was doubtful.
At the end of the 1st and 2nd years the concentration of BaP in plants of barley were 6-62 and 1-18 mkg/kg, respectively. The concentration of BaP in plants are also increase in proportion of BaP content increasing in soil (tab. 1). The dry mass of plants of the barley from vegetative vessels fluctuates within 4-8 g that means that carrying out of BaP from the soil by plants didn't exceed a percent share, and this factor couldn't affect the speed of decrease in BaP concentration significantly. From this it follows that decrease in concentration of a BaP in the soil is caused by mainly microbic decomposition of a pollutant.

Table 1

BaP concentration in soil and spring barley initial soil and after 13 and 24 months after vegetation experiments starting date and degree of decomposition of BaP

Variant	Soil					Spring barley	
	BaP concentration, mkg/kg			Degree of decomposition, %		BaP concentration, mkg/kg	
	Initial	13,8 мес.	24,4 мес.	13,8 мес.	24,4 мес.	13,8 мес.	24,4 мес.
control	24,3 (2,7)	21,8 (3,2)	20,5 (3,1)	10,3 (13,2)	15,6 (12,8)	6,5 (0,4)	1,4 (0,5)
background	27,6 (3,1)	25,4(3,3)	23,6 (2,9)	8,0 (12,0)	14,5 (10,5)	5,8 (0,7)	1,2 (0,4)
1 MPC	37,4 (4,3)	31,6(2,8)	27,1 (4,3)	15,5 (7,5)	27,5 (11,5)	15,6 (1,2)	2,9 (0,8)
10 MPC	221,7 (12,8)	159,1 (6,7)	127,7 (5,7)	28,2 (3,0)	42,4 (2,6)	25,4 (2,1)	3,5 (1,5)
20 MPC	406,0 (26,4)	320,9 (16,7)	255,6 (17,5)	21,0 (4,1)	37,0 (38,4)	62,4 (3,8)	12,9 (1,7)
40 MPC	743,4 (31,2)	497,3 (15,1)	458,0 (22,4)	33,1 (2,0)	38,4 (3,0)	61,5 (5,4)	18,3 (2,2)

Mathematical modelling shows that dynamics in BaP concentration decrease in soil is well described by the exponential equation, and decomposition speed constants in the soil in each option remain approximately identical within 2 years of supervision. However with increase in initial level of pollution the constant of BaP decomposition speed in proportion increase ranging from 0,07 to 0,29 g-1, and the semi-decomposition period respectively decreases from 9,3 to 2,4 years in proportion to increase in initial BaP concentration in the soil (table 2). Other major ecological indicator is the coefficient of BaP bioaccumulation in plants - Kr which in 1st and 2nd years varies within 0,12-0,49 and 0,03-0,11, respectively (table 2).

Table 2

Indicators of BaP decomposition in the soil during 2 years of experiment, and coefficients of BaP bioaccumulation in plants

Variant	Average indicators of BaP decomposition in the soil		Coefficients of BaP bioaccumulation in plants	
	Constant of BaP decomposition (K), year^{-1}	T_{50}, years	13 month	24 month
control	0,089 (0,005)	7,8	0,30 (0,01)	0,07 (0,01)
background	0,074 (0,002)	9,3	0,23 (0,01)	0,05 (0,01)
1 MPC	0,152 (0,006)	4,6	0,49 (0,01)	0,11 (0,01)
10 MPC	0,279 (0,009)	2,5	0,16 (0,03)	0,03 (0,00)
20 MPC	0,215 (0,011)	3,2	0,19 (0,02)	0,05 (0,01)
40 MPC	0,293 (0,056)	2,4	0,12 (0,01)	0,04 (0,00)
Average	0,07-0,29 year^{-1}	2,4-9,3 year	0,12-0,49	0,03-0,11

Conclusions

Thus, for the first time the features of accumulation, migration and transformation of BaP in the soil-plant system were studied in the conditions of vegetative experiment with the chernozem ordinary carbonate. It is established that sizes of BaP accumulation in soils and plants, as well as indicators of BaP decomposition in the soil increased in proportion to increase in BaP initial concentration in the soil equal from 1 to 40 maximum concentration limits.

Acknowledgements

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The main rheological characteristics of the soil and its changes in the process of soil constructions functioning in conditions of the city

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Key words: soil constructions, physical properties and regimes of soil, urban greening, rheological characteristics

Introduction

More and more number of people nowadays lives in conditions of the city with the high degree of loads on the territory. Greening is one of the main ways of improvement of peoples life quality in the citys conditions. In view of this there is a need to create konstruktozem. But before we come to the problem of rapid soil degradation of such soil constructions, in particular by means of the transformation of physical properties of soils. The aim of this work was investigating of main physical properties of soil constructions and their changes in the process of functioning.

Materials and Methods

Complex of experimental model soil constructions with different structure was created on the territory of Lomonosov Moscow State University in 2012 year. There were formed 3 variants of experimental sites with follow profiles structure: 1) horizon Aarable 0-30 cm (ground constructions); 2) Aarable (0-6cm) - lowland peat (6-12cm) – sand (12-18 cm) – Aarable (18-30 cm) (layered constructions); 3) construction mixed from 3 components (Aarable, peat, sand, mixed in the same proportions as in the layered construction) (mixed constructions). The same external conditions were maintained at all sites: they were planted a lawn grass mixture (0.05 g seeds/cm^2): Festuca rubra and Lolium perenne.
The following definition of soil properties were done: the density of the solid phase by bottle method; particle size distribution by laser diffraction on the device Analysette 22; the content of carbon by coulometric titration on the analyzer AN-7529; specific surface area by low-temperature nitrogen adsorption analyzer series SORBTOMETR–M; determination of rheological properties (viscosity in the viscometer "RHEOTEST 2").

Results and Discussion

Regular increase in the density of the solid phase (ρ_s) of all samples after 3-year-old functioning compared to initial samples was identified as a result of studying the dynamics properties of soils solid phase. It happened on the background of decreasing the content of organic substance (Corg). The transformation of the granulometric composition in the process of their functioning was studied. It showed us, that all the

samples were enriched by fine fractions. This is especially noticeable in horizons of mixture and sandy layer, which are located under the layers of peat and Aarable.
Rheological properties were most sensitive to transformation. The main rheological curve (MRC) was defined on reotest in highly concentrated suspensions (HCS) of soil moisture samples at daily capillary saturation. Main rheological curves of the initial samples and samples after 2-year functioning present on Fig. 1. The shape of MRC of horizon Aarable has the form characteristic of the liquid bodies, and of peat and sand - more solid. The feature mix was the fact that the shape curves of its forward stroke, i.e. with increasing shear rate, similar to the curves of peat and sand for a forward stroke. Reverse stroke of mixture during decreasing shear rate curves is similar to curves of horizon Aarable for reverse stroke. MRC graphics of soil samples are the most interesting for consideration. Samples were taken after 2 years of beginning of soil constructions functioning.

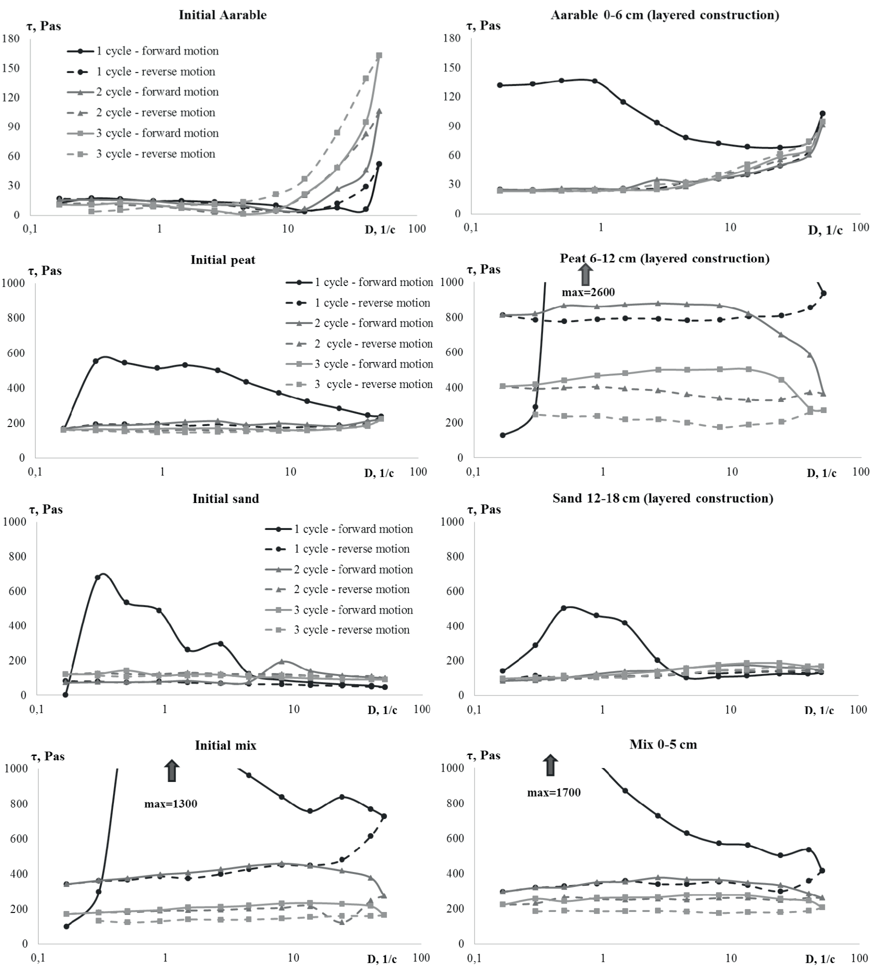

Fig. 1. Main rheological curve of soil samples: a) horizon Aarable; b) peat; c) sand; d) mix

There are noticable changes in the shape and location of the rheological curves, especially in the surface horizons, after 2 years of functioning in the composition of soil constructions (fig.1).
There was an increase in viscosity of the suspension of the horizon Aarable of 1st variant compared to the initial sample. In which connection greater than the depth of the specimen, the sooner it begins to flow, the hysteresis curves in forward and reverse cycles appears earlier. The largest transformation from all variants of location of Aarable horizon was in the composition of the layered construction. Shear strength was increased in 10 times in this samples compared with the initial sample of Aarable. There were also changes in rheological properties in the layer of peat on the depth 6-12cm. Shear strength of peat increased after 2-year functioning from 600 Pas to 2600 Pas, also viscosity increased in several times, but shapes of curves were the same.
Rheological properties of sandy layer, located on the depth 12-18cm, changed less of all. The values of shear strength was almost unchanged, but the shape of the MRC was more gentle. MRC of initial samples and samples, taken in 2013, have very similar shapes in the mixed construction. Thus, the rheological properties were very sensitive to changes in the characteristics of the solid phase: changes the density of the solid phase of soils, carbon content.

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Methods of increasing productivity and environmental sustainability of cotton on irrigated light gray soils of the South Kazakhstan region

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Key words: humic drug adaptogen, harvest

Introduction

In 2012, the planted area with cotton in the South Kazakhstan region amounted to 147.800 hectares, including 95.800 hectares in the Maktaaral district/area. Cotton yield in the region was 17.9 kg/ha in 2010, in 2011 - 21.8 c/ha, in 2012 - 26.2 c/ha. Gross harvest of raw cotton was 2389.8 thousand tons in 2010, in 2011 - 336.0 and in 2012 is 379.7 thousand tons. Due to the diversification of the production area of cotton decreased from 223.7 to 147.8 thousand hectares with comparing in 2004. Nowadays, many scientists have a task is to obtain a high yield under different soil salinity.

Aggravation of environmental conditions in Kazakhstan requires a restructuring of agricultural production on a more rational use of agro products based on environmental laws. Therefore, in order to increase productivity and quality of agricultural products is of great importance as the use of new types of fertilizers and growth promoters.

One of the perspective directions is the development and application of agricultural technologies in agriculture to increase a bioenergy of seeds and plants in ontogenesis based on a fundamentally new bio-energy products-adaptogens [1].

The drug-adaptogen began testing in 2012 on the irrigated sierozems (gray soils) in the South Kazakhstan and have been obtained positive results with increasing harvest of 0.8 ± 1.2 cwt/ha, which allows for further research. The drug is used for treatment of seeds and plant spraying.

Materials and Methods

The study object is light serozems (gray soils) in Maktaaral district of South Kazakhstan region. The parent rock is loess loam. The soil texture of the light serozems is loamy. Culture is cotton, variety is Maktaaral - 4007. The scheme of the experiment is following: 1) Control, 2) Drug PA-2, 3) $N_{75}P_{40}K_{30}$ + PA-2, 4) $N_{150}P_{80}K_{60}$ + PA-2.

The drug-adaptogen PA-2 was used in spraying on cotton during in germination and budding phase by physiologically active aqueous solution of the following composition: Nitro- ammonium phosphate 20-26 kg, PA-2 - 400g water - 1000 liters. Consumption rate of 300 l/ha. The spraying on cotton was held in the evening [2].

Results and Discussion

Due to the climatic conditions, cotton sowing was carried out on a light gray soil with medium salinity in May 12, 2013; and was 12 days later compared with 2012. Also for laying experience the soil samples were selected from different regions to determine the source of humus content, total and mobile food elements. Initial average content of total humus (**Table 1**) on the study sites ranged from 0.73 % (2012) and 0.62 % (2013). Nitrogen is one of the main constituents of the organic substance; its average content is 0.063 %. Another important indicator of soil fertility are gross forms of phosphorus and potassium with average content ranged from 0.12 to 2.05 %. Hydrolysable nitrogen content in the plow layer of light gray soils in average from 32.5-30.8 mg/kg, due to graduation it refers to very low. The mobile forms of phosphorus ranged from 48.2 to 34.0 mg/kg.

Table 1

Chemical composition of light serozem (gray soils) before laying experience

Soil layer, cm	Humus, %		Bulk forms, %			Mobile forms, мг/кг						CO_2, %		pH	
			N	P	K	Hydrolysable N		P_2O_5		K_2O					
	2012	2013				2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
0-20	0.73	0.62	0.063	0.12	2.05	32.5	30.8	48.2	34.0	540.0	375.0	8.15	6.82	8.33	8.40
20-40	0.55	0.50	0.062	0.10	1.95	29.1	28.3	43.8	30.8	528.0	320.0	7.88	6.70	8.35	8.35
40-60	0.41	0.43	0.062	0.11	2.00	28.0	27.0	30.6	28.6	510.0	288.0	8.01	6.58	8.28	8.34

Due to graduation of light gray soils with exchangeable potassium relates to increased form from 540 to 375 mg/kg. The soils are calcareous, alkaline pH is 8.35-8.40.

The aqueous extract is one of methods widely used in soil studies. The method mimics the material composition of the soil solution to some extent and hence using the aqueous extract can reveal an idea about the content and composition of the most moving parts of the soil. Substances obtained from aqueous extract as rules are able to migrate which may have a direct impact on plant growth and development [3]. According to our data, the type of salinization of irrigated light gray soils is chloride-sulphate. Soil washing significantly reduced the content of the most harmful soluble salts - chlorides in the soil. Salinity degree of the soil before planting cotton is average, with a total salt content of 0.6 %. The sprouts of cotton do not affect sulphate content from 0.298 to 0.318 in the root zone. This indicates that salts are often a source of saline irrigation water. For instance if the harvest of cotton in the control variant is 16.8 cwt/ha, in the last variants was much higher (**table 2**).

Use of the humic preparation -adaptogen PA-2 increased the harvest up to 17.7 cwt/ha providing an increase of 0.9 cwt/ha which is 5.35 %. Use of the humic preparation adaptogen with half dose of fertilizers increases the harvest of raw cotton to 3.25

cwt/ha (19.3 %). Application of recommended dose of fertilizers and humic preparation -adaptogen raises an additional harvest of 3.4 cwt/ha (20.2 %).

Assessment of fiber quality according to the new international system adopted by many countries since 2009 outputs a high level of production. According to the new State Standard 52224-2008 is "Cotton. Technical conditions " [4] by a rate of maturity (2.0-2.1) and norms of cotton fiber (32.5-32.9) the Maktaaral grade refers to the first type.

Due to the world cotton market the fiber with micronaire of 3.5 to 4.9 is basic requirement of cotton. All these data show that cotton fiber quality indicators related to first type and is included in the base, in that micronaire is between 4.3-4.4.

Table 2

Harvest of raw cotton (2012-2013)

Variants/version of experience	Harvest of raw cotton, cwt/ha			Harvest increase 2012		Harvest increase 2013	
	2012	2013	mean	cwt/ha	%	cwt/ha	%
Control	16.6	17.0	16.8	-	-	-	-
Humic preparation-adaptogen	17.4	18.0	17.7	0.8	4.8	1.0	5.9
$N_{75}P_{40}K_{30}$+ Humic preparation -adaptogen	20.1	20.0	20.05	3.5	21.0	3.0	17.6
$N_{150}P_{80}K_{60}$+ Humic preparation -adaptogen	20.0	20.4	20.2	3.4	20.5	3.4	20.0
$HCP_{0.05}$=2.85 P=2.0		$HCP_{0.05}$=2.57 P=2.2					

Efficacy of all types and forms of fertilizer depends on obtaining reliable harvest increase of crops and material costs required for their application. During calculating the comparative effectiveness of fertilizer application was used the regional market price of 1 kg of raw cotton is 80 tenge. Costs for the use of mineral fertilizers include the cost of fertilizers and their usage. The economic efficiency of humic preparation -adaptogen and mineral fertilizers for cotton. According to the estimates the income of additional raw cotton harvest with using the humic preparation -adaptogen PA-2 was 5.0 thousand tenge. Joint use of the humic preparation -adaptogen with half dose of fertilizers increases the income up 6.9 thousand tenge. Bringing a full dose of fertilizers and use of the humic preparation -adaptogen was not economically efficient.

Conclusions

Irrigated light serozems (gray soils) in Maktaaral district of South Kazakhstan region belong to secondary (anthropogenic) saline soils. Baseline characteristics of the mobile forms of nutrients before laying the content of nitrogen was 31.6 mg/kg, phosphorus was 41.1 mg/kg. Exchangeable potassium content in all versions is high.

Seed treatment, spraying of cotton plants in the phase of budding and sprouting by humic preparation- adaptogen PA- 2 increases the resistance of cotton to extreme environmental conditions such as soil salinization, and improves the growth and development of cotton as well as increases the harvest of raw cotton to 0.9 cwt/ha (5.35 %) . Use of the humic preparation- adaptogen with half dose of fertilizers increases the harvest of raw cotton to 3.25 cwt/ha (19.3 %). Application of recommended dose of fertilizers and humic preparation- adaptogen gives extra harvest of 3.4 cwt/ha (20.2 %). Use of the humic preparation- adaptogen PA -2 provides income equal to 5.0 thousand and improves the quality of raw cotton.

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Boron Toxicity of Kiwifruit Plants

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Key words: kiwifruit, nutrition, toxicity, boron, calcium,

Introduction

The Blacksea and the Marmara Regions have pioneered during the last twenty years to kiwifruit production of Turkey. In the last twenty years, kiwifruit cultivation has been developing a lot in my country due to high yield and income. But the practices of growing are still not good enough for best production results. Fertilization experiment of kiwifruit has begun since spring 1999 in Turkey and farmer generally apply heavy organic and low mineral fertilizations.

Boron is an essential trace element required for optimal growth and development of higher plants. Therefore, boron fertilization may increase yield, particularly when plants are grown on sandy soil with a low content in available boron. Over liming can also induce boron deficiency by reducing the solubility of boron compounds in the soil. Kiwifruit has been known to be very sensitive to excess boron. As with other boron sensitive plants, the margin between boron sufficiency and toxicity is very narrow for kiwifruit. It was reported that nutritional disorders of kiwifruit are common among vines grown in New Zealand. Such disorders have resulted inconsiderable losses of fruit production and in some cases affected the storage quality of the fruit (Smith et al. 1987a, b; Smith and Clark 1989). While potassium deficiency is by far the most wide-spread of these disorder (Smith et al. 1987c) extensive surveys of the major growing regions of New Zealand and Greece have shown an unexpectedly large number of vines affected by excess boron due to the high B concentration in the irrigation water (Sotiropoulos et al. 1999, 2003). The purpose of this study was to determine the effects of foliar calcium application on kiwifruit yield and some nutrient contents of leaves.

Materials and Methods

The study was carried out on Hayward kiwifruit cultivar in northeast Turkey at Ordu, during 2007-2008 growing season. The vines used in this study were five years old and were trained on a T-bar structure and planted 4x4 m growing conditions. The vines had 10-13 bud load on 20-30 canes in 2007 and had the same bud number on 29-34 canes in 2008. In this research has randomized complete block design with four replications.

Potassium and nitrogen were applied to the soil mid May and June at the amount of 750 g K_2SO_4 (%50) and 500gr CAN (%26) per vines. A large quantity of boron (200-370 gr per vines) was accidentally applied to 33 vines after fruit set in mid July 2007. Ten days after boron had been applied, boron toxicity symptoms observed in kiwifruit leaves and then 1.5kg lime applied to the soil immediately. Trial was planned to after leaf B analysis according to the severity of toxicity. For this purpose five doses of Ca (Calcium nitrate) at the amount of 0.5-1.0-1.5-2.0-2.5 percent of foliar application was made for two times in every year. Lime and nitrogen were applied to the soil mid February and April at the amount of 1.5 kg lime and 400gr CAN (%26) per vines in 2008.

Leaf samples were taken from the third and fourth leaf, consist of the youngest fully expanded leaves, past the final cluster on a fruiting. Calcium and Zn content were analysed using AAS and boron was determined using the azomethine-H reagent method, spectrophotometrically.

Some characteristic of the soil were as follows: clay in texture, organic matter 2.83 %, lime trace, pH 5.62, total nitrogen 0.163 %, available P 7.81 $mgkg^{-1}$, exchangable K 0.758 cmol kg^{-1} and available B 1.71 µg gr^{-1}. Variance analysis of obtained data was performed using MSTAT-C statistical program and diferences between averages were determined with LSD multiple test.

Results and Discussion

Results indicated that increasing foliar Ca applications had significant effect on the yield and mean fruit weight except first yield (Fig 1). Yield and mean fruit weight of kiwifruit plants was severely reduced by excess boron application in every year. But the effects of boron toxicity were not alleviated by liming and foliar Ca application. Yields were reduced from 40.5-24.1 kg $vine^{-1}$ on unaffected plants to less than 16.6-0 kg $vines^{-1}$ on severely affected plants. Total fruit yield was of 991.0, 284.6 and 1827.0 kg thirty three kiwifruit wines in 2007, 2008, 2009 respectively. Kiwifruit has been known to be very sensitive to excess boron. Smith and Clarck (1987a) reported that excess boron was associated with large reduction in total weight of fruit and in addition to this effect on yield resulted from a reduction in fruit numbers. Sotiropolus et al (1999, 2003) have concluded that kiwifruit orchards of northhern Greece indicated that the existence of B toxicity, which resulted in a dramatic reduction of fruit yield.

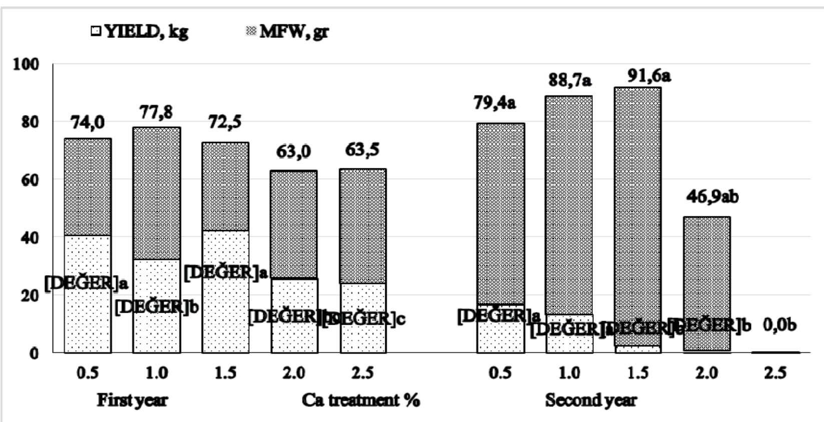

Fig 1. Fruit yied and mean fruit weight in different Ca treatment.

Symptoms of excess boron were clearly visible on the vines 10 days after the applications of boron fertilization to the soil. Leaf boron concentrations increased with the soil boron applications in every year and every sampling period, but B concentration in leaves was higher first year than second year (Table 1). The results also show that increasing foliar calcium applications had no consistent effect on the boron concentrations in the leaves. In 2008, leaf B concentration was reduced especially second sampling period. According to Smith et al. (1987), typically the concentration of B in the leaves of the high-producing kiwifruit vines in New Zealand from 40 to 50 µg g^{-1} dry weight. Leaf boron concentration was found out between 42.8 and 71.0 µg/gr in this orchard by Tarakçıoğlu (2006) in the same orchard. Sotiropoulos et al. (1999) stated that boron toxicity were alleviated by 12 mMof Ca in soilless cultur. Smith and Clarck (1989) have reported yield reductions exceeding 10 % were associated with boron concentrations greater than 80 µg gr^{-1} in leaves.

Table 1

Boron, calcium and zinc concentration in kiwifruit leaves receiving different calcium application.

		Calcium application,%					Statistical Analysis /
	Year/period	0.5	1.0	1.5	2.0	2.5	LSD (5%)
B concent, µg B g^{-1}DM	2007/1	291.7 e	521.4 d	588.3 c	783.6 b	1013.4 a	**41.58
	2007/2	341.3 d	586.7 c	704.9 b	1032.3 a	1111.3 a	**93.16
	2008/1	351.2 c	573.9 b	641.7 b	966.9 a	976.2 a	**102.2
	2008/2	179.5 d	191.2 cd	208.8 c	236.9 b	287.2 a	**19.57
Ca content, %	2007/1	2.12	2.27	2.68	2.39	2.30	ns
	2007/2	2.13 b	2.47 ab	2.49 ab	2.77 a	2.67 a	*0.41
	2008/1	2.53	2.63	2.53	2.76	2.78	ns
	2008/2	2.77	3.04	2.84	2.87	3.02	ns
Zn content µgZn g^{-1} DM	2007/1	29.95	29.55	29.45	31.35	35.90	ns
	2007/2	23.85	24.00	24.45	25.40	32.85	ns
	2008/1	27.35	26.35	27.20	29.05	35.40	ns
	2008/2	22.90	23.50	19.05	23.10	21.20	ns

Means within rows with the same letter are not significantly different at $P \leq 0.05$.

There was a general increased in the concentration of calcium in the leaves with increasing quantities of calcium applied to the plants. While leaf boron concentration was reduced second year, leaf calcium concentration was increased. These results were supported by Sotirpolus (1999). Smith et al. (1987b) indicated that the concentration of Ca and boron in the leaves declined initially after leaf emergence but then increased for the remainder of the season. The Ca contents were compared with

the recommended sufficient values (2.5-3.0 %) and leaf Ca contents were adequate on second year but inadequate on first year.
Zinc concentration in leaves were not affected significantly by foliar application of calcium. The Zn contents were compared with the recommended sufficient values (22-55 μg g^{-1}) and leaf Zn contents were adequate on second year but inadequate on first year. Zinc content of kiwi fruit leaf was usually determined to be sufficient levels by Tarakçıoğlu et al. (2007) in Ordu. Smith et al. (1987b) observed that the high concentration of Zn in the leaves at leaf emergence declined rapidly during the following 12 weeks to reach values which remained relatively constant in leaf but for the remainder of the season.

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Peculiarities of magnetic signal distribution in soils of different elements of geochemically conjugated landscape

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Key words: clay fraction, magnetic susceptibility, magnetic fraction, total iron

Introduction

In the mid-1980s it was shown that there was a strong positive correlation between the magnetic susceptibility (MS) of loess-paleosol deposits and marine oxygen isotope data [7]. This has contributed to increased use of the parameter of MS in the study of paleoecological soil formation processes [4, 8], which has a specific property – new formation of authigenic magnetite crystals [1, 3]. However, not in all cases the periods of warming of climate correspond to high values of MS, which is related to the integrated nature of the parameter [2, 6, 9].

Materials and Methods

In this regard the aim of this study was to identify patterns of distribution of a magnetic signal due to parent rocks, relief and the level of atmospheric moistening within the Ergeni Upland. The objects of the study were light chestnut soil within the slope of southern exposure with a slope of about 2º and a length of 680 m.
Values of specific magnetic susceptibility were measured using a Kappabridge KLY-2 susceptibility meter. Clay fractions (<2 μm) from soils and parent material samples were separated by sedimentation after dispersion of samples in a wet paste. Magnetic extraction procedures were also used to concentrate the magnetic carriers for independent investigation by scanning electron microscopy (Tescan VEGA II).

Results and Discussion

Both in the modern light chestnut solonetzic soil and paleosol under the mound B1 horizons have the highest values of MS. The increase of the magnetic susceptibility compared to rocks showed accurate confinedness of this parameter to the elements of the slope (Fig. 1A). A comparative analysis of the MS parameter with the distribution of total iron indicates the presence of ferrimagnetics in the upper horizons of the background soil in the watershed and in the middle part of the slope and their absence in the lower part of the slope. Despite of the high content in the lower part of the slope of total iron (Fig. 1C), a fraction of physical clay (Fig. 1D), and elements which enter in the clay minerals and with which MS parameter traditionally correlates, its a significant increase as a result of soil formation was not observed. Thus increase of the proportion of ferrimagnetic minerals in the watershed associated with an intensive iron oxide genesis whereas their absence in inundated terrain connected with accumulations of plaster and carbonates that is confirmed by the increase of sodium, calcium, magnesium and sulfur, and, apparently due to discrepancy of the physicochemical parameters of the carbonate buffer system to ferrimagnetics formation conditions.

In order to clarify the sources of the magnetic signal from samples of soil formed on different elements of the slope of southern exposure the clay fraction was isolated by sedimentation method. The results show that the clay fraction has susceptibility by 2-5 times greater than the gross samples from which it is isolated. In the parent rocks and transitional horizons to them the ratio is 1.5 (Fig. 1B). Thus, the main source of the magnetic signal is the clay fraction.

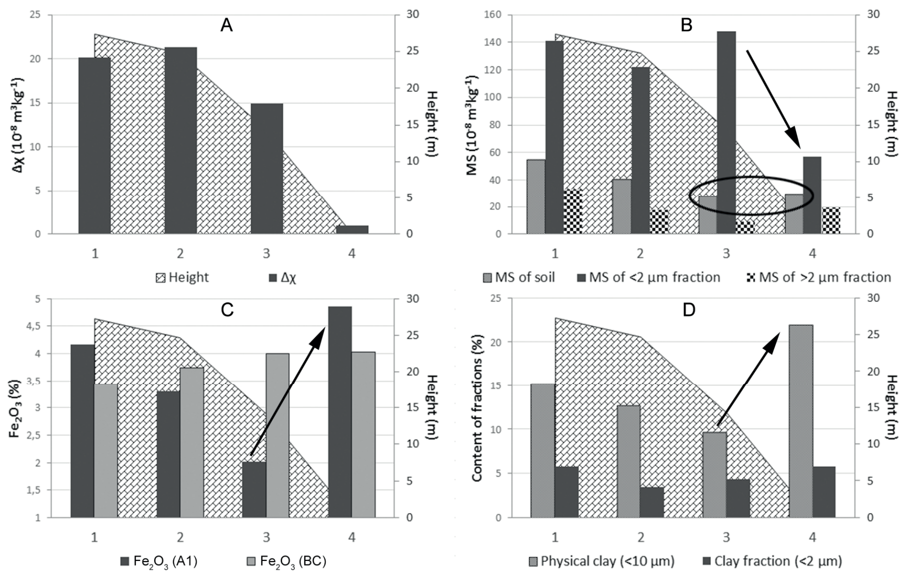

Fig. 1. Increase of MS relative to the parent rock (Δχ) calculated for the different elements of the landscape (A); specific MS of soil, clay fraction (<2 μm) and coarse fraction (>2 μm) for A1 horizon (B); amount of total Fe_2O_3 (C), physical clay and clay fraction (D)

For receiving ideas of the nature of the magnetic signal the magnetic fraction was isolated and its submicromorphology was investigated by means of a scanning electron microscope. In samples from A1 horizon of light chestnut solonetzic soil spherical magnetic particle size of 3-8 μm with smooth and rough surfaces often encountered. The particles with rough surfaces were apparently covered clay covers. Similar particles form technologically disturbed soils were characterized in detail by A.M. Zagurskiy et al. [5]. On individual anisometric particles formations resembling bacteriomorphic colonies with the size of separates less than 1 μm were found. The magnetic fraction isolated from parent rock is characterized by monotony of forms and consists of the anisometric particles with sizes of 5-50 μm. There are octahedral magnetite particles with distinct edges smooth. A high positive correlation between MS and fractions of medium and fine dust (*r*=0.60-0.83) indicates a strong association of the magnetic particles with clay minerals and quartz which is confirmed by the results of electron microscopic studies of the magnetic phase.

Thus, the main carrier of the magnetic signal is the clay fraction. Despite the close correlation of the MS parameter with content of total iron and physical clay the qualitative composition of the clay fraction provides decisive influence on the increase of the magnetic signal. Negative correlation of MS with the content of sodium, calcium, magnesium and sulfur indicates a discrepancy of accumulation conditions of gypsum and carbonate to synthesis conditions of ferrimagnetics. The differences between the soils of different elements are defined by intensity and direction of the process of leaching, carbonatization, salt and humus accumulation modifying the magnetism of iron compounds. The comparative analysis of the MS growth curves with respect to rock shows that within the studied catena exposure of sandy rocks are observed. The low growth of MS in floodplain landscape indicates a long stagnation of moisture, the fall of the oxidation-reduction potential and, consequently, the discrepancy of physicochemical parameters of the carbonate buffer system to the conditions of formation of magnetic ferrous minerals.

Acknowledgements

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Changes in the composition of the microbial community chernozem soil at different types of plant litter

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Key word: plant litter, soil microorganisms, gas chromatography-mass spectrometry (GC-MS)

Introduction

About 80–90% of plant litter primary production enters the soil system after mineralization (Bardgett, 2005), forms a major source of N for plant growth and C for soil's bacteria. The soil's microbial community composition changes with time in accordance with litter components changes. Fresh plant material (e.g., litter) represents a readily available substrate for both soil fauna and soil microorganisms. While there are many studies on litter decomposition (Pärtel et al., 2005; Sayer, 2006; Espersch et al., 2011), studies integrating observations on changes in litter microbial community and soil are scarce in particular with use of molecular microbiological methods.

The goal of our study was to investigate the changes in the composition of the microbial community chernozem soil at different types of plant litter. We hypothesized that the litter decomposing microbial community and its C course of the decomposition incorporation change with changing litter quality is a key factor in controlling litter decomposition.

Materials and Methods

Soil was collected from the upper 20 cm from the central chernozem reserve after V.V. Alyokhin. 100-gram portions of air - dry litter of leaves (the *Quércus* material) and grasses (the *Stipa* material) were put in lizimeter bags with 4 kg chernozem (h soil layer in the bags were 10 cm). The C/N ratios of the two types of material were 6 and 4 (wt/wt), respectively. The soil covered the litters was punched at influence the lizimetre waters within 4 months.

GC-MS analysis of microbial community was provided by chromate-mass-spectrometer AT-5973 D (Agillent Technologies, USA). A special program was designed for selective detection with accumulation of specific ion signals from microorganism marker compounds. The areas of marker's peaks were integrated automatically (mass-phragmentography) and supervised manually under regular programs of the device with using of internal standard. Then these data were input into account program prepared in electronic EXCEL tables. The method allows defining species of bacteria number more than 10^3-10^4 cells/g of soil. The methodology of a molecular method of a gas chromatography-mass spectrometry (GC-MS) was in detail presented by (Osipov, Turova, 1997; Shekhovtsova, 2003).

Results and Discussion

The number of microorganisms in the microbial community under leaves and under grasses did not differ, but relatively to the untreated soil it was increased by 60% (Table 1).

The main increase was due to the bacterial phylum *Actinobacteria*, which is characterized by high hydrolytic abilities. It could lead to decrease in quantity Corg in the punched soil. Biomass of microscopic mushrooms which also possess hydrolytic abilities, on the contrary, decreased in the punched soil by 8 times, apparently, due to reorganization of community of microorganisms in the course of a composting. Reproduction of protozoa was promoted by litters: their quantity increased in 2 and 3 times in the soil under leaves and under grasses, respectively.

The number of microorganisms in litters was 10 times more in comparison with the soil's microorganisms, higher in leaves (75.3×10^7 cells/g in initial period and 110.6×10^7 cells/g at a composting), than in grasses (64.7×10^7 cells/g in an initial grasses and 67.2×10^7 cells/g at a composting). Increase in number of *Agrobacterium radiobacter* (phylum *Proteobacteria*) and *Mycobacterium* sp. (*Actinobacteria*) could promote increase in number of water strong units, thanks to hydrophobic mycolic acids of mycobacteria and polysaccharide gels of agrobacteria. Besides, increase of number of *Acetobacter* sp., *Agrobacterium radiobacter* and *Caulobacter* sp. (phylum *Proteobacteria*) at 2-10 times can promote increase in mineral forms of phosphorus in soil solution due to essential local acidulation of the soil by the first two types and phosphatase activity of a caulobacter. The first two look can promote also increase in mobile potassium in soil solution due to the same local acidulation in the soil.

Essential increase (in 5 times) in the number of *Nitrobacter* sp., that is the nitrifier of the second phase of translation process of ammonia nitrogen in nitrate nitrogen can promote quantity increase of nitrates in soil's solution.

Thus, the litter over the chernozem can increase quantity of mobile forms of nitrogen, phosphorus and potassium, to promote formation of water strong units and reorganization of hydrolytic community of microorganisms. Plant residues are a crucial source of nutrients in both natural and agricultural ecosystems, where synchronous plant growth and residue decomposition are essential for soil fertility.

Table 1

Structure of the reconstructed microbic complex and number of microorganisms of the top of the initial chernozem ordinary (Kursk), under a grass and leaves of an oak according to GC-MS

№	*PHYLUM*	Microorganisms	Number, ×10⁶ /g air - dry soil		
			Initial chernozem	Under litter of leaves	Under litter of grasses
1.	*PROTEOBACTERIA*	*Acetobacter* sp.	1.7	4.1	3.1
2.		*Agrobacterium radiobacter*	1.0	1.9	1.9
3.		*Brevundimonas vesicularis*	0.1	0.2	0.2
4.		*Caulobacter* sp.	0.3	3.1	2.4
5.		*Nitrobacter* sp.	0.3	1.5	1.6
6.		*Pseudomonas fluorescens*	0.5	0.8	0.8
7.		*P.putida*	0.3	0.4	0.4
8.		*Sphingomonas adgesiva*	0.2	0.2	0.2
9.		*Sphingomonas capsulata*	0.2	0.3	0.3
10.		*Xanthomonas* sp.	0.3	0.4	0.5
11.		*WARB**	0.1	0.1	0.2
12.		*FeRed*	0.1	0.1	0.1
		Сумма	5.10	12.99	11.49
13.	*ACTINOBACTERIA*	*Actinomadura roseola*	0.5	0.7	0.7
14.		*Arthrobacter* sp.	1.8	3.8	3.9
15.		*Corynebacterium* sp.	0.4	1.0	1.1
16.		*Mycobacterium* sp.	1.2	2.0	2.4
17.		*Propionibacterium freudenreichii*	2.4	4.2	5.7
18.		*P. jensenii*	2.8	5.2	7.2
19.		*Rhodococcus equi*	6.4	11.4	11.6
20.		*Rhodococcus terra*	0.6	1.9	1.2
21.		*Streptomyces* sp./ *Nocardiopsis* sp.	3.2	5.9	5.3
		Сумма	19.30	36.14	39.18
22.	*FIRMICUTES*	*Acetobacterium* sp.	0.0	0.4	0.1
23.		*Bacillus subtilis*	0.8	1.2	1.3
24.		*Bacillus sp.*	0.8	0.2	0.4
25.		*Butyrivibrio 1-2-13*	0.0	0.5	0.4
26.		*Butyrivibrio 1-4-11*	0.7	0.1	0.6
27.		*Butyrivibrio 7S-14-3*	3.3	5.8	6.8
28.		*Clostridium pasteurianum*	7.1	0.6	1.6
29.		*Clostridium OPA***	0.7	0.5	0.5
30.		*Eubacterium lentum*	0.4	0.8	0.7
31.		*Ruminococcus* sp.	1.3	2.6	2.5
		Сумма	15.10	12.90	15.09
32.	*BACTEROI-DETES*	*Bacteroides hypermegas*	0.00	0.00	0.00
33.		*B. ruminicola*	0.1	0.2	0.2
34.		*Cytophaga* sp.	0.2	0.4	0.4
35.		*Sphingobacterium spiritovorum*	0.2	0.2	0.3
		Сумма	0.5	0.8	0.9
Общая численность			40	63	40
FUNGI по 18:2 ,биомасса, мкг/г			314	37	314
PROTOZOA по альдегиду C_{18} (октадекановый альдегид)			1,7	3,0	1.7

WARB - Wolinella-Acholeplasma-Roseomonas-Burkholderia; Clostridium OPA** - C. omelianskii, C. pasterianum, C. acetobutyricum*

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Micromorphological properties of lamellae in some arid soils in central Iran

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Keywords: Argillic horizon, Bedding plains, Illuviation, Isfahan province.

Introduction

The lamellae definition is used in Soil Taxonomy (Soil Survey Staff, 2014), where soils containing lamellae are distinguished at the subgroup level. In Soil Taxonomy, a lamella is an illuvial soil horizon less than 7.5 cm thick that contains an accumulation of oriented silicate clay on or bridging sand and silt grains. Lamellae are horizontal-to-wavy stripes with a clay-size fraction concentration that occur in sandy soils and sediments in a variety of landscapes around the world. They generally form in an approximately parallel sequence in which each lamella is separated from the other by interlamellae, defined as stripes containing less clay (Holliday and Rawling, 2006; Rawling, 2000). The origin of lamellae has been generally attributed to petrogenic, pedogenic, or petro-pedogenic processes (Dijkerman et al., 1967). Petrogenic lamellae originate during the deposition of the sediments; therefore, they usually parallel bedding planes and cross-cut the current topographical surface (Schaetzl, 2001). Pedogenic lamellae are attributed to clay illuviation within soil and are characterized by their parallelism with the modern surface and micromorphological evidence of coats and/or bridges of oriented clay between primary particles (Holliday and Rawling, 2006). Finally, petro-pedogenic lamellae occur when clay illuviation is controlled by features of the parent material, such as alternating layers with different particle sizes. This type of lamellae tends to parallel bed planes but also can exhibit oriented clay coats or bridges between sand and silt particles (Rawling, 2000)

In this study, we investigated micromorphological properties of some soils in central Iran containing lamellae that are apparently formed by illuviation to better understand the mechanisms responsible for the formation of lamellae in arid soils.

Materials and methods

The area under investigation is located in the northeast of Isfahan province, central Iran. The area has a mean annual rainfall of 110 mm and mean annual temperature of 19.5°C.The soil moisture and temperature regimes of the area are aridic and thermic, respectively. Piedmont is the main geomorphologic unit of the study area with less than 2% slopes and the soils under investigation have been generally formed on aeolian deposits .After identifying and navigating the study area, six soil profiles have been described. The soils were then classified according to SoilTaxonomy (Soil Survey Staff, 2014). Among the studied pedons, one pedon has been chosen as representative pedon. Selecting the representative pedon hase been done according to the presence and thickness of bands with different soil color and texture. All the genetic horizons of this profile have been sampled. Soil colors were determined by using the Munsell Soil Color Chart. In the laboratory, the disturbed samples were air-dried and coarse fragments (>2 mm) were removed by sieving to gain the fine earth fraction. The particle-size distribution was determined by the hydrometer method, and the organic C content was determined. Alkaline-earth carbonate was measured by acid neutralization. Soil pH and EC were measured in a saturation extract (Soil Survey Staff, 1996). Undisturbed soil samples were collected from representative pedon, air-dried, impregnated with a polyester resin and cut into thin sections. These thin sections were described using the terminology of Stoops (2003).

Results and discussions

According to Soil Taxonomy (Soil Survey Staff, 2014), the studied soils are mainly classified as TypicArgigypsids. These soils are very deep and are formed in aeolian doposits with suitable drainage conditions. The amount of organic matter in surfase layers are few (less than 1%) and the particle-size class is coarse-silty. Table 1 presents some morphological characteristics of representative pedon.

Table 1. Soil morpholigical characteristics of representative pedon.

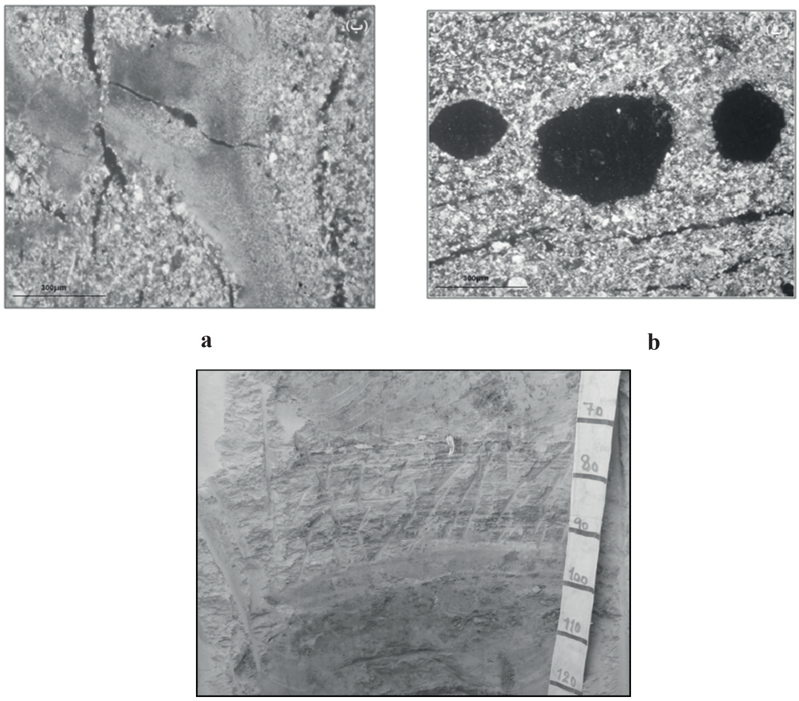
Horzon	Depth (cm)	Color (moist)	Structure	Texture	Concentration
0-70	ABpyzn	10YR4/4	2mpl (0-10cm), m, 1f-cosbk	SiL	G1f1
70-100	Eyzn&Btyzn	10YR4/4 & 10YR4.5/3	m	SiL	G1f1
100-140	Eyz&Btyz	10YR4/6 & 10YR6/4 & 7.5YR3/4	m	SiL-SL	G1f1
140-200	2C	10YR3/3	Sg	S	

In the second and third layers of of representative pedon, various bands can be observed with diverse colors and textures that constitute the required conditions for lamella and argillic horizon, according to Soil Taxonomy (Soil Survey Staff, 2014):

- A lamella is an illuvial horizon less than 7.5 cm thick formed in unconsolidated regolith more than 50 cm thick.
- Each lamella contains an accumulation of oriented silicate clay as coating, hypo-coating and and intercalation (Fig. 1a). These pedofeatures are sometimes covered under a coating of iron oxides. The color of this coating is showed in profile demonstration with 7.5YR3.4 (Table 1).
- Each lamella is required to have more silicate clay than the overlying eluvial horizon. The difference between silicat clay percentage of lamella and eluvial part have been reported about 20%. There are more than 60% and 40% silt and sand respectively in some parts of the eluvial horizon and the amount of clay reaches to zero percent (Fig.1b).
- Lamellae occur in a vertical series of two or more, and each lamella must have an overlying eluvial horizon (Fig. 1c).
- In representative pedon, there is 15 cm or more cumulative thickness of lamellae that are 0.5 cm or more thick (Fig. 1c). Since the eluvial part and lamellae contain

0% and 20% clay respectivelly, the lamellas in this profile are considered argillic horizon.

Lamella formation in this area occurs in a very thin layer of soil with smaller particles and pores than the overlying and underlying materials (Bedding planes). These bedding planes are formed when the speed of wind or water reduces.



a **b** **c**

Fig. 1. Photomicrograph of a) Eyzn&Btyzn, with clay intercalation; b) some eluvial parts of Eyzn&Btyzn whitout clay; c) Eyzn&Btyzn, with lamellae

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Sustainable development of territories and environmental requirements for land use

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Key words: ecological assessment, ecological regulation, sustainable development.

In General terms the concept of sustainable development of humanity is a model of forward motion that achieves the satisfaction of vital needs of the present generation without depriving such opportunities of future generations. This definition of sustainable development, adopted by the United Nations in the 80-ies of the last century, is currently perceived by the world community with particular sharpness, due to the increasing risk of environmental, social and economic threats.

Sustainable development of the territory is possible only under certain interconnected environmental requirements. These requirements are based on the implementation of the concept, conventionally called "zero land degradation".

Zero land degradation (which corresponds to the background level of nature quality) cannot be reached in the process of real land use. Under the guise of zero degradation we understand the establishment of acceptable ecological state of the environment and permissible anthropogenic impact on it, wherein self-healing of nature quality is possible and there is no accumulation of irreversible environmental damage. That is, the certain constant of sustainable development is observed.

Great attention is payed to the questions of sustainable development and connection of the environmental quality and the level of land degradation in the materials of international and Russian forums ("Agenda 21", 1992; United Nations Conference on Sustainable Development "Rio + 20", 2012; Russian Ecological Congress in 2013, etc.).

The values of parameters that characterize the relationship between the ecological state of the environment, in particular, land degradation, and the socio-economic development of the Russian Federation (eco-efficiency indicators) are represented in the materials of recent issues of the Russian State environmental report (2012 – 2014). At the same time the environmental problems in Russia is actively discussed in relation to issues of environmental and socio-economic development of the neighboring countries of the Eurasian region. So the Law "On Soil Protection", which was developed and adopted by the Union: Russia, Belarus, Kazakhstan, is dedicated to the protection of soil and soil degradation control.

Ecological Doctrine of Russia (2012) and the State Environmental Program (2012-2020) identify the main strategic steps to combat land degradation in our country. In the first place, it has been tasked to identify and eliminate past environmental damage followed by the organization of nature "from scratch", in accordance with environmental regulations.

The idea of life and human activity "from scratch" embraced the international community of ecologists and found an active response in the activities of the Ministry of Ecology of Russia. Guided by this idea, it was decided to conduct an environmental cleaning in our common home. It is assumed that, after this cleaning the people will live and work on the ground, controlling the main trends in violations of the environment, by adhering to common environmental requirements, rules and regulations, approaching, thus, to the principles of zero degradation of soils and land.

Reaching the goals of ecological land use for our country is particularly relevant. The fact that the already accumulated damage caused by the degradation of soil and land, inherited from the Soviet past, imposed damages formed for more than 20 years of the adjustment period of lack of proper environmental monitoring and control.

Currently on the initiative of the Ministry of natural resources of Russia on the state level implementation of the Federal target program on environmental-economic assessment and the elimination of past environmental damage is started. The main steps of this program are the work related to the inventory of degraded and contaminated land and their subsequent reclamation and return to the appropriate land use system [1].

In turn, the return to the system of traditional land use areas must comply with the officially adopted state environmental requirements (article 20, 34-56 of [2]). The list of requirements can be divided into two areas:

- requirements to the criteria and standards of environmental assessment of environmental components, based on perceptions of their environmental functioning, with particular attention to soils and lands as natural connecting link of the biosphere; soils and lands are considered as independent components of the environment.
- requirements to the level of tension of the environmental situation in programming and land use system and land management design, implemented on specific territories and land plots.

Typically, the implementation of requirements is based on the principles of sustainable development and the organization of reversible changes, the quality of the natural environment and an appropriate environmental management system supported. In the heart of the control system is an integral system of environmental assessment, regulation, monitoring and environmental expertise. If we talk about soil and land as separate components of the environment, in the first case we are talking mainly about the evaluation and standardization of the implementation of the environmental functions of soils, and in the second, on the evaluation and regulation of the natural complex of territories represented by the apportionments of land of varying size and organization with the combination of heterogeneous economic use.

The analysis of the relevant foreign literature shows that our colleagues abroad believe that the requirements to the environmental standards of soils and lands quality are sufficiently identified by calculating environmental risks. They are worried about the possible level of environmental stress and loss of ecological well-being or ecological and economic services at specific lands when inevitable errors are made in the process of conducting various types of planning and land management [3, 4, 5].

In Russia the environmental requirements for components of the environment are based primarily on stringent environmental and health standards (maximum permissible concentration, permissible residual oil content in the soil, etc.), compliance of which involves the maintenance of the ecological state of nature in close to background rates. The assessment of environmental stress in planning and land management is not provided with official regulations and is based primarily on expert opinions.

However, under domestic law, many of the projects and land use programs must pass the corresponding procedure of environmental expertise.

Currently, in the environmental practice of our country the rating, ranking and regulation of soil and land quality allows to establish the level of it's disturbance and the ability to heal itself, according to the methodological approach developed and adopted by key agencies: environmental, agricultural and General land use agencies [6,7]. In these documents the basis for assessing the ecological status of soils was based on the five-level evaluation scale according to which a fairly conventional boundary of reversibility is considered to be the third (threshold) level, and irreversible accumulation of environmental damage occurs when reaching . fourth and fifth level of loss of environmental quality of soils. According to a separate study in the field of environmental regulation irreversible changes occur in the loss of more than a quarter of Bioorganic capacity of soils [8-12].

The main condition for sustainable development is the development, which does not cause irreversible damage to nature and society, based on compliance with environmental quality requirements for components of the environment, particularly soils and lands and secure planning and safe placement of the productive forces.

The sustainable use of renewable natural resources and at the same time minimized use of non-renewable resources must be guaranteed in the modern land use. Soils and arable lands are considered to be renewable natural resources.

In the modern developed World, including Russia, the society started to implement the system of sustainable development with the liquidation of the past accumulated damage with subsequent land use, assuming compliance with key environmental requirements. The concept of integration of processes of socio-economic development and environmental protection is now developing.

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Effects of gyttja and polyacrylamide applied to soils with different texture on soil erodibility

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Key words: dispersion ratio, gyttja, polyacrylamide, wet aggregate stability

Introduction

Soil organic matter has great impact on many physical, chemical and biological soil properties also it affect structural stability. To supplement declining organic matter conditioners, originated organic materials are applied to soil. When organic wastes and residues are used as soil conditioner both soil quality improve and environmental hazards of these materials are decrease to low level. In addition, organic carbon can be stored in soil by application organic material into soil. Thus, it is challenge to emission of CO_2 which is a greenhouse gas released in storage area of any residues via occurred mineralization process.

One of the sources used as organic conditioner is gyttja material that it has developing character in soil physical, chemical and biological properties. Gyttja is a freshwater deposit (mud) consisting of organic and mineral matter found at the bottom or near the shores of lakes. The term was originally defined by the Swedish scientist Hampus von Post in 1862, as a light colored coprogenic deposit consisting of a mixture of plankton particles, mollusc shells, chitin remains from the exoskeletons of insects, pollen and spores of higher plants, and mineral particles, formed in eutrophic water bodies (Lachacz *et al.* 2009).

Anionic polymers increase soil aggregate stability when they are duly implemented (Sojka and Lentz, 1997; Sharma *et al.* 2006). It emphasized as a general idea that even very low doses of polymers can be successful for increasing aggregate stability (Imbufe *et al.* 2005). One of the most widely used of these conditioners is a polyacrylamide (PAM). In the present study, time-dependent changes of structural stability of clayey and sandy soils treated with gyttja and polyacrylamide (PAM) were investigated.

Materials and Methods

Two different soils (Typic Xerorthent and Mollic Xerofluvent) were used in the study. These soils were taken from agricultural land. Some chemical and physical properties of soils were given in Table 1 and 2, respectively. Gyttja as organic conditioner and PAM as polimeric conditioner were used in the study. Gyttja material was obtained from lignite area of Afsin-Elbistan Power Plant in Kahramanmaras, Turkey. Some physical and chemical properties of gyttja were given in Table 3. Polyacrylamide was obtained through a commercial firm. Molecular weight of PAM is 0.2 Mg mol^{-1} and it is anionic character and in dust form.

For the purpose of the study various dose combinations of gyttja and PAM were applied to the soils basis oven dry weight. Application doses were given in Table 4. Before application procedure, gyttja was sieved from 0.5 mm. Constructed experiment according to a randomized complete block experimental design was carried out in plastic pots (13.5 cm height and 9 cm diameter dimensions) kept under greenhouse conditions. Each group pots were deteriorated in 4th, 8th and 12th months and necessary measurements were realized. Wet aggregate stability (WAS) and dispersion ratio (DR) indices were used for evaluating changes in the structural stability of soils. In addition, soil total organic matter concentration (SOM) was determined for each four-month periods.

Soil organic matter content was determined by modified Walkley-Black wet digestion method (Kacar, 1994). Aggregate stability (WAS) was measured by wet sieving method (Kemper and Rosenau, 1986). Dispersion ratio (DR) index were determined according to Lal (1988).

Table 1. Some chemical properties of experiment soils

Soil	pH	$EC_{25°C}$ dS m^{-1}	$CaCO_3$ g kg^{-1}	[1]OC g kg^{-1}	[2]CEC $cmol_c(+)kg^{-1}$	Ca^{++} µg g^{-1}	Mg^{++} µg g^{-1}	K^+ µg g^{-1}	Na^+ µg g^{-1}
Mollic Xerofluvent	8.1	2.53	67	13.2	38	12030	871	116	60
Typic Xerorthent	8.5	1.90	181	10.1	17	7915	427	127	57

[1]OC: organic carbon, [2]CEC: cation exchange capacity

Table2. Some physical properties of experiment soils

Soil	Clay gkg^{-1}	*Silt gkg^{-1}	Sand gkg^{-1}	Textural class	[1]BD Mg m^{-3}	[2]K_{sat} cm h^{-1}	[3]SAT cm^{3}cm^{-3}	[4]FC cm^{3}cm^{-3}	[5]PWP cm^{3}cm^{-3}	[6]AWC cm^{3}cm^{-3}
Mollic Xerofluvent	548	228	224	C	1.30	2.92	0.65	0.44	0.33	0.11
Typic Xerorthent	291	192	517	SCL	1.36	10.4	0.40	0.31	0.19	0.12

*USDA silt, [1]Bulk density, [2]Hydraulic conductivity under saturated condition, [3]Saturation degree, [4]Field capacity, [5]Permanent wilting point, [6]Awailable water content

Table 3. Some physical and chemical properties of the gyttja

Variables	Unit	Value
Ash	%	61.79
[1]OC	%	22.16
C/N	-	12.6
pH	-	7.01
$EC_{25^{\circ}C}$	dS m^{-1}	0.77
$CaCO_3$	%	39.1
[2]BD	Mg m^{-3}	0.65
[3]PD	Mg m^{-3}	2.25
[4]POR	%	71
[5]WHC	%	206

[1]Organic carbon, [2]Bulk density, [3]Particle density, [4]Total porosity, [5]Water holding capacity

Table 4. Application doses in the experiment

Notation	Application
Control	1500 g air dry soil per each pot
G1	Gyttja including % 3 OM base on oven dry weight
G2	Gyttja including % 6 OM base on oven dry weight
G1 + PAM	0.005 % PAM into pots applied G1
G2 + PAM	0.005 % PAM into pots applied G2

Results and Discussion

In the end of the experiment, statistical assessments were done on data set. ANOVA test results were given in Table 5. According to this table soil organic matter content was affected SOM (P<0.001) depending on sampling time, soil and application. Wet aggregate stability (WAS) was influenced by time and soil at the level of 0.001 and influenced by application at the level of 0.01. Effectiveness of soil and application on soil dispersion ratio (DR) were found as significant (P<0.001) whereas effectiveness of sampling time on DR was found as insignificant. Table 6 and 7 shows Duncan test results for applications and sampling times, respectively. According to Table 6, the effective implementation on the SOM and DR were [G2+PAM], while G1 application was not effective on these varibles. Control and G1 application was found same, statistically. All applications were found different from control in term of WAS but all material applications were found same as statistical for WAS. As shown in Table 7, SOMs were same statistically in 4th and 8th months but SOM in 12nd month was different form them. All months were different from each other in terms of WAS values. These result showed that when gyttja used with PAM soil organic matter content more increase and aggregate dissolution by water more decrease than only gyttja applications. As another results, gyttja applications with polymer or polymer without did not occur any difference on WAS values. These finding might attribute to action mechanism in soil of PAM on aggregate stabilization (Blanco-Canqui and Lal, 2008).

Table 5. ANOVA test results belong to dependent variables

	[1]SOM		[2]WAS		[3]DR	
Variation	F	Significance	F	Significance	F	Significance
Time	14.065	0.000***	19.419	0.000***	2.477	0.107ns
Soil	20.194	0.000***	17.609	0.000***	577.317	0.000***
Application	20.233	0.000***	5.004	0.005**	15.444	0.000***

[1]Soil organic matter, [2]Wet aggregate stability, [3]Dispersion ratio

Table 6. Comparison of applications in terms of mean values by Duncan test (α = 0.05)

Application	Mean SOM, %	Mean WAS, %	Mean DR, %
Control	2.2333c	33.0000b	13.0333a
G1	2.8967c	42.4833a	12.1833ab
G2	3.8817b	47.1667a	11.3667bc
G1 + PAM	4.3683ab	48.4833a	10.4500c
G2 +PAM	4.8450a	50.1167a	8.8333d

[1]Soil organic matter, [2]Wet aggregate stability, [3]Dispersion ratio

Table 7. Comparison of sampling times in terms of mean values by Duncan test (α = 0.05)

Application	Mean SOM, %	Mean WAS, %
12nd month	2.8780b	55.3300a
8th month	3.8400a	43.0500b
4th month	4.2170a	34.3700c

[1]Soil organic matter, [2]Wet aggregate stability

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Particle size distribution of agrosoddy-podzolic soil morphons and morphemes by laser diffraction analysis

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Introduction

Examination of the research results of soil samples with their interdependencies understood as morphological soil components can give better understanding of soil functioning processes. However, often it is not possible to investigate a lot of interesting properties of the analyzed sample because of insufficient amounts of material required for the analysis.

Classical techniques (pipette-method (PM), areometric method) require ~5-30 g of sample, while LD requires only ~50-600 mg. This LD advantage enables a micro-level soil analysis and investigation of PSD for soil neo-formations and ped surfaces being the most dynamic and representative component of a solid phase.

LD results are a continual PSD. This enabled us to consider soil texture in a different way, not only as a proportion between the size fractions of elementary soil particles (ESP). A detailed study of continual PSD could reveal complex PSD indices. An interesting example of such approach is the analysis of integral PSD curves made by P.N. Berezin [1, 2] which made it possible to deduce four probability rates giving the extended information about soil genesis.

In spite of the wide use of LD in soil science and its increasing impact a lot of methodological problems remain unsolved. In our research we tried to uncover the capabilities of the described above LD method applied in soil science and to consider possible application of Berezin's probability rates in the context of LD data.

Materials and Methods

Field stage of soil investigations included morphological description and sampling. Selection and indication of samples were performed according to the established order of soil profile description [3, 4, 5, 6]. This work was carried out at Zelenograd station of V.V. Dokuchaev Soil Science Institute in Pushkin district, Moscow region, Russia. The object of research was agrosoddy-podzolic soil on clay loam mantle laying on non-carbonate moraine at the depth of 2-3 m. Research was performed in a trench (length 20 m, depth 2,2 m) at the experimental ground of Zelenograd station.

Average samples of the total mass (TM) were selected layer-by-layer (with a step of 10 cm) in accordance with the profile genetic horizons. Samples of morphological components of various profile hierarchy structure levels were represented by: intra-ped mass (IPM); intra-fracture mass (IFM) - soil material, which in terms of its

properties had sharp visual distinctions as compared with the enclosing horizon; eluvial (clarified) zone of IFM (IFMe); humic-clay and clay cutans (IFMt); inter-fracture mass (InFM) - transition part from IPM to IFM close to ped surface, which could have morphological features of gleying (InFMg).
For our analysis we selected a soil profile on 13 m of a trench and three morphons: morphon 1 - 13 m, clay-humic cutan on the main fracture surface stretching from 80 to 170 cm in depth and about 50 cm in width; morphon 2 - 14.5 m, pseudomorphosis in fracture from eluvial to textural horizon with the depth ranging from 44 to 76 cm; morphon 3 - pseudomorphosis in the vein fracture from eluvial to textural horizon spreading from 88 to 164 cm in depth.
Analysette 22 comfort (Fritsch, Germany) was used for PSD analysis. Calculations were based on the Mie theory. Refractive index value for solid phase was selected as 1.55, for liquid phase - 1.33. Before the PSD analysis roots were removed from the samples, then grinded with a rubber pestle and sifted through a sieve (mesh aperture 1 mm).
After that the samples were dispersed by ultrasound on a sound-type dispergator Digital Sonifier 250 (Branson Ultrasonics, USA) with a standard disruptor horn tip during 5 minutes at 40%W. In this case dispergation energy reached ~ 500 J/ml. Dispergator was calibrated beforehand, according to the accepted methodology [7]. In addition, PSD of GM samples was analyzed by PM with the same pretreatment and dispergation.
Also probability rates of all samples were calculated by Berezin method including: two for clay components (particles < 1 μm) - F5 and k, two for sand components (5-1000 μm) - α and n.

Results and Discussion

PSD results obtained for GM samples are shown in Table 1. There are essential differences between the absolute values of size fractions determined with different methods. However, both methods give similar or analogical results of physical clay (particles < 10 μm) content except humus-accumulated horizons.
Fine sand and coarse silt fractions have accumulative distribution in soil profile. Middle silt content was constant, fine silt and clay had eluvial distribution (Fig. 1).
Differentiation of morphon 1 components is higher than that of GM samples. Differentiation coefficient of clay (ratio of clay contents in eluvial to textural horizons) is 1.7.
Clay-humic cutan, most massive at 90-135 cm depth, is sharply distinct from IPMg and IPM part **(**Fig. 2**)**. The content of <0.7 μm fraction is increased by 3-4 times as compared with IPM. The most contrast distinctions were noted for cutans with IPMg, which represented a less heavy texture morphon component. Clay-humic cutan contains from 11 to 19% of fraction >10 μm. This fraction in IPM contains about 50% of all particles.
Similar relationships between morphemes were observed in the 3rd morphon. IFM is humic-clay cutan material light in the upper layer and getting darker with the depth which is the most interesting quality of the morphon. Coarse silt was sharply decreasing (from 53 to 7%) with a notable increase in the clay and fine silt fraction (from 18 to 29 and from 36 to 49 %, respectively) with the depth in comparison with

IPM. Content of clay particles is lower in the upper part and higher (in 3-4 times) in the lower part of IPM.

For the 2nd morphon a clarified IPM is depleted with clay and fine silt fractions as compared with IPM while a coarse silt fraction increased nearly to 65%. There is a more sharp differentiation between IFP and InFM. InFM has a more heavy texture of morphon.

Content of clay components (F5, %) is more variable than that of silt fraction depending on the soil profile. There is a clear minimum of F5 in EL horizon.

Table 1

PSD of agrosoddy-podzolic profile (PM – in numerator, LD – in denominator)

Horizon	depth, cm	Content (%) of fraction ESP (μm)							Classification by N.A. Kachinskiy
		>250	250-50	50-10	10-5	5-1	<1	<10	
Ap'	0-10	0	3.63 / 13.4	42.88 / 53.7	16.44 / 11.9	33.68 / 14.0	3.36 / 7.1	53.48 / 33.0	Light clay / Medium loam
Ap"	20-30	0	1.41 / 10.6	53.79 / 54.6	13.78 / 9.7	25.34 / 13.6	5.69 / 11.4	44.81 / 34.7	Heavy loam / Medium loam
Elfrag-ElB	30-40	0	1.33	54.54	16.27	21.73	6.13	44.13	
	40-50	0	0.14 / 10.4	48.71 / 39.6	15.0 / 11.5	27.69 / 14.9	8.46 / 23.5	51.16 / 50.0	Light clay / Light clay
B2	60-70	0	0.44 / 7.9	48.49 / 42.0	15.36 / 13.2	27.36 / 16.5	8.36 / 20.4	51.08 / 50.1	
B3	80-90	0	0.82 / 9.5	47.31 / 39.7	15.02 / 6.4	28.40 / 19.6	8.45 / 24.8	51.87 / 50.8	
	100-110	0	0.03	43.43	16.48	30.83	9.23	56.54	
	120-130	0	0.20 / 2.8	42.91 / 43.1	16.47 / 11.1	31.71 / 18.9	8.71 / 24.2	56.8 / 54.2	
B4	140-150	0	0.01	37.59	16.86	35.67	9.87	62.40	
	160-170	0	0.24	36.93	16.20	36.38	10.26	62.83	
	180-190	0.47 / 0.5	0.21 / 8.2	35.72 / 34.8	16.41 / 13.1	36.74 / 21.4	10.46 / 22.0	64.48 / 56.5	
BC	200-210	1.88	0.27	30.28	17.50	40.12	9.94	69.06	
	220	1.91 / 1.9	0.70 / 10.9	27.85 / 30.7	18.03 / 13.1	41.74 / 22.8	9.76 / 20.6	71.22 / 56.5	Medium clay / Light clay

K rate represents a share of coarse material in clay components [2]. Therefore, K describes the degree of coarse material weathering. By Berezin’s classification all of the analyzed GM samples and morphemes belong to a coarse dispersed category. But K is not constant varying from 0.89 to 1.34 in different parts of soil profile (Fig. 3). Humic horizon has the highest K values.

This K rate “non-susceptibility” can be explained by the specific nature of LD data: higher fine silt and lower clay fraction content as compared with other methods of grain-size analysis. The analyzed samples belong to a coarse-dispersed category because a fine silt contribution to clay components is always very high. For now we can confirm that K values could be described as a relative value, as an increase or decrease in the dust content (or coarseness) of clay components. K increases (to 0.98-

1.05) in the lower part of soil profile (100-150 cm). Gravel inclusions were found at the depth more than 200 cm. Also this layer includes medium and coarse sand fractions. In general K rate has a regressive-accumulate type of distribution.

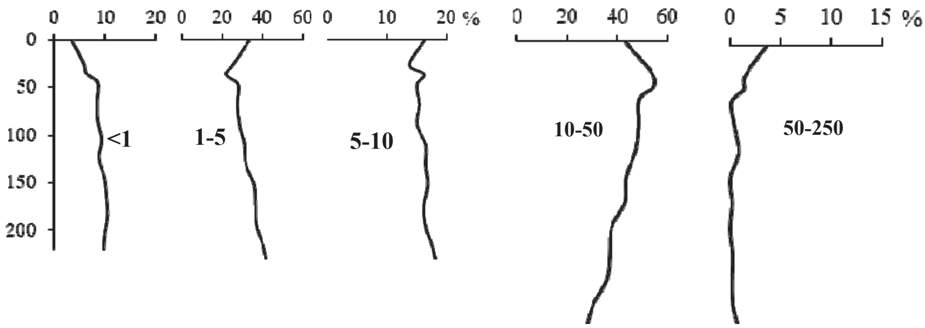

Fig.1. PSD in soil profile

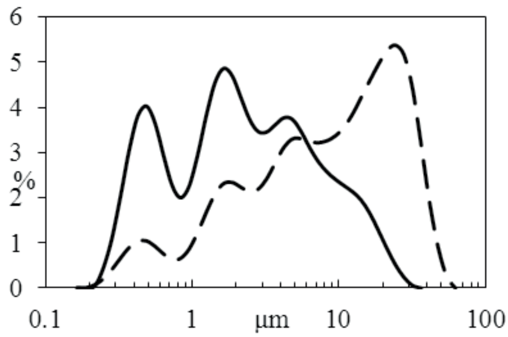

Fig.2. Differential PSD curve: 1 – humic-clay cutan, 2 – IPM (morphon 1, 90-135 cm)

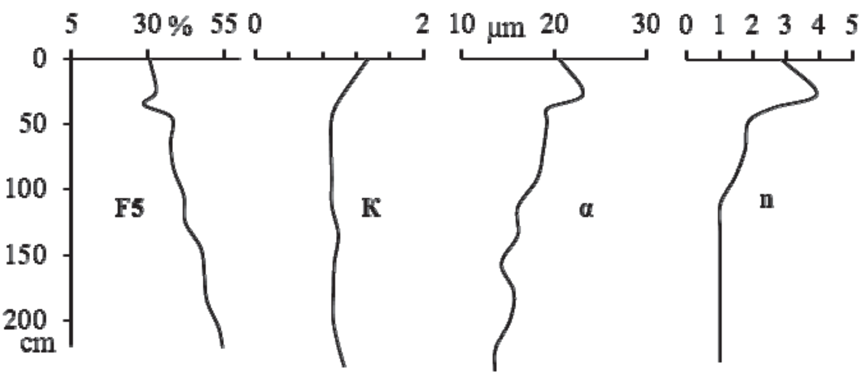

Fig. 3. PSD probability rates of agro-soddy-podzolic soil

According to Berezin [2], in the same conditions an average diameter of sand components (α) indicates the time when a parent rock was exposed to formative factors. Sand soil components belong to a non-grained category (α < 20 μm) except the lowest part of humic horizon which is fine-grained. The size of sand components decreases with the depth (Fig. 3).

Sorting rate n characterises monodispersity of soil sand components. The analyzed soil was characterised by a sharp transition in the textured profile part with n rate amounting to <1 (Fig. 3).

Clay-humic cutans of agrosoddy-podzolic soil are characterized by the following qualities: the highest content of clay components; the lowest K rate values, i.e. the highest slit enrichment of clay particles < 1 μm; decreased K rates with the depth in clay-humic cutan of the 3rd morphon; the smallest diameters of sand components; high values of sorting rate for particles larger than 5 μm.

On the contrary, a clarified soil IFM is characterised by the increased dust content (K rate) and greater sizes of sand components as compared with IPM.

Conclusions

Comparative analysis of data obtained by PM and LD methods in the aggregate with a probability rates application showed that any adaptation of PSD parameters previously deduced by methods based on other physical principles required additional investigation and sometimes even a revision of fraction boundaries.

PSD analysis of agrosoddy-podzolic soil by LD makes it possible to come to the following conclusions:

1. Profile textural differentiation is more distinct between the morphological components of lower levels than soil horizons.
2. Concentration of clay material in the form of clay-humic cutans is considerably higher (by 3-4 times than in IPM) in the main fractures. Clay material includes not only clay fraction but also fine silt. IPMg has the lightest composition of morphons.
3. Soil PSD probability rates described by P.N. Berezin make it possible even in its present non-adapted state to obtain additional information about the nature of differentiation process in soil solid phase.

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Change in the salinity composition of drainage water in soil columns irrigated by different salinity and varying leaching fractions of water

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Key words: leaching fraction, drainage water quality, salinity, sunflower

Introduction

Irrigation is a vital source for crop production in arid and semi arid regions. All water used for irrigation always contains a certain amount of dissolved salts. The concentrations and compositions of these salts widely depend on the source of the irrigation water.

The most common salts present in irrigation water are NaCl, $CaSO_4$, $MgSO_4$ and $NaHCO_3$. In natural soils, the most commonly faced cations are Ca^{+2}, Mg^{+2} and Na^{+} while the most common anions are Cl^{-}, $SO4^{-2}$ and HCO_3^{-} (Grattan, S.R., 2002). These dissolved salts are accumulated in the root-zone during irrigation. Water gets used by plants and evaporates while dissolved salts mostly remain in the root zone. High salt in the plant root zone interferes with the uptake of water and can cause death no matter what kind of salt it is. Thankfully, plants have different levels of tolerance to salts found in the soil or in irrigation water (Flynn and Ulery, 2011). If the salt concentration in the root-zone rises over the threshold salinity level, the plants would be affected negatively by the decrease in yield, deterioration of fruit quality or even death. Leaching is the most important application to prevent salt accumulation in root zone. Leaching is the process of applying more water to the field that carrying salts with it. The more excess water is applied, the less salinity is left in the root even if it seems like more salts have been added to the field. The term leaching fraction (LF) is used to relate the fraction or percent of water applied to the field that actually drains below the root zone (Ayers and Westcot, 1989; Hanson, 1990).

Continuous irrigation in saline soils is generally recommended to help leaching salts by drainage from the root-zone particularly if the quality of water is poor. Prolonging irrigation interval under saline soil is unfavorable for plant production. Prolonging irrigation intervals markedly increased soil salinity and decreased the plant yield significantly (El-Shakawi et al. 2006).

The salts accumulated in the root zone not only affect the plant but also threaten the nature. The studies of leaching are becoming increasingly important because of the movement of the dissolved salts out of the root-zone. When these solutes reach the surface or the ground of water they may create environmental problems. Leached solutes reach drainage water or ground water. In many part of the world, drainage water and ground water are used for irrigation. So dissolved salts are spread out in large areas. Studies on this subject have increased because of the importance of the movement of salt movement in the soil. Hodson and Langan (1999) carried out leaching column experiments to investigate the effects of increase and decrease in the sulphate load on the uppermost mineral horizon of an acidified podzolic soil from NE Scotland. They reached a conclusion that the adsorption was probably limited by the rate of diffusion of ions from the bulk soil water to the surfaces of soil particles.

Heng et al. (1991) have carried out an experiment to determine the leaching losses of Cl, SO_4, NO_3, K, Mg, Ca and Na. They found that Cl was the dominant anion in the drainage water, with losses total concentration of 100 kg/ha per year. The leaching loss of $S0_4$ was concentration of 13 kg S/ha per year from the paddock fertilised with superphosphate compared with 3 kg/ha per year from the elemental S-fertilised paddock.

A study was carried out to determine the influence of leaching with different amounts of water on desalinization and permeability behavior of chloride and sulphate-dominated saline soils. Desalinization of the Cl profiles was more efficient than the SO_4 profiles, but the reverse was the case with desodification. They have also evaluated the effects of leaching water depth, ESP, application of farmyard manure on soil permeability (Sharma and Manchanda, 1996).

In this study, it was analyzed the effect of irrigation of sunflower with having different salt concentrations and varying leaching fractions of water, on EC and ion concentrations of drainage waters collected from the bottom of the PVC soil columns.

Materials and Methods

The study was carried out in the experimental fields of Agricultural Faculty of University of Ankara, located at Dışkapı region.

The study was carried out with sunflower in PVC soil columns with 40 cm diameter and 115 cm length. The study was carried out with 3 different irrigation amounts, two of which with leaching fractions, and 5 irrigation waters with different salinity levels, repeated 3 times. 45 soil columns were used in total. The three irrigation treatments contained 75%(L_1), 115%(L_2) and 135%(L_3) of the required water. The irrigation water salinities were 0.25 dS m^{-1} as control treatment (S_1), 1.5(S_2) and 3.0 dS m^{-1}(S_3) with NaCl+$CaCl_2$ salts and 1.5(S_4) and 3.0 dS m^{-1}(S_5) with NaCl+$CaSO_4$ salts as saline treatments. Soil water contents were determined with the TDR probes installed at depths of 15, 45 and 75 cm in the columns. Drainage waters were collected from the leached columns (i.e. from L_2 and L_3) by situating plastic cups at the bottom of the soil columns. The soil used for this study was sandy-loam with field capasity 25.1%, and $EC_{1:2}$=2.98 dS m^{-1}.

Irrigation were made by a drip system and amount of water applied were calculated from the TDR measurements, and soil samples taken and analyzed gravimetrically during the irrigation time as well. As the average of all irrigations salinity(EC_i),pH, Cl^-, and SO_4^{-2} contents of irrigation water were given in Table 1.

Table1. Average EC, pH, Cl, and SO_4 contents of irrigation waters

Treatments	Cl^-, ppm	SO_4^{-2}, ppm	EC, µS cm^{-1}	pH
S1	83.12	72.17	0.27	7.82
S2	3761.63	265.28	1376.46	7.45
S3	924.24	13.94	2736.01	7.42
S4	104.52	869.67	1682.77	7.69
S5	308.08	1327.09	2997.58	7.53

Results and Discussion

In this study, the results of Cl^- and SO_4^{-2} are given especially because these two ions are the added salts to the irrigation water for the leached treatments L2 and L3 in different concentrations. Beside the EC measurements are given as well in the graphics.

The Cl- is the most movable and easily leachable ion in the soil amongst the most common ions such as SO4, CO3, HCO3, NO2, NO3 etc.

Adding Cl- to the irrigation water causes more leaching chlorade in drainage water for the columns. Generally, if Cl^- is more in the irrigation water and more leaching is applied (L_3), a higher concentration of Cl- will be in the drainage water. So S_2 and S_3 treatments produced a higher concentration of Cl^- in drainage water in comparison to S_1, S_4 and S_5 salinity treatments which had lesser Cl^- in irrigation water. Besides, a higher water application for leaching (L_3) causes more Cl^- load in the drainage water (Fig.1).

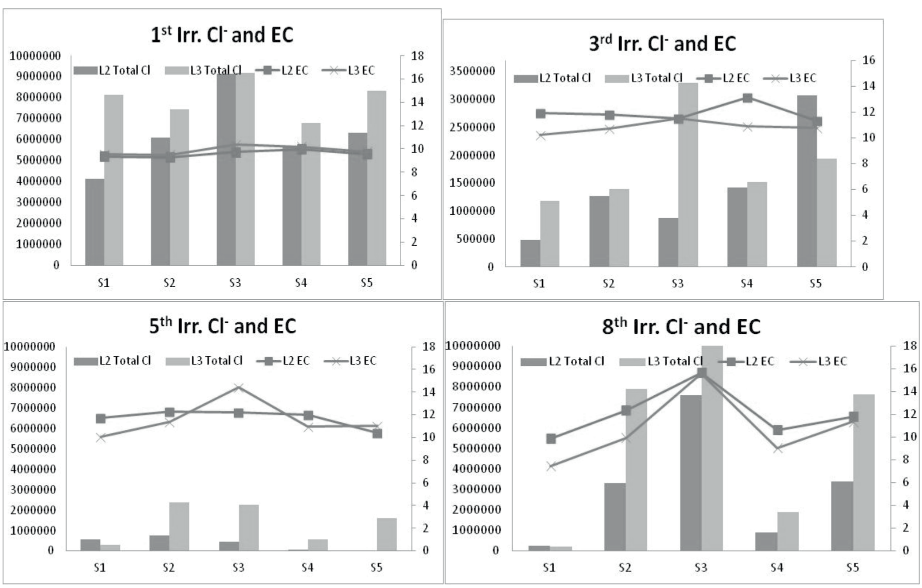


Fig. 1. Chloride changes in drainage water in relation with the experimental treatments.

The most Cl^- leaching for the seasonal irrigation period of sunflowers, was during the beginning. This is because Cl^- naturally existent in the soil was leached along with the Cl^- added to the irrigation water.

Since chloride is an easily transportable ion in the soil and an easily soluble salt, it has widely variated in the drainage water throughout the irrigation period(Fig.1).

The results for SO_4^{-2} are similar to that of Cl^-. More SO_4^{-2} ion added in the irrigation water caused more leached sulphate in the drainage water. And as more leaching water was applied to the soil, more SO_4^{-2} leached in the drainage water (Fig. 2). However, it is not clear whether the increased leaching on sulphate in the drainage water was caused by the chloride which could be a possibility because generally sulphate is not as easy to leach as Cl^-.

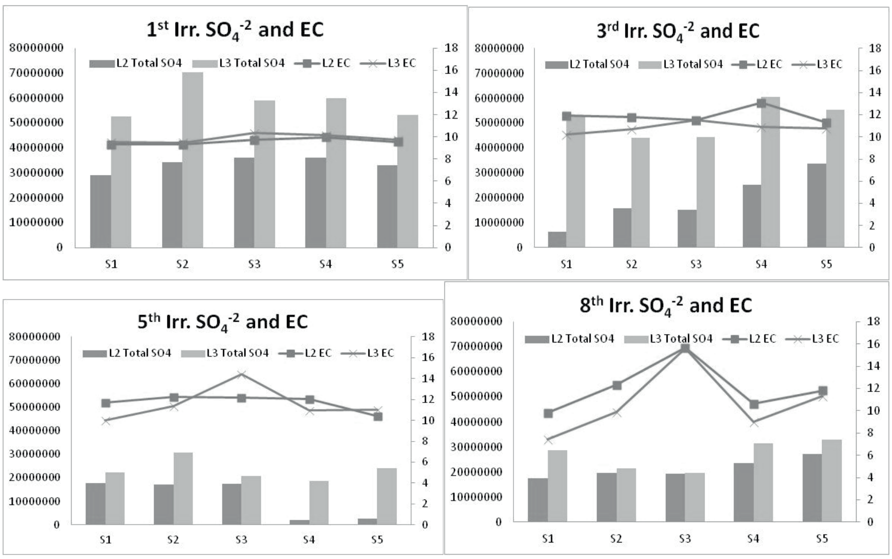
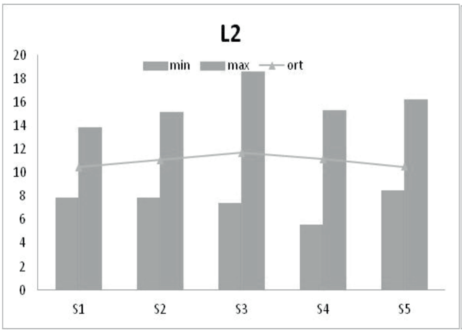


Fig. 2. Sulfate changes in drainage water in relation with the experimental treatments.

Increasing the leaching ratio from 15% to 35%, caused an increase of leached sulphate for all the irrigation applications. In addition, the leached SO_4^{-2} the first irrigation time caused more sulphate load in the drainage water because of the SO_4^{-2} which was initially present in the soil was leached along with the SO_4^{-2} added with the irrigation water (Fig.2).

EC of drainage waters were measured by EC meter (YSI3200), and shown on the Cl and SO_4 graphics, as well as in Fig.3 with max, min and average values in relation with the experimental treatments.



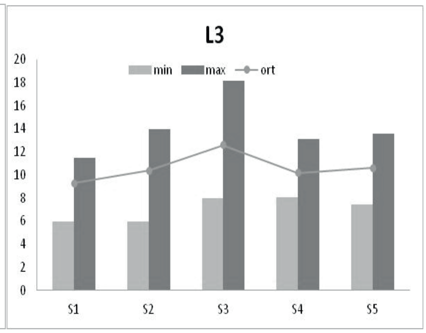


Fig. 3. EC (dS m^{-1}) of drainage water as max, min and average values in relation with the treatments

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Factors of volcanism, determining the formation of Andosols (taking Kamchatka as an example)

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Key words: Kamchatka, volcanic activity stage, maturity Andosols.

Introduction

Depending on climatic conditions Andosols are characterized by either andic or vitric horizons. Andic horizons are common for mature Andosols, which develop mainly in warm climates. These horizons are rich in allophanes (and similar minerals) or metal-humus complexes. Andosols of temperate climate contain fewer amounts of allophanes and vitric 'horizons are dominating for them. Vitric horizons contain large amounts of volcanic glass and primary minerals of ashes. In accordance with the World Reference Base for Soil Resources (WRB, 2014) vitric properties require the content of amorphous (oxalate-soluble) forms of iron and aluminum not less than 0.4 percent, and Andic properties - not less than 2 percent. Amorphous (oxalate-soluble) forms of iron and aluminum testify to content of allophanes or metal-humus complexes in soils.

In Kamchatka, in humid and cold climate, the maturity of Andosols is determined by different conditions of volcanism. Observed differences in the properties of soils, formed under the influence of different volcanic types allow to identify volcanism factors which have an effect on soil formation.

Materials and Methods

Works were carried out in the west, south, south-east of the region, within the central part of the peninsula, in slightly off to the south-west of the northern Kamchatka volcanic center, to the north of it (the upper river Ozernaya) and to the north-west (Cape Utkholok, north -western coast of Kamchatka) (Fig. 1). The basis of the work was routing soils research having been carried out for 10 seasons. During the field work 142 soil profiles were laid down and described, 40 of them were basic for the selection of soil samples for analytical processing in the laboratory.

Amorphous forms of silica, iron and aluminum were extracted by ammonium oxalate buffer at pH 3 (extractor A. Tamm), the metathetical forms of calcium and magnesium were detected by complexometric method.

Results and Discussion

Analysis of available data on the Holocene volcanism in Kamchatka and the study of specific conditions it provides for soil formation allowed to separate out North and

South provinces of soils on the peninsula, the formation of which took place under the influence of volcanic eruptions in different stages of development, differing in composition, volume and frequency of ash falls.

1. For Southern part the soils formed mainly on the ashes of southern volcanoes of Kamchatka are typical (Opala, Ksudach, Kuril Lake). The latter are in the mature phase of volcanism - with rarely occurring large caldera-forming eruptions, whose products are of rhyolite and rhyolite-dacite composition.

2. Northern part, where the soils are formed on the ashes of the northern group of volcanoes of Kamchatka (Shiveluch, Tolbachik, Nameless, Kluchevskoy) which are in a young basaltic stage of development with often occurring eruptions with a minor amount of pyroclastic material of mostly basalt, basaltic-andesite compositions.

Within the large provinces smaller individual territories have soil profiles with similar structure of their dated ash horizons. A comparative analysis of soil properties of the Northern Province and the Southern Province was performed.

Considering the different intensity of volcanic activity and regional climate in Kamchatka in the Holocene, when comparing the soil properties, we distinguish two main elementary aggregate soil profiles as individual units of general soil profile - Early and Late Holocene. Early Holocene part of the profile was formed with ash deposited during the regional increase in volcanic activity in the early Holocene (8700-6800 YA), and transformed in the period of weakening intensity of explosive eruptions and climate warming in the mid-Holocene (6800-1800 YA). Late Holocene – was formed in the second period of explosive volcanic activity of Kamchatka (1800-1400 YA) in cold climatic conditions.

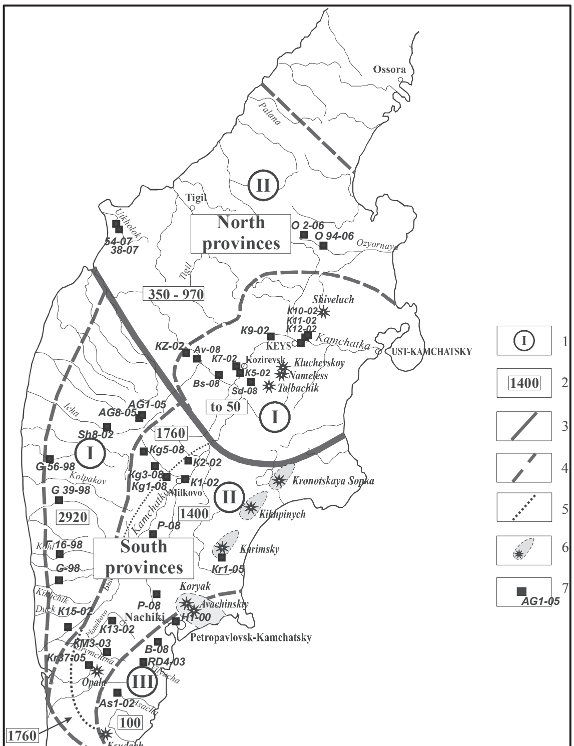

Fig . 1 . Provinces and regions of Kamchatka volcanic soils

Results and Discussion

Late as well as Early Holocene of the soil profile of the Northern Province in comparison with similar elementary profiles of the Southern Province have relatively higher soil pH, base saturation, and they are poor in humus and oxalate-soluble forms of silicon, iron and aluminum (Fig. 1).

Table 1

Comparative analysis of the chemical properties of the soil horizons formed in different periods under the influence of mature Holocene (Southern Province) and young (Northern Province) volcanism

Soil properties	Southern Province		Northern Province	
	Late Holocene part of the profile	Early Holocene part of the profile	Late Holocene part of the profile	Early Holocene part of the profile
Surface coarse organic horizons AO				
Number of samples	12	–	9	–
pH (water)	5.76±0.46	–	6.08±0.14	–
LOI, %	40.74±26.36	–	48.67±21.02	–
The degree of soil base saturation	42.68±11.75	–	58.58±5.22	–
Siox	0.24±0.11	–	0.40±0.12	–
Feox	0.48±0.14	–	0.37±0.08	–
Alox	0.64±0.43	–	0.43±0.17	–
Amount Feox+ Alox	1.12±0.58	–	0.80±0.25	–
Humus (surface and buried) horizons A				
Number of samples	20	24	27	14
pH (water)	5.33±0.54	5.65±0.45	6.02±0.49	6.58±0.47
Humus. %	5.78±2.91	5.75±2.41	2.03±1.54	2.55±1.62
The degree of soil base saturation	25.00±16.63	20.56±10.51	56.10±12.86	76.60±7.37
Siox	0.41±0.37	2.44±1.08	0.58±0.23	1.93±0.46
Feox	0.71±0.43	3.00±1.25	0.84±0.28	1.59±0.38
Alox	0.94±0.61	5.86±1.78	1.00±0.50	3.12±0.47
Amount Feox+ Alox	1.65±1.04	8.86±30.3	1.84±0.72	4.71±0.58
Transitionalhorizons B				
Number of samples	21	24	20	16
pH (water)	5.63±0.30	5.78±0.38	6.27±0.49	6.62±0.38
Humus. %	2.85±1.18	4.51±2.22	0.67±0.39	1.58±0.89
The degree of soil base saturation	12.32±5.38	24.20±14.51	56.35±13.64	75.93±8.74
Siox	0.51±0.39	2.92±1.08	0.60±0.31	1.75±0.78
Feox	0.85±0.41	2.75±1.00	0.61±0.34	1.24±0.69
Alox	1.25±0.80	7.79±3.27	0.92±0.55	2.69±1.06
Amount Feox+ Alox	2.10±1.21	10.54±4.27	1.53±0.84	3.93±1.66

Higher alkalinity of soil near active volcanoes which are in the early stages of volcanic activity (Northern Province) in the geological past and nowadays is provided by frequent supply of fresh material, basic and intermediate compositions ashes.

These ashes are saturated with alkaline earth cations, which having been released by weathering, alkalize soil, prevent the formation of allophane and accumulation of organic matter. The conditions of early stage volcanism are not favorable for the formation of mature Andosols. For soils in the northern province of the modern period (late Holocene part of the profile) vitric characteristic properties are common, in the geological past (the Early part of the profile) they lack andic properties in content of oxalate-soluble forms of iron and aluminum.

The Southern Province soils formed under the influence of volcanoes in the mature stage of volcanic activity, when fresh volcanic material enriched with alkaline earth cations was not provided for long periods. These conditions determine the development of more acidic soils, slower, but more thorough weathering of rhyolite and rhyolite-dacite ash. More acidic soil composition makes the process of formation of allophane or metal-humus complexes dominant and contributes to the accumulation of organic matter.

In the mid-Holocene long period of decrease of volcanic activity in Kamchatka coincides with climatic temperature maxima. These conditions explain the presence in the Early Part of elementary profiles of both provinces soil horizons which have Andic properties on the content of amorphous forms of Al, Fe (weakly represented for soils of the Northern Province and well-developed in soils of the Southern Province). In soils of the Southern Province these properties are expressed much stronger. The territory is remote from the northern group of young volcanoes, which continue to supply fresh material in small portions and alkalize the soil of the Northern Province even during the decay of caldera volcanic activity in Kamchatka. In the middle of the Holocene within the territory of the South Kamchatka province conditions for the formation of mature Andosol become favorable. Concentrations of amorphous forms of iron and aluminum in the humus and mineral horizons range from 8.9% to 10.5%, respectively. Humus content in the organic horizons is an average 5.7%, in mineral - 4.5%.

In general, the soil of the South Province, developed in acidic volcanic ashes which are in the mature stage of development CALDERA, is characterized by a low degree of base saturation, more acidic environment, with relatively high humus content and the presence of the lower profile horizons with distinct andic properties. Soils of the Northern Province, formed from the ashes of modern volcanic eruptions are basaltic in early stages of development, have a relatively higher degree of alkaline saturation and higher degree of alkaline reaction. Humus content in them is low, in the lower parts of the profiles andic properties are undeveloped.

Conclusion

In the early stage of the volcanic activity, as opposed to the mature stage, the main influencing factors of volcanism on soil formation are frequent supplies of fresh-material composition of basalt and andesite ash in small quantities.

In the mature stage of volcanic activity the main factors of volcanism which influence soil formation are acidic composition of ash, large volumes and their regional distribution, long periods of absence of any supply of fresh volcanic material.

Experiment in the use of Kamchatka volcanic ash to improve soil fertility

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Key words: Kamchatka, volcanic ash, catalytic properties, soil fertility

Introduction

The most obvious and often discussed reason for bio-productivity increase of ecosystems while using product of volcanic activity is associated with the additional supply of chemical elements from the volcanic ashes [2, 3]. Although, data about the favorable properties of volcanic ash is available, mechanism of raise of bio-productivity of ecosystems while using products of volcanic activity still remains poorly understood. Perhaps this is due to the fact that international scientific literature lacks positive examples of application of products of volcanic activity as an independent fertilizer in agriculture. Our work describes the first field Agronomy experience with volcanic ash of Kamchatka for growing crops and analyzes the mechanism of influence of ash that raise bioefficiency of acrocyanosis.

Materials and Methods

The experiment was conducted in the ochreous volcanic soils (Andosols Acroxic) in the central region of South Kamchatka soil provinces [1] on the experimental fields of the Kamchatka Research Institute of Agriculture (South Kamchatka, Avacha River valley).

During the experimental studies soils were enriched with fresh volcanic ash of Sheveluch eruptions and converted ochreous Holocene volcanic ash forming the transitional horizon most common in the south and in the central part of Kamchatka volcanic ochreous soils. Ashes were added in the amount of 2.5-7.5 t / ha in combination with mineral fertilizers. As a conventional mineral additive we used fertilizers containing basic elements of nutrition: nitrogen, phosphorus, potassium, in the doses of 120 kg / ha (N120P120K120 - the usual dose used in the region), and 60 kg / ha (N60P60K60) of the active substance.

In soils and volcanic ash gross content of 62 chemical elements and the concentration of soluble (ammonium acetate-hood) forms 65 elements were detected by mass spectral (ICP-MS) + atomic emission (ICP-AES) analysis method with inductively coupled plasma. The parameters evaluated in soil: pH of the water and salt extraction, hydrolytic acidity, content of mobile forms of calcium and magnesium (by complexometric method). The content of nitrate and starch in potato tubers was measured.

Ashes of Shiveluch are represented mainly by loam, pulverized material of previous eruptions, selected from fresh sediment, brought by water to the foot of the volcanic edifice.
Transformed Holocene volcanic ash widespread in mid-profile ochreous volcanic soils of Kamchatka is promising for agriculture. These ashes have undergone maximum transformation in the period of the Atlantic climatic optimum[1]. They owe their properties to favorable climatic conditions in the middle Holocene (4800-6800 years ago), when the temperature was 4 ° C higher in Kamchatka than it is nowadays [7] and a long spell of decrease of volcanic activity during this period. [6]. Being in warmer climates for a long time and close to the surface (in the zone of active soil), while not overlapped by young products of volcanic activity, these horizons have acquired properties that are typical for mature subtropical Andosols.

Results and Discussion

The study of the chemical composition of ash material, introduced into the soil during the agricultural field experiment showed that there was no significant enrichment of its available forms of chemical elements compared to arable soils (Fig. 1). Fresh volcanic ash of Shiveluch compared with experimental field soils show higher content of only 4 out of 57 elements studied: As (6,7) - P (1,4) - Mg (1,07) - V (1,06) . 37 elements have increased content in converted Holocene volcanic ashes with a multiplicity of excess of 1.12 (Rb) to 11.6 (Se), with an average of 4.45.

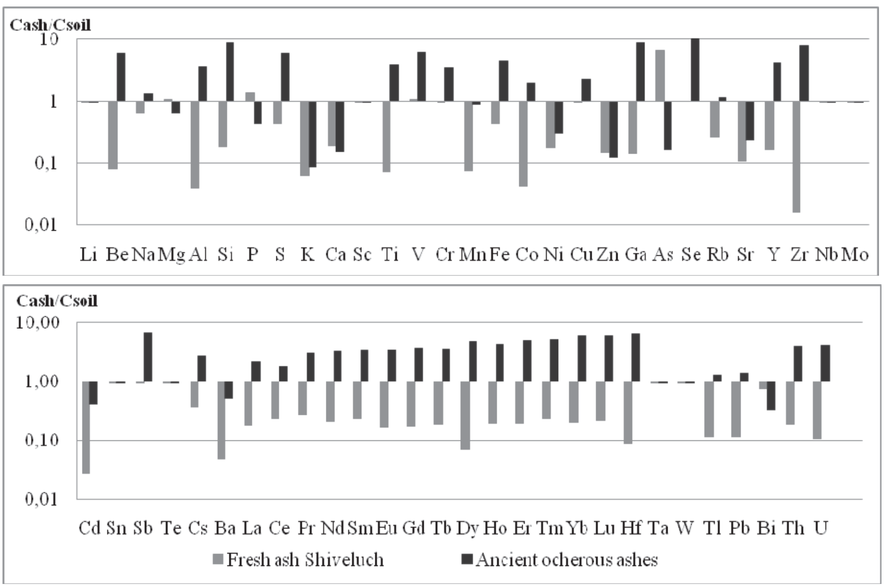

Fig. 1. The content of mobile forms of chemical elements in volcanic ash (C-ash) in relation to the concentrations of elements in volcanic ochreous soils of experimental field (Csoil).

In the first years of experiment due to the usage of ancient ocherous ash (in combination with various doses of fertilizer) for different variants of the experiment the increase of potato yields was from 37 to 72%, on average 52% compared to background sample (Table. 1). In all variants while using fresh volcanic ash yield increase was slightly lower - from 31 to 63%, an average of 47%. This is due to the fact that Holocene ocherous ashes have richer chemical composition in comparison with fresh ash (Fig. 1). A more significant increase in the average yield in relation to the background samples was observed when using twice as low doses of mineral fertilizers. In all variants of the experiment direct proportion of the growth of productivity to the amount of ash contributed was not detected.

Table 1

Results of field experiment for the study of the effectiveness of ocherous (ash o) and fresh (ash f), volcanic ash

Experiment variants	Yields average of four repetitions		Potato tubers				The degree of soil base saturation	
			Nitrates		Starch			
	t/ha	±*, %	mg / kg	±, %	%	±, %	%	±, %
Without fertilizer - control	62.0	–**	182.0	–	11.00	–	55.53	–
Background 1 – $N_{120}P_{120}K_{120}$	118.0	–	213.8	–	10.20	–	43.05	–
Background 1 + ash o 2,5 t/ha	162.0	+ 37.0	347.3	+ 62.4	10.70	+ 4.90	–	–
Background 1 + ash o 5,0 t/ha	172.0	+ 46.0	281.8	+ 31.8	10.70	+ 4.90	69.53	+ 26.48
Background 1 + ash f 2,5 t/ha	156.0	+ 32.0	257.8	+ 20.6	10.50	+ 2.94	–	–
Background 1 + ash f 5,0 t/ha	155.0	+ 31.0	338.8	+ 58.5	11.00	+ 7.84	69.21	+ 26.16
Background 1 + ash f 7,5 t/ha	163.0	+ 38.0	446.7	+ 108.9	10.20	+ 0.00	69.68	+ 26.63
Background 2 – $N_{60}P_{60}K_{60}$	105.0	–	180.2	–	11.20	–	54.01	+ 4.64
Background 2 + ash o 2,5 t/ha	181.0	+ 72.0	190.5	+ 5.5	11.50	+ 2.68	–	–
Background 2 + ash o 5,0 t/ha	161.0	+ 53.0	138.0	-23.6	11.90	+ 6.25	54.91	+ 5.54
Background 2 + ash f 2,5 t/ha	165.0	+ 57.0	168.0	-6.9	11.50	+ 2.68	–	–
Background 2 + ash f 5,0 t/ha	171.0	+ 63.0	183.4	+ 1.6	11.00	-1.79	58.89	+ 9.52
Background 2 + ash f 7,5 t/ha	172.0	+ 63.0	184.8	+ 2.4	10.70	-4.46	–	–

Note. * ± - relative to the background, ** "-" - no data available.

Taking into account that the doses of ash applied in the soil are quite low and content of available forms of chemical elements in the ash is not significant in comparison with the arable lands, there is no reason to believe that the yield increase is related to the receipt of additional chemical elements. There is no doubt the effect is triggered by the activation of the plants' assimilability of nutrients available in the soil and in mineral fertilizers, introduced along with the ashes , as well as increased microbial enzymatic activity due to the presence of a very wide range of microelements in the ashes.

The catalytic action of ash is confirmed, along with an increase in productivity, by an increase of 3-8% in the potato tuber starch content (Table. 1). Along with the stimulation of nitrogen fixation, ashes have a favorable impact on nitrogen and carbohydrate metabolism of plants and affect the increase of starch content.

In this very case specifically a broad composition of trace elements present in the volcanic ash increase the intensity of microbiological processes in soils. This fact is also confirmed by the growth of nitrate nitrogen content in potato tubers when the ash was used in the course of experiment , this growth is definitely associated with the more intense activity of microorganisms in the soil and above all autotrophs bacteria that can absorb nitrogen from the air (Table. 1).

During the experiments with the use of the ash in the soils, as compared with the background, the growth of saturation of soil with bases was observed (Table. 1). The problem of quite expensive liming of areas, which are located at a substantial distance from the known deposits of limestone, is very relevant today and can be partially solved by the use of volcanic ash.

Conclusion

The presence of a broad spectrum of mobile forms of chemical elements in volcanic ashes in small amounts, but in proper proportion for effective life activity, gives catalytic and stimulating properties to the ashes. Due to the catalytic action of the ashes, the use of them along with the application of fertilizers raises the level of crop yield.

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The content of trace elements in soils of the Astrakhan region

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Keywords: soil, heavy metals, trace elements.

Soil - a very specific component of the biosphere, because it not only geochemically components accumulates contaminants, but also acts as a natural buffer that controls the transfer of chemical elements and compounds in the atmosphere, hydrosphere, and living matter [1]. Soil-specific natural formation, which has a number of properties inherent in animate and inanimate nature, formed in the result of a long transformation of the surface layers of the lithosphere under the combined influence of the hydrosphere, atmosphere, living and dead organisms [2].
Unlike water and air, where the pollutants are diluted thereby decreasing their concentration, soil accumulates contaminants falling in from various sources. Moreover, pollutants do not remain on the soil surface and penetrate the different soil horizons.
In the paper the basic soil of the Astrakhan region: light brown, brown semidesert, loamy and sandy soils.
Light brown soil has a higher content of humus, slightly alkaline reaction medium, heavy and srednesuglinistym grading. They have a high absorption capacity.
The most common ground with a light-brown soils are used for pasture. These soils are potentially fertile. In terms of reference of irrigated farming on the lands occupied by light-brown soils, formed a strong crack crust.
Brown semidesert soils characterized by low humus content, particle size distribution of light loamy, neutral pH.
In hot climates the formation of brown soils associated with chemical and mechanical composition of the parent rocks. Increased salinity is one of the main reasons for the low natural fertility of brown soils. For this type of soil in arid climate characterized by the fact that at a depth of salt gradually move to the surface by capillary currents of water, resulting in their salinity. Sparse vegetation brown soils enriches their little organic matter and dead plant residues, coming to the surface, under the influence of aerobic processes and high temperatures undergo rapid degradation.
The sandy soil is brown semidesert introzonalnoy brown soil in the area of semi-desert; It characterized by very low humus content, particle size distribution of sand, slightly alkaline reaction medium.
As overgrowing sands is the formation of soil. On the soil slightly overgrown sands are in the initial stages of formation. With increasing overgrowing sands over time acquire a number of new properties. A weak differentiation of the soil profile into

genetic horizons. These features are enhanced by the transition from medium to heavily overgrown overgrown sands. But in some places the area loose, dispels sands increases. This is due to grazing on natural pastures, which are degraded and poor soil cover has been destroyed.

Loamy soil type has a brown color, loose constitution, lumpy structure, slightly acidic reaction medium, high humus content.

In the Astrakhan region in low humid processes, arid climate, the high content of salts in the soil, humus and a low prevalence of fulvic acids in its composition, migration significantly increases the ability of trace elements, especially in soils with a slight grading. With the worsening of particle size distribution in the soil increases the total content of trace elements and can be placed in the soil following decreasing sequence: alluvial-meadow <light brown <brown semidesert. [3]

Sampling was conducted by an envelope. Collection of soil samples was carried out in November 2013 and 2014 years. Mass fraction of metals in the soil samples was determined by tribal atomic absorption spectrometry.

Studies brown semidesert soils showed that the content of heavy metals in the soil does not exceed the maximum allowable concentrations.

Distribution of trace elements in different salinity, light chestnut and brown soils are very different (Table. 1).

Table 1

The average content of trace elements in different types of soils of the Astrakhan region

	brown semidesert, mg / kg	light brown, mg / kg	loamy, mg / kg	sand, mg / kg
Plumbum	8,78	13,35	12,8	3,15
Cuprum	21,55	17,95	15,5	19,45
Nickel	16,5	52,15	54,15	27,7
Cadmium	0,075	0,06	0,1	0,06
Zincum	53,2	61,25	58,35	48,9
Cobalt	8,53	11,8	15	7
Marganec	312,5	1070,5	1179,5	276
Ferum	24702	30201,5	30805	22072
Mercury	<0,1	<0,1	<0,1	<0,1

The zinc content in the light-brown soil is in relatively normal amount - 61.25 mg / kg, and in the semi-desert-brown and sandy soils found zinc deficiency (53.2 mg / kg and 48.9 mg / kg, respectively). This is due to the high content of phosphorus, which is the result of unbalanced practices fertilizer application.

In the Astrakhan region copper deficiency is observed on the same soil as the zinc. loamy soil mean the amount equal to 15.5 mg / kg, light-brown soil - 17.95 mg / kg.

Liming increased phosphate content and reduce the mobility of copper in the soil due to the poor solubility of carbonates and phosphates of copper in the soil. Heavy-textured soils richer in copper than light (sandy, loamy).

The manganese content in the soil depends not only on the form in which are his connections, but also on pH, temperature, humidity, soil aeration, and others. With the improvement of soil aeration manganese content is reduced and high humidity - is increasing. This explains the insufficient amount of manganese in the sand (276 mg / kg) and brown semidesert (312.5 mg / kg) of soil, as compared to other types of soil.

Lead adsorbs mainly the surface of clay particles, organic compounds and oxides of manganese, etc. Among the heavy metals lead, less mobile, as evidenced by its low content in the soil solutions of the soils of the Astrakhan region. It is important to know the amount of lead in the soil, because it accumulates in the terminal units of the food chain, who is the man. The average content of lead-brown semi-desert soil - 8.78 mg / kg, loam - 12.8 mg / kg, light-brown - 13.35 mg / kg in the sand - 3.15 mg / kg.

A higher content of humus leads to fixation of lead and cadmium in the soil and increased acidity - to their solubility and mobility. The average content of cadmium-brown semi-desert soil -0,075mg / kg loam - 0.1 mg / kg, light-brown - 0.06 mg / kg in the sand - 0.06 mg / kg. The mercury content unlike lead and cadmium humus content increases with the tillage layer, indicating that the biological nature of its migration. In the study of the mercury content in all types of soils of less than 0.1 mg / kg.

The increased nickel content in soils lead to endemic diseases - plants appear ugly forms, the animals - an eye disease associated with the accumulation of nickel in the cornea. The study revealed that the average number of nickel-brown semi-desert soil - 16.5 mg / kg, loam - 54.15 mg / kg, light-brown - 52.15 mg / kg in the sand - 27.7 mg / kg nickel Clark soil is 40 mg / kg. [5] Nickel in soil differs weak mobility, mostly concentrated in the clay fraction enriched with minerals.

In soils iron is present mainly in the form of oxides and hydroxides, and stored either in the form of small particles, or associated with the surface of minerals. Iron deficiency is manifested at high levels in the soil, manganese, zinc, copper. Iron toxicity is often associated with soil salinity and low content of phosphorus. The average iron content in the brown semi-desert soil--24 702 mg / kg, loam - 30805 mg / kg, light-brown - 30201.5 mg / kg in the sand - 22 072 mg / kg.

An important factor in the distribution and behavior of cobalt in soils is the presence of organic matter and clay compounds. The more soil organic matter and clay compounds, the more the cadmium found in soil. The average cobalt content-brown semi-desert soil -8.53 mg / kg, loam - 15 mg / kg, light-brown - 11.8 mg / kg in the sand - 7 mg / kg.

Most suitable for cultivation of various garden and vegetable crops are considered to loamy soils. The advantages of loamy soils include a high content of mineral components and nutrients, the number of which is constantly increasing as a result of vital activity of soil microorganisms inhabiting this and its relatively high biological quality.

The advantage of loamy soils is the high level of air permeability and transmissivity. They have the ability to retain moisture, spreading it evenly over the entire thickness of the horizon, and keep warm. This, in turn, leads to a balanced water and heat regimes of the soil of this type.

The value of the soil is determined not only by its economic importance for agriculture, forestry and other sectors of the economy, but also an indispensable ecological role of soil as an essential component of all terrestrial biocenoses and the Earth's biosphere as a whole. Currently, you must have the methods for assessing soil contamination, which can give an objective picture of the state of the soil, that is how it is able to perform its designated function.

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The effects of different fertigation frequencies on yield and nutrient uptake of muskmelons (*Cucumis melo* L.)

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Key words: Fertigation, phosphorus content, irrigation.

Introduction

Water and nutrient management have recently become a significant issue in agricultural practices to minimize negative environmental impacts and to have higher yield levels. Accurate combination of water and nutrients is a base priority for high and quality yields. Fertilizer application method has significant effects on efficient use of nutrients. Fertigation is defined as the combined application of water and fertilizers. It is the application of fertilizers through irrigation water (Bar-Yosef, 1991). Fertigation is a recent modern agricultural implementation technique improving fertilizer use efficiency. It also provides easy application of fertilizers, minimizes fertilizer use and consequent environmental impacts of fertilizers on environment and allows producers to have maximum yield increases. Fertigation timing may easily control the amount and concentration of fertilizers (Hagin et al., 2002). Fertigation provides a precise timing to meet deficient and required nutrients for plants and allows homogeneous and sufficient supply of water and nutrients (Mohammad, 2004b). Through fertigation, water and nutrient contact with the soil is reduced and directly applied to root zone of the plants, consequently significant savings are achieved in irrigation water and nutrients (Mohammad and Zuraiqi, 2003; Beyaert et al., 2007).
The present study was conducted to compare fertigation with conventional fertilization, to find out the best fertigation frequency and the effects of different fertigation frequencies on yield and macro-micro nutrient (P, K, Mn, Fe, Cu and Zn) uptake of two different muskmelon cultivars grown under the same regional and climate conditions.

Material and Method

Material

Experiments were conducted under field conditions over the experimental fields of Crop and Animal Production Department of Cumhuriyet University Sivas Vocational Collage. Physical and chemical characteristics of experimental soils are provided in Table 1. The muskmelon cultivars of Kırkağaç and Yuva were used as the plant material of the study. Muskmelons were seeded in turf and perlite mixture (1:1 V/V) and irrigated regularly. Then the resultant seedlings were transplanted over experimental plots.

Table 1

Some physical and chemical characteristics of experimental soils

Sand	Silt	Clay	**P_2O_5**	**K_2O**	**Organic Matter**	**pH**	**$CaCO_3$**	**Salt**	**Fe**	**Zn**	**Cu**	**Mn**
(%)			**(kg ha^{-1})**		**(%)**		**(%)**			**(mg kg^{-1})**		
14.6	48.3	37.1	34.0	935.9	1.7	7.28	19.6	0.032	3.99	0.42	1.21	4.68

Method

Planting, Care and Harvest Processes: Muskmelon seedlings were planted in seedbeds with 1.80 m row spacing and 1 m on-row plant spacing. Experiments were conducted in randomized blocks split plots design with three replications in 36 plots. Each plot had 4 rows and each row had 4 plants, thus each plot had 16 plants.

Main plots were composed of muskmelon cultivars (Kırkağaç and Yuva) and sub-plots were composed of control, conventional fertilization, fertigation in every irrigation, fertigation in every second irrigation and fertigation in every third irrigation.

Fertilization: Considering the chemical analysis results of experimental soils, 160 kg N/ha nitrogen (N), 60 kg P_2O_5/ha phosphorus (P) and 200 kg K_2O/ha potassium (K) were applied to muskmelon plant as fertilizer. Despite high K_2O content of experimental soils, additional K fertilization was performed because of high K requirement of muskmelons. N was applied in the form of ammonium sulphate $(NH_4)_2SO_4$, P was applied in the form of MKP (mono potassium phosphate) and K was applied in the form of potassium nitrate (KNO_3).

Fertigations were implemented in every irrigation, every second irrigation and every third irrigation. Conventional fertilization is applied as the one implemented by the local farmers (all of P and K was applied to plant row at planting and N was applied in 3 portions).

Irrigation: For irrigations, values observed from the tansiometers buried to 30 and 60 cm soil profiles were taken into consideration. Irrigation was initiated at 25 cbar on 30 cm tansiometer and terminated at 10 cbar on 60 cm tansiometer. A total of 16 irrigations were performed throughout the growing season.

Macro-Micro Nutrients: Fully developed leaf samples were taken at the initiation of fruit ripening. Samples were dried at 70 °C for 48 hours and ground in an agate mill. The ground samples were then subjected to etching with H_2O_2-HNO_3 acid mixture. P content was colorimetrically at 882 nm in a spectrophotometer (Murphy and Riley, 1962) and K, Fe, Mn, Zn and Cu contents were determined with an ICP-OES device.

Statistical Analyses: Resultant data were subjected to ANOVA by using SPSS 22.0 for Windows software. The differences between the treatments were tested by Tukey test.

Results and Discussion

Considering the effects of treatments on yields, the highest yield (47.7 t ha^{-1}) was observed in fertigation in every second irrigation treatment of Kırkağaç muskmelon cultivar and it was followed by fertigation in every irrigation treatment of Yuva cultivar (41.3 t ha^{-1}). Compared to conventional fertilization treatments, increased fertigation frequency increased the yield levels. Dogan et al., (2008) carried out an irrigation research in 2005 and 2006 under semi-arid climate conditions and reported the muskmelon yields for sub-surface and surface drip irrigation systems respectively as 16.2-31.1 t ha^{-1} and 16.2-43.8 t ha^{-1} in 2005 and as 8.2-40.4 t ha^{-1} and 8.2-38.9 t ha^{-1} in 2006.

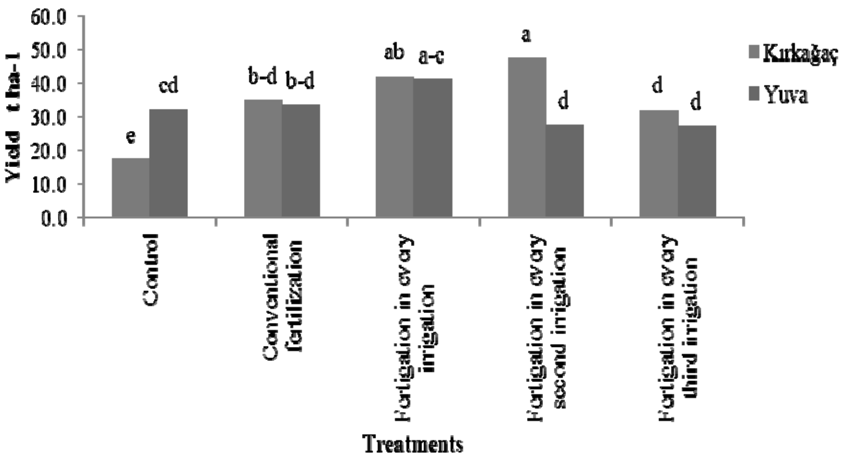

Fig. 1. Effects of treatments on yields of Kırkağaç and Yuva muskmelons

Table 2

Effects of treatments on P and K content of Kırkağaç and Yuva muskmelons (%)

Cultivar	Treatments	P		K	
			%		
Kırkağaç	Control	0.22	±0.01 c	2.26	±0.18 f
	Conventional fertilization	0.30	±0.00 b	2.87	±0.07 bc
	Fertigation in every irrigation	0.33	±0.01 ab	2.38	±0.00 ef
	Fertigation in every second irrigation	0.30	±0.02 ab	2.61	±0.28 c-e
	Fertigation in every third irrigation	0.31	±0.01 ab	2.87	±0.03 b-d
Yuva	Control	0.22	±0.01 c	2.60	±0.03 c-e
	Conventional fertilization	0.30	±0.02 b	3.33	±0.20 a
	Fertigation in every irrigation	0.34	±0.01 a	3.08	±0.01 ab
	Fertigation in every second irrigation	0.24	±0.03 c	2.57	±0.23 d-e
	Fertigation in every third irrigation	0.24	±0.00 c	3.00	±0.01 b

P<0.05

The highest phosphorus level (0.34%) was observed in fertigation in every irrigation treatment of Yuva cultivar. The highest value of Kırkağaç cultivar (0.33%) was observed again in fertigation in every irrigation treatment (Table 2). Similarly, Demirbas (2012) carried out a study to determine the effects of fertigation frequency on nutrient content of peppers and observed the highest phosphorus content in fertigation in every irrigation treatment. The highest potassium content (3.33%) was observed in conventional fertilization treatment of Yuva muskmelon cultivar.

Table 3

Effects of treatments on Fe, Zn, Mn and Cu content of Kırkağaç and Yuva muskmelons (mg kg^{-1})

Cultivar	Treatments	Fe		Zn		Mn		Cu	
		mg kg^{-1}							
Kırkağaç	Control	104.20	±8.8 d	35.55	±0.4 a-d	30.00	±1.1 c	10.70	±0.3 f
	Conventional fertilization	175.30	±26.4 a	34.03	±0.0 b-d	38.05	±1.5 a	12.35	±0.6 e
	Fertigation in every irrigation	151.90	±19.8 ab	34.32	±1.9 b-d	34.90	±1.7 a-c	10.95	±0.9 f
	Fertigation in every second irrigation	131.45	±1.5 bc	39.21	±0.9 a	34.50	±0.4 a-c	14.60	±0.9 bc
	Fertigation in every third irrigation	103.00	±6.9 d	36.78	±0.3 ab	32.95	±0.8 a-c	13.35	±0.8 de
Yuva	Control	110.85	±11.7 cd	32.26	±0.2 cd	35.80	±0.4 ab	13.70	±0.3 cd
	Conventional fertilization	133.75	±11.0 bc	32.50	±0.5 cd	31.25	±2.6 bc	15.30	±0.4 ab
	Fertigation in every irrigation	110.50	±5.8 cd	33.53	±19 b-d	32.00	±0.4 bc	16.60	±0.4 a
	Fertigation in every second irrigation	102.35	±0.1 d	32.52	±0.1 cd	33.55	±2.2 bc	16.65	±0.6 a
	Fertigation in every third irrigation	123.10	±3.3 cd	30.54	±0.6 d	37.25	±2.8 a	16.30	±0.4 a

P<0.05

While the highest iron and manganese contents were observed in conventional fertilization treatment of Kırkağaç muskmelons, the highest zinc content was observed in fertigation in every second irrigation treatment of Kırkağaç cultivar and the highest copper contents were observed in fertigation in every irrigation, fertigation in every second irrigation and fertigation in every third irrigation treatments of Yuva muskmelon cultivar. (Table 3).

Fertigation frequency is a basic management tool in drip irrigation systems. It was commonly mentioned that high fertigation frequencies were preferred to low frequencies. Several researchers also pointed out that plants should be irrigated with less water and high fertigation frequencies (Stark et al., 1983; Burt et al., 1995). Considering the overall results, it was concluded that fertigation in every irrigation improved muskmelon yields and nutrient uptakes.

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