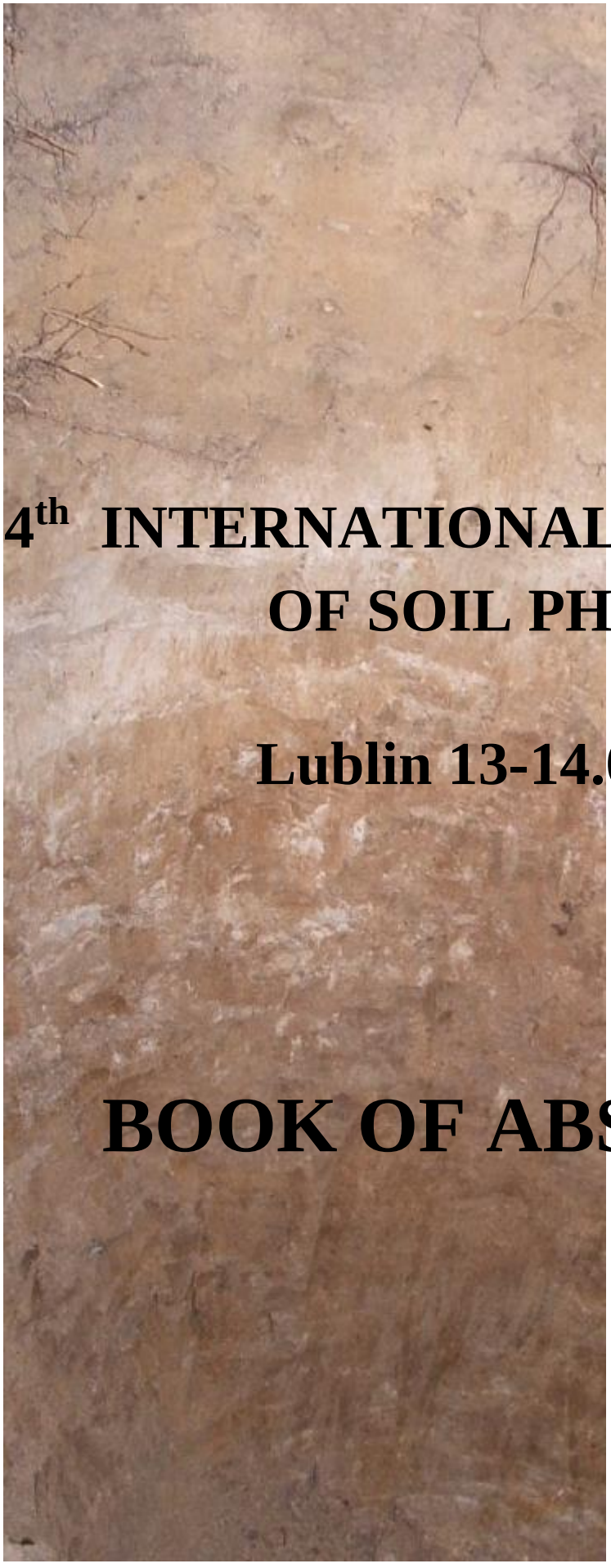

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BOOK OF ABSTRACTS

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13-14 February, 2019

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13th of February 2019

18.00 Get-together meeting - Institute of Agrophysics, Polish Academy of Sciences, 4 Doswiadczalna str., 20-290 Lublin, POLAND

14th of February 2019

9.00 – 9.10 Opening of the Symposium

9.10 – 11.00 Presentations Session I,

Charmen: Rimantas VAISVALAVIČIUS, Tomasz ZALESKI

9.10 András MAKÓ, Gyöngyi BARNA, Zsófia BAKACSI, Kálmán RAJKAI. **Soil structure and its role in the development of pedotransfer functions**

9.40 Beata HOUŠKOVÁ, Jarmila MAKOVNÍKOVÁ, Rastislav BUŠO, Roman HAŠANA, Ján ŠLINSKÝ. **The use of fertilisers and different cultivation technologies in agriculture and their influence on soil properties**

9.55 Miroslav FÉR, Radka KODEŠOVÁ, Antonín NIKODEM, Aleš KLEMENT. **Simulation of pharmaceuticals transport in soil columns**

10.10 Marzena RACHWAŁ, Tadeusz MAGIERA, Marcin SZUSZKIEWICZ, Małgorzata WAWER. **The effect of long-term deposition of dust from steel plant on magnetic properties and chemical pollution of soil and groundwater on protected areas Nature 2000**

10.25 Jonas VOLUNGEVIČIUS, Mykola KOCHIIERU, Virginijus FEIZA, Inga LIAUDANSKIENĖ, Rimantas VAISVALAVIČIUS, Kristina AMALEVIČIŪTĖ-VOLUNGĖ, Alvyra ŠLEPETIENĖ, Gražina SKRIDLAITĖ, Gailė ŽALUDIENĖ. **Some aspects of SEM application in the research of soil weathering and clay mineral formation**

10.40 TDR presentation

11.00 – 11.30 Coffee break and Poster session

11.30 – 13.10 Presentations Session II,

Charmen: Beata HOUŠKOVÁ, Radka KODEŠOVÁ

11.30 Mykola KOCHIIERU, Krzysztof LAMORSKI, Virginijus FEIZA, Dalia FEIZIENĖ, Jonas VOLUNGEVIČIUS. **The effect of macropore network on plant root length in *retisol* of western Lithuania**

11.45 Tomasz STAŃCZYK, Amanda KOSMOWSKA, Anna BARYŁA, Ewa PAPIEROWSKA. **Assessment of soil surface relief evolution in laboratory experiment under simulated rainfall**

12.00 Rafał MAZUR, Magdalena RYŻAK, Michał BECZEK, Agata SOCHAN, Andrzej BIEGANOWSKI. **Analysis of the ways of using glass beads as a soil model material in splash research**

12.15 Agnieszka JÓZEFOWSKA, Magdalena RYŻAK, Justyna SOKOŁOWSKA, Karolina WOŹNICA, Romualda BEJGER, Bartłomiej KAJDAS, Tomasz ZALESKI, Andrzej BIEGANOWSKI. **Structure formation in soils with differing textures: the role of varied organic additives and earthworms - laboratory experiment**

12.30 Virmantas POVILAITIS, Sigitas LAZAUSKAS, Šarūnas ANTANAITIS, Renaldas ŽYDELIS. **Cereal crop productivity in long term field experiment under changing climate**

12.40 Jarosław KNAGA, Tomasz ZALESKI, Stanisław BOGDAŁ. **The analyses of the temperatures fluctuations in the strawberries cultivated in growing gutter in low tunnel system**

12.55 Piotr BARTMIŃSKI, Marcin SIŁUCH. **Verification of the extent of organic soils on the basis of remote sensing data**

13.10 Summary and closing

13.20 Lunch and visiting laboratory

11.00 – 11.30 Poster session

List of posters:

1. Guillaume DEBAENE, Jacek NIEDŹWIECKI. **Mapping soil stability with an on-the-go sensor**
2. Magdalena DĘBICKA. **Mobility of soil colloids depending on some basic physical-chemical and chemical properties of soil**

3. Edyta HEWELKE, Lidia OKTABA, Dariusz GOZDOWSKI, Marek KONDRAS, Ewa Beata GÓRSKA, Izabella OLEJNICZAK. **Temporal fluctuations of soil water repellency in the pine forest Peucedano−Pinetum affected by the surface fire**
4. Jarosław KASZUBKIEWICZ, Przemysław WOŹNICZKA, Krzysztof PAPUGA, Dorota KAWAŁKO. **Device for measuring of the soil granulometric composition with an integrated mixer with sample changer**
5. Aleš KLEMENT, Miroslav FÉR, Antonín NIKODEM, Radka KODEŠOVÁ, Pavlů LENKA. **The impact of different mulching materials on soil water contents**
6. Radka KODEŠOVÁ, Aleš KLEMENT, Oksana GOLOVKO, Miroslav FÉR, Olga KOBA, Martin KOČÁREK, Antonín NIKODEM, Roman GRABIC. **Uptake of pharmaceuticals from sewage sludge amended soils by spinach**
7. Adam KUBACZYŃSKI, Małgorzata BRZEZIŃSKA, Anna WALKIEWICZ, Cezary POLAKOWSKI, Andrzej BIEGANOWSKI, Bogusław USOWICZ. **The effect of biochar addition to the soil (Haplic Luvisol) on Water Holding Capacity**
8. Inga LIAUDANSKIENE, Aleksandras VELYKIS, Antanas SATKUS, Tomas ZUKAITIS. **The effect of reduced tillage on soil organic carbon in clay loam soil in Lithuania**
9. Antonín NIKODEM, Radka KODEŠOVÁ, Miroslav FÉR, Aleš KLEMENT. **Temporal changes of soil hydraulic properties in soil columns with green pea plants**
10. Lidia OKTABA, Marek KONDRAS, Edyta HEWELKE. **Bulk density of soils after a fire in the Kampinos National Park**
11. Ewa PAPIEROWSKA, Jan SZATYŁOWICZ, Tomasz GNATOWSKI, Tomasz STAŃCZYK, Mateusz PORTKA. **Impact of soil pollution by petroleum substance on soil water evaporation**
12. Vaida STEPONAVIČIENĖ, Vaclovas BOGUŽAS, Aušra SINKEVIČIENĖ, Lina SKINULIENĖ, Alfredas SINKEVIČIUS. **Long-term impact of reduced intensity tillage systems, straw and green manure combinations on soil physical properties**
13. Oskar TYLMAN. **Changes in the basic properties of selected organic soils after 10 years of impact of the dewatering barrier around open pit mine Tomisławice**
14. Rimantas VAISVALAVIČIUS, Romutė MIKUČIONIENĖ, Jūratė ALEINIKOVIENĖ, Vita SMALSTIENĖ. **Water stability of soil aggregates under the different fertilization systems**

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Mastersizer 3000 - lider w dziedzinie dyfrakcji laserowej. Technika ta, dzięki swojej niezawodności i zautomatyzowaniu pomiarów, oferuje błyskawiczne analizy wielkości cząstek w ekstremalnie szerokim zakresie. Metoda dyfrakcji laserowej stanowi doskonałą alternatywę dla żmudnych i uciążliwych pomiarów metodą sedymentacyjną i metodą sitową. Analizator umożliwia pomiary cząstek od wielkości nano do milimetrów (zakres 0,01 - 3500 µm). Oferowany jest z całą gamą przystawek umożliwiających badania zawiesin cieczowych jak i suchych proszków, w tym odpowiednie do pomiarów składu granulometrycznego gleby.

Morphologi 4 - w pełni zautomatyzowany, bardzo czuły analizator do jednoczesnego określania kształtu, wielkości i liczby analizowanych cząstek w próbce. Umożliwia pomiar zarówno proszków w stanie suchym, jak i emulsji, a także zawiesin cieczowych, w zakresie wielkości cząstek 0,5 - 1300 µm. Model 4-ID wyposażono w spektrometr Ramana, który umożliwia dodatkową identyfikację chemiczną cząstek. Analizator dobrze sprawdza się w pomiarach kształtu i wielkości cząstek gleby oraz umożliwia identyfikację chemiczną poszczególnych minerałów czy zanieczyszczeń w próbce.

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Optimass 9600 ICP-TOF-MS – jedyny spektrometr masowy z analizatorem czasu przelotu jonów z plazmą wzbudzaną indukcyjnie na rynku. Analizator wykonuje jednoczesny pomiar wszystkich pierwiastków w zakresie 1 - 260 amu w zaledwie 25 sekund. OptiMass wyposażono w oktopolową komorę kolizyjną dla jeszcze większej dokładności pomiarów. Dodatkowy moduł pozwala oznaczać pierwiastki w ilości pojedynczych ppt, a także ograniczyć zakłócenia.

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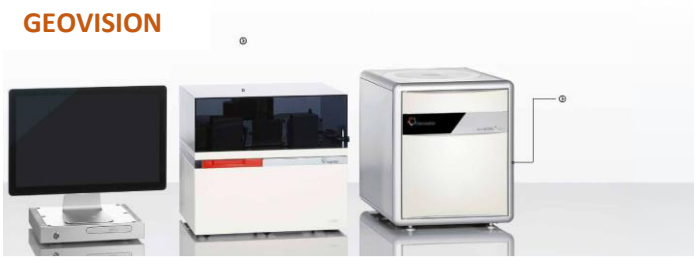

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Abstracts:

Oral presentations

Soil structure and its role in the development of pedotransfer functions

<u>András MAKÓ,</u> Gyöngyi BARNA, Zsófia BAKACSI, Kálmán RAJKAI

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There is no objective or generally applicable method to quantify soil structure. It is not known yet how the structural properties depend on other soil and environmental parameters, and how they affects other soil physical properties. Our work aims to characterize statistically the interrelationships between the particle size distribution (PSD), structure and pore size distribution (in connection with fluid retention and conductivity) of soils analyzing existing and a newly built soil structural databases.

Our new soil physical database with structural information represents the major Hungarian soil types. The dataset is based on an extensive sampling and laboratory measurement program. Compared to similar ongoing international projects, our project has a many-sided measurement plan (e.g. soil mineralogy, shape analysis and surface measurements), moreover the fluid retention and conductivity measurements will be done with nonaqueous phase liquids, as well.

In our presentation we wish to present the process of producing the database and the first results of the project, which are related to the soil structure studies. We would like to emphasize our aggregate stability tests, which are based on wet sieving and laser diffraction method.

The use of fertilisers and different cultivation technologies in agriculture and their influence on soil properties

Beata HOUŠKOVÁ[1], Jarmila MAKOVNÍKOVÁ[1], Rastislav BUŠO[2], Roman HAŠANA[2], Ján ŠLINSKÝ[3]

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Type of soil cultivation and the use of fertilisers in agricultural production have significant effect on the environmental burden. This is one of the reasons why in ecological farming the use of artificial fertilisers is forbidden. Long-term application of a particular method of soil cultivation leads to the change in soil properties. Intensity of such change is very closely related to the textural category of soil and soil type, concretely to the kind and arrangement of soil horizons. We have studied the influence of different cultivation practises on soil physical properties and the use of organic type of fertiliser in ecological farm.

Concerning cultivation practices we assessed soil physical properties in experimental farm Borovce as follows: fields with conventional cultivation, minimal cultivation, no-till and mulch application. The highest maximum retentive capacity (in Θ) and bulk density (ρd, $g \cdot cm^{-3}$) was observed in the field with convention cultivation; 36,23 (Θ) and 1,45 ρd, g.cm-3 respectively. Total porosity P was the highest (47,01 Θ) in the soil with minimizing technology. Minimal air capacity (Θ_{VA}) was the highest in the soil with mulch type of cultivation (12,55 Θ) and the lowest in conventional cultivation (8,98 Θ). Soil moisture in profile 0 – 0,8 m was the highest in minimizing technology (18,35 Θ) together with mulch (18,33 Θ). In case of no till there have been dry conditions in soil profile 0,4 – 0,8m. Reasons of this were the weather and the type of crop / grain maize. The lowest penetrometric resistance (MPa) has been observed in the soil with minimizing technology (2,06 MPa) and no-till (2,09 MPa) on the contrary to the soil with conventional cultivation (2,34 MPa). All these facts show positive soil saving effects of assessed cultivation technologies in comparison to conventional cultivation.

In ecological system of farming it is important to decide what kind of organic fertilisers will be used and how to apply them without harm to the environment and without loss of nutrients which can contaminate it. It is also important from the point of view of the economy to realize that even a small reduction in consumed fertilizer or the elimination of surplus labour operations will favorably affect the total costs of cultivation. Thus, the solution of effective and non-harmful fertilisation is the targeted application to the immediate vicinity of the plants with the necessary nutrients, depending on plant's developmental stage. The fertilizer thus comes in close proximity to the cultivated plant to save the amount of fertilizer needed (as opposed to wide-spread fertilization) and also prevents the outflow of nutrients to the weeds. Such soil saving fertilising has positive effect on soil structure, especially on the formation of agronomically valuable structure.

Ecological farming has significant positive effect on biological life in soil because of low soil disturbance and effective use of organic fertilisers. The earthworms density in soil monoliths from ecological farm Ekofarm Agrokruh recalculated per square meter shows that the amount of individuals was in 2 years observations in average as follows 248 – 246 - 7 for 5 years ecological farming, 3 years ecological farming and conventional farming respectively. Concerning biomass, the

order was approximately 70 – 55 – 5 g m^{-2} for 3 years of ecological farming followed by 5 years of ecological farming and conventional farming. These results show significant positive effect of ecological farming on the amount of earthworms in comparison to conventional cultivation. The biomass was the highest in 3 years ecological farming comparing with 5 years. It can be also the effect of the type of crop. The biomass in conventional cultivation field was again significantly lower in comparison to the ecological fields.

Ecological farming is soil awareness in praxis and can significantly contribute to soil protection and its sustainable use requested also in Agenda 2030 of UN and its sustainable development goals (SDG's), especially SDG 15 which aims to "protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss".

The authors acknowledge the Slovak Research and Development Agency for the financial support via contract No. APVV-15-0160.

Simulation of pharmaceuticals transport in soil columns

Miroslav FÉR, Radka KODEŠOVÁ, Antonín NIKODEM, Aleš KLEMENT

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Pharmaceuticals can be found in agricultural soils mainly due to use of wastewater for irrigation or sewage sludge as soil amendment. The aim of this work was to describe transport of the selected pharmaceuticals in the undisturbed soil columns. Study was performed on the soil samples taken from different horizons of a Haplic Luvisol and Greyic Phaeozem. Columns (volume of 100 cm3) were used to measure soil hydraulic properties using the multistep outflow experiment and numerical inversion using HYDRUS-1D. Larger columns (1220 cm3) were used to perform solute transport experiments. Initially solution of 4 pharmaceuticals (sulfamethoxazole, carbamazepine, trimethoprim and atenolol) of known volume and concentrations was applied at the soil surface followed be ponded infiltration with fresh water. Two tensiometers were inserted into the each column to monitor water regimes in the soil samples. The cumulative infiltrations, outflows at the bottom and concentrations of compounds in infiltrated and leaked solutions were measured. The HYDRUS-1D program was applied to simulate observed water regime and compounds transport through the soil columns using two models (single porosity and dual-permeability). Some of soil hydraulic parameters were set as obtained from the multistep outflow tests and some were optimized using the numerical inversion. Adsorption isotherms were measured. Other parameter related to the transport of pharmaceuticals were estimated using the numerical inversion. The results showed that the dual-permeability model describing preferential flow and two-site sorption model describing non-equilibrium sorption could approximate measured data.

Acknowledgment: Authors acknowledge the financial support of the Czech Science Foundation project No. 17-08937S, Behavior of pharmaceuticals in soil-water-plant system. The work was also supported from European Regional Development Fund Project NutRisk Centre (No. CZ.02.1.01/0.0/0.0/16_019/0000845).

Key words: pharmaceuticals, HYDRUS-1D, dual-permeability model, two-site sorption

The effect of long-term deposition of dust from steel plant on magnetic properties and chemical pollution of soil and groundwater on protected areas Nature 2000

Marzena RACHWAŁ, Tadeusz MAGIERA, Marcin SZUSZKIEWICZ, Małgorzata WAWER

Institute of Environmental Engineering, Polish Academy of Sciences

Keywords: magnetic susceptibility, soil pollution, metallurgical dust deposition, trace elements

The research on soil contamination was carried out in the forest complex Grabicz located on the slope of Jasieniowa Berg (521 m a.s.l.). Part of this complex constitutes a protected area named Nature 2000 which is covering a spring area with deposition of limestone necrosis and travertine. Forest Grabicz is the large forest complex (95 ha) located the nearest (5 km away in the south-west direction) to the Czech ironworks and steel mill (operating continuously since 1839) in the border city Třiniec.

The aim of this investigation was to explain the origin of magnetic anomaly extending from the area of Třinec and Cieszyn eastwards up to Skoczów and visible on the map of Magnetic Susceptibility of Polish Soils (Magiera, Lis, Nawrocki, Strzyszcz, 2002). Simultaneously, the origin of one of the strongest geochemical anomalies of chromium in Geochemical Atlas of Poland (Lis, Pasieczna, 1995) in the same area will be examined. In the area of the forest enclave, surface measurements of magnetic susceptibility (κ) were carried out using the MS2D Bartington field equipment. In the laboratory, vertical distribution of magnetic susceptibility in 30 cm deep cores was determined with the MS2C Bartington sensor.

The results showed high surface magnetic susceptibility values ranging from 50 to 175 $\times 10^{-5}$ SI units in the entire study area, which indicates a significant concentration of technogenic magnetic particles (TMPs) in the topsoil. The highest κ values were recorded in the southern and southwestern part of the area as well as in the top part of Góra Jasieniowa. The vertical distribution of κ is characteristic for contaminated soils developed on the paramagnetic substrate (brown soils) with values of approx. 10 $\times 10^{-5}$ SI units in the mineral soil horizon and a wide magnetic peak in the organic soil horizon, with κ values at a depth of about 5 cm ranging from 120 to 220 $\times$ 10^{-5} SI units.

Determination of the content of heavy metals (Fe, Cr, Cu, Ni, Pb, V and Zn) in soil samples was performed with the ICP OES method after digestion in the aqua regia. The content of individual metals ranged as follows: Fe 1.6-3.2%, Cr 27-55 mg/kg, Cu 10-46 mg/kg, Ni 12-39 mg/kg Pb 33-86 mg/kg, V 37-66 mg/kg, Zn 87-158 mg/kg. The contents of Cr, Ni and V are much higher than the average contents of these elements in Polish soils and their highest values were also recorded in the southern and south-western part of the enclave showing significant spatial correlations with the magnetic susceptibility (correlation coefficients 0.61 for Cr, 0.62 for Ni and 0.68 for V). All three metals are usually emitted into the atmosphere during iron metallurgy processes, therefore the 180 years of activity of the steel plant in Třinec is the probable reason of their accumulation in the organic soil horizon. What is more, the analysis of groundwater taken from natural outflows in the spring area in the Grabicz Forest, as well as in other protected areas included in the so-called Cieszyn Sources of Tuff (Kamieniec Forest located 10 km from the smelter and Skarpa Wiślicka reserve - 15 km from

the steelworks) showed elevated nickel content in groundwater so that these waters do not meet the criterion of the first quality class, because the Ni content exceeds 5 μg/dm^3.

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Some aspects of SEM application in the research of soil weathering and clay mineral formation

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Keywords: scanning electron microscope, soil formation, mineral particle weathering, illite.

Relevance and goal. There are not so many soil studies using the Scanning Electron Microscope (SEM), where clay particles are analysed in their natural pedogenic environment (*in situ*). No such studies were carried out in Lithuania till now. Some earlier research was mostly based on SEM and X-ray investigations of clay particles extracted from mineral soil samples (Bridickaitė, 1971; Vaičys, 1975; Vaisvalavičius, 1998; Prosyčevas et al., 2003, etc.). An application of the modern SEM analysis for *in situ* clay particles is valuable for better understanding the peculiarities and processes of clay formation in the soils of different genesis.

Hypothesis. The SEM analysis of undisturbed soil samples provides an opportunity to evaluate soil degradation processes, while the clay particle analysis allows determining nature (origin) of clay particle and their forming processes.

Objectives: to determine micro-morphological differences due to weathering processes in soils of different ages; to identify clay particle compositions that developed during soil forming processes.

Methods. Samples were taken from mineral soils developed on Quaternary rocks of different ages: Upper Pleistocene (13,600 to14, 000 years) and Middle Pleistocene (128,000 to 100,000 years). Thin undisturbed soil tablets (diameter 29 mm, thickness 5-6 mm) from contrasting soil genetic horizons – eluvial and parent rock – were prepared. The tablets were coated with Araldite 2020 from both sides and polished. The clay fraction was isolated by pipette analysis and clay dispersion methods. For the SEM (Quanta 250 with the BSED detector) analysis, samples were coated with carbon (Emitech SC7620 Sputer Cooter). The Samples were prepared at the Institute of Agriculture, Lithuanian Research Centre for Agriculture and Forestry, while the SEM analysis was performed at the Laboratory of Bedrock Geology, Nature Research Centre in Vilnius.
Morphology of the soil profile was described in detail and the soil typological unit was identified according to WRB guidelines (WRB 2014).

Results. The SEM analysis of a thin soil section with undisturbed structure made it possible to observe soil weathering processes and the secondary clay mineral formation. We assume that clay minerals of glacial origin form a debris or cryptocrystalline mass (made up of clay mineral

plates adhering to each other). Newly formed (during soil formation) clay occurs as separate plates or films between other soil grains. The chemical composition spectrograms of these particles can help to determine from which mineral they have been formed during weathering. However, the identification of a particular clay mineral, as the clay particle is covered with various weathering products.

The analysis of film of separated and dispersed clay particles make it possible to identify the exact chemical composition of the clay particles, however, chemical dispersants (e.g. Na_2CO_3, $(NaPO_3)_n$) cannot be used in the dispersion process, because they contaminate the sample. In such a study, it is not possible to determine the nature of the clay particles and the processes that caused them to form.

The investigation revealed:

1. SEM analysis allows us to estimate soil weathering along the quartz particle surface (Fig. 1). We think that strong weathering or desquamation, i.e. surface chapping and lamination are typical for Planosols quartz particles of Middle Pleistocene glacial deposits in Lithuania (128,000 to 100,000 years of age). This is the most visible in the sheet of periglacial weathering. These processes were not recorded in the Upper Pleistocene (13600–14000 years) Luvisols and Cambisols of Lithuania. Also, weathering is clearly visible in mica minerals. They break down into plates, which are later transformed into clay minerals (Fig. 1a, 1b, 1c, 1d).

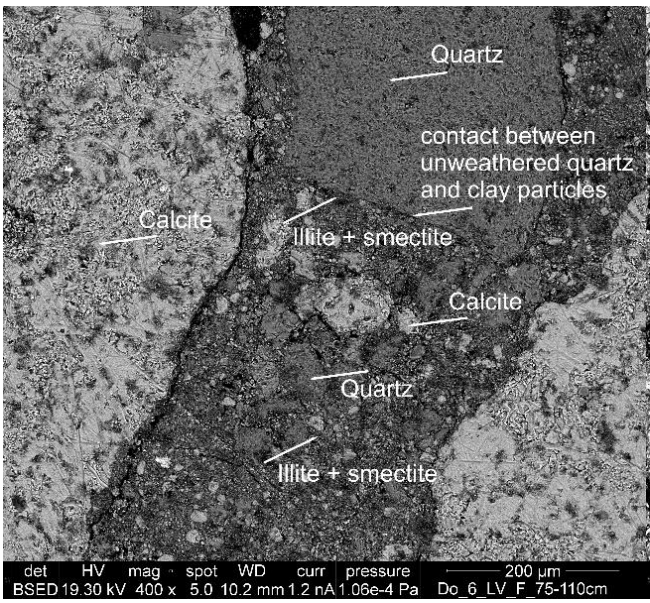

Fig. 1a. Non-weathered quartz in the forest soil of the Upper Pleistocene deposit (Central Lithuania, Dotnuva)

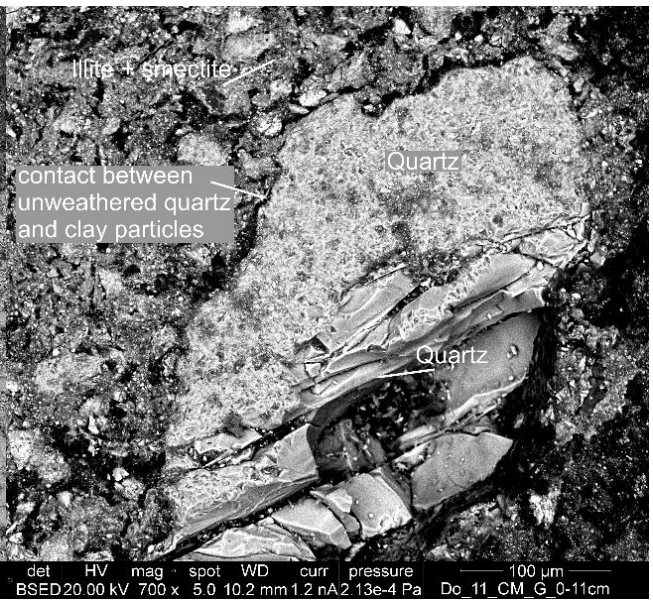

Fig. 1b. Non-weathered quartz in the agrarian land soil of the Upper Pleistocene deposit (Central Lithuania, Dotnuva)

2. Clay minerals of several origins were identified: clay minerals of presumably glacial origin such as kaolinite (debris particles up to 1000 µm) and a finely-dispersed mixture of illite and montmorillonite (Fig. 2) as well as illite that we think was formed during the soil forming process (2–20 µm plates) (Fig. 3). Under Lithuanian climatic conditions (humid and cold), the illite is most abundant clay mineral to form in modern soils. In pedogenic environment kaolinite may form from feldspars in topsoil due to interaction with atmosphere or in aeration

zone above the groundwater level. It is difficult to recognize kaolinite and montmorillonite of soil-forming origin, moreover that they usually form in hot and humid or warm and dry climate.

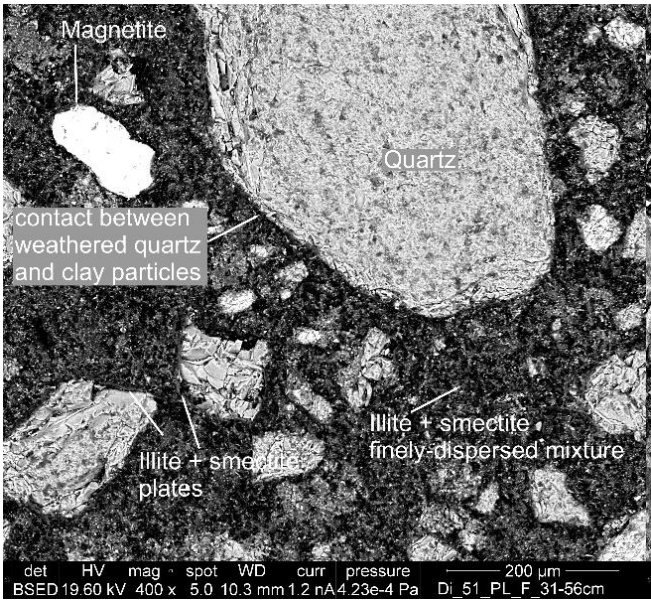

Fig. 1c. Weathered quartz in the soil of the Middle Pleistocene deposits (Southeast Lithuania, Dieveniškės)

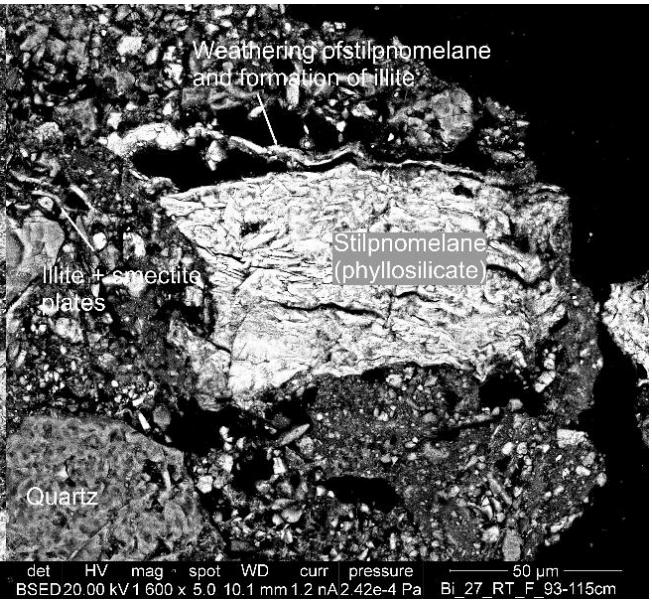

Fig. 1d. Weathered phyllosilicate (stilpnomelane) in the soil of the Upper Pleistocene deposits (Western Lithuania, Bijotai)

3. According to the SEM results, the secondary minerals containing titanium (Ti) have been formed during the phyllosilicate (mica and stilpnomelane) weathering (Fig. 4a, 4b), and they are most abundant in the Lithuanian soils. In clay minerals formed from feldspars, Ti is absent (Fig. 5).

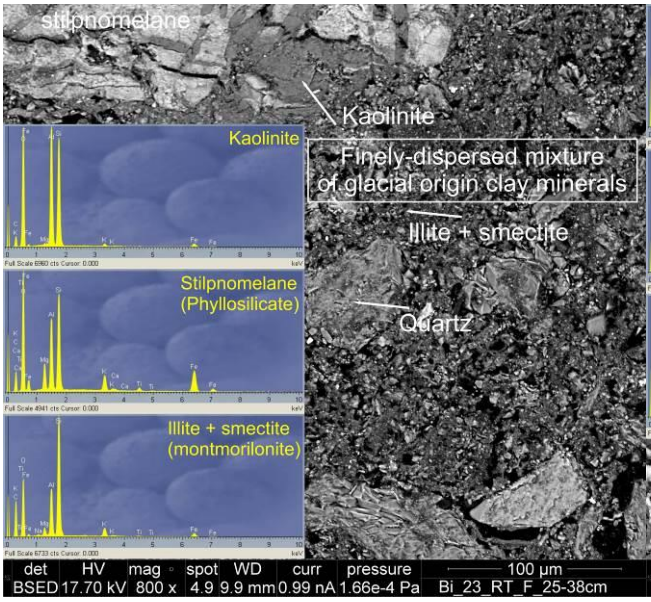

Fig. 2. Clay minerals of presumably glacial origin in the soil of the Upper Pleistocene deposits

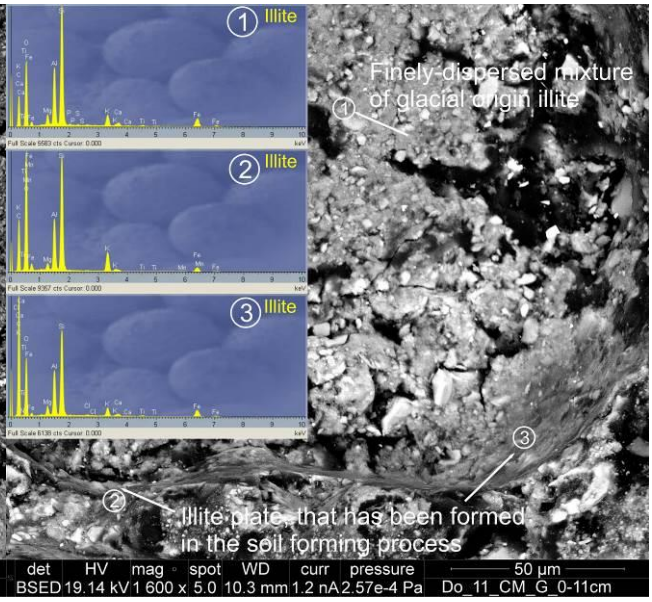

Fig. 3. Clay minerals of presumably pedogenic origin in the soil of the Upper Pleistocene deposits

4. We looked after a mineral bentonite (aluminium phyllosilicate clay consisting mostly of montmorillonite (Ca) and montmorillonite (Na) w during the study in order to justify the process of Cambisols formation in Lithuania. Bentonite was not found in the soil profile weathering horizon in Lithuanian Cambisols while the amount of Na in the identified mixture of illite and smectite (montmorillonite) was below 2.95% (Fig. 6).

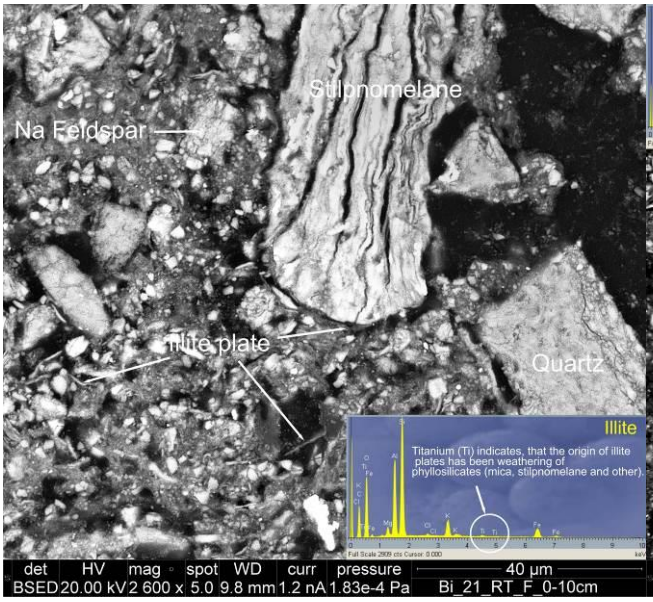

Fig. 4a. Clay minerals formed in weathered phyllosilicates (mica, stilpnomelane and others) in the soil of the Upper Pleistocene deposits (Western Lithuania, Bijotai)

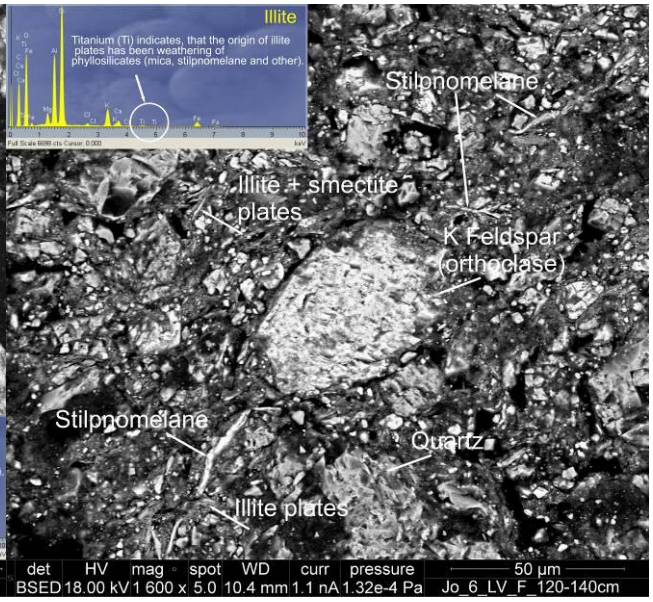

Fig. 4b. Clay minerals formed in weathered phyllosilicates (mica, stilpnomelane and others) in the soil of the Upper Pleistocene deposits (Northern Lithuania, Joniškėlis)

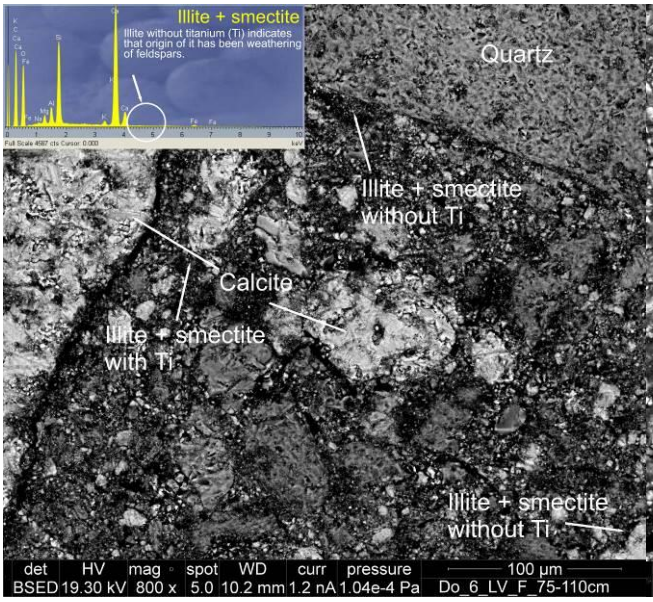

Fig. 5. Clay minerals formed in weathered feldspars in the soil of the Upper Pleistocene deposit (Central Lithuania, Dotnuva)

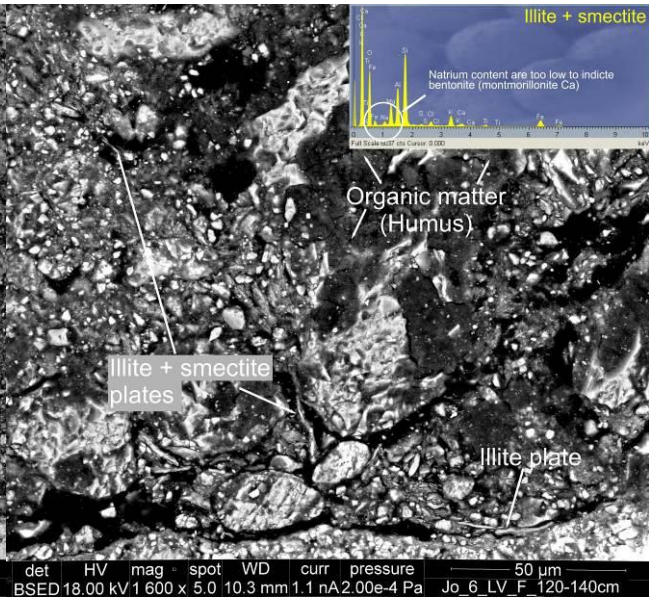

Fig. 6. A suspected bentonite (Northern Lithuania, Joniškėlis)

Conclusions. The results of the SEM investigations are highly dependent on the sample preparation. Membrane-forming or membrane encapsulation (up to 40μm) methods are most suitable for testing of separated and dispersed clay particles, while in pedogenesis studies the most suitable are thin sections of intact soil structure. In order to investigate pedogenesis, clay minerals should be used for the SEM analysis since they are the most informative minerals of weathering process and associated with climatic conditions.

Acknowledgments

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The effect of macropore network on plant root length in *retisol* of western Lithuania

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Many soils, even if hard, contain continuous macropores that provide niches for the roots to grow in. The presence of such macropores increases the extent of the root system.

The objective of this study was to determine the effect of different macropores on plant roots length under different land use (grassland, forest and arable farming) in different soil depth (0–10 and 10–20 cm) on Retisol in hilly landscape, Western Lithuania. Root length analysis was performed using the software WinRhizo. Soil macropore network was researched by implementing an X-ray computed tomography and carried out at the laboratory of the Institute of Agrophysics, Polish Academy of Sciences in Lublin, Poland.

The greatest values of length of plant roots averaged across the depth (0-20 cm) amounted from 672 to 1517 km m^{-3} in the grassland and 85–361 km m^{-3} in the forest, while the lowest values – 106–246 km m^{-3} were observed under conventional tillage of arable farming system. The macropores were classified by Brewer (1964) according to their size: coarse >5000 μm, medium 2000–5000 μm, fine 1000–2000 μm and very fine 75–1000 μm. The volume of different size of macropores values averaged across the land use and depth amounted from 0.30 to 1.41% (coarse), from 0.47 to 3.02% (medium), from 0.47 to 2.56% (fine) and from 0.17 to 1.19% (very fine). The highest amount in the framework of macropores was registered for medium pores under arable farming (3.02%), for fine pores (2.56%) in the forest and very fine pores in the grassland (to 1.19%) at the 0–10 cm soil depth, while at the 10–20 cm soil depth, the coarse macropores dominated in the conventional tillage of arable farming system (to 1.41%).

The relationship between length of plant roots and the volume of very fine macropores at different land use and depth can be described by a linear regression model $y = 1305.81x - 312.51$, $R^2 = 0.85$ ($p>0.01$). Root length also displayed linear relationships with volume of coarse, medium and fine of macropores at different land use and depth; however, the relationships were very weak.

Acknowledgements

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Assessment of soil surface relief evolution in laboratory experiment under simulated rainfall

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Keywords: soil microrelief, soil erosion, rain simulation, roughness, DEM, 3D scanner

Spatial differentiation of soil surface of microtrelief is recognized as important factor determining the course and intensity of various processes underlying water erosion, for example surface runoff and sediment transport. In the study we evaluated spatial and quantitative changes in soil surface microtopography to describe water erosion process under simulated rain with use of a structured light, optical 3D scanner. Three silt soils samples collected from farmlands laid in Outer Western Carpathians in Strzyżowskie and Dynowskie Foothils – one of the areas with highest vulnerability to soil erosion risk in Poland.

Four subsequent laboratory tests of simulated rain were applied, with intensity equal to 90 mm h^{-1} to the soil samples with four different slope angles. The soil surface was scanned after every 15 minutes of rainfall simulation resulting in 3D cloud of points. The surface points coordinates were interpolated using natural neighbour method and GIS software to generate Digital Elevation Models (DEM) with a 0.5 mm resolution. Additionally the volume of surface and underground runoff and sample weight were measured.

The DEMs analysis allowed to obtain spatial information about changes in height and roughness of the soil surface. Averaging to the entire scan enabled the measurement of the surface rise due to the expansion of the moistened soil and then the measurement of the rate of soil surface depression and its smoothing or washing out as a result of water erosion.

In the first sprinkling stage, the soil surface was lifted by a maximum of 1.3 mm. This expansion observation lasted up to 30 minutes on samples with an inclination of 5% and up to 15 minutes for a slope of 10% and more. In the next phase, the soil surface was shaped by erosion, which led to reduction of its mean level by a maximum of 2 mm. Parallel measurements of the leachate volume and sample mass showed a strong dependence of the total volume of surface runoff and time of the highest erosion intensity from the slope of the sample surface.

The research showed a high potential of associated topographic soil surface evaluation and measurements of outflow and soil loss in the assessment of the process of the soil erosion and surface changes during rainfall.

Analysis of the ways of using glass beads as a soil model material in splash research

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Keywords: drop impact, splash, Soil model, glass beads

The impact of raindrops on the soil surface results in the first stage of water erosion - splash erosion. Scientific papers focused on the splash show that, over the last decade, there has been a noticeable increase in the popularity of measuring methods based on recordings made by high-speed cameras. The research has also included the use of a soil model such as sand and glass beads. This allows simplification of the experimental part and facilitates the first steps in working on the investigated problems. Model materials have been used, among others, in studies of the crater formation process, analysis of the influence of particle size distribution on the distance and number of ejected particles and in determination of their trajectory.

The work presents the possibility of using beds made of glass beads containing elements with different colors, which act as markers. Taking into account the structure, the samples can be divided into two types: deposits with a simple surface pattern of individual elements and deposits with "monolayers" with a different color. The structure of the samples allows determination of the effect of splash on a particular element of the bed or on the whole group (layer) of elements, through analysis of the area of the drop impact.

The beds used in the study were formed in aluminum rings with a diameter of 40 mm and a depth of 10 mm. Drops of distilled water (diameter - 4.2 mm) had been falling from a height of 1.5 m. The arrangement of the surface of the sample before and after the impact of the drops was registered with a digital camera. The measurements were complemented by the recordings made by the high-speed cameras, which allowed comparison and verification of the obtained results.

The use of the presented beds allowed analysis of the displacement of elements invisible in recordings captured with high-speed cameras and, therefore, it may contribute to extension of knowledge about the phenomenon of splash.

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Structure formation in soils with differing textures: the role of varied organic additives and earthworms - laboratory experiment

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Keywords: soil texture, aggregate stability, organic additives, earthworms, microbial activity,

Lubbers et al. (2017) emphasised that earthworm by creating macroaggregates increase the amount of organic carbon in the soil. Such macroaggregates contain particulate organic matter, fungal hyphae, or roots, and afterwards, during the decomposition of macroaggregates, organic matter becomes more resistant to microbial attack (Pulleman et al. 2005). Earthworms, through feeding and burrowing, are important elements in C cycling (Curry and Schmidt 2007). However, the type of introduced organic matter (Huang et al. 2018) and abiotic factors (Six et al. 2004) are equally important in creating stable organic-mineral components as well as the presence of earthworms.

A six-month experiment was carried out to test how the soil structure (the stability of soil aggregates) behave under the influence of various organic additives. For each soil, except the reference samples, one of the listed additives was introduced, i.e. straw, straw with fulvic acid, peat (garden soil), compost, compost with active bacteria cultures and straw with fulvic acids, humus and active bacteria cultures. The research was carried out on soils with four types of texture, i.e. sandy, loamy, silty and clayey soil. In the project, three different species of earthworms commonly occurred in Polish soils were a structure-forming factor (*Apporectodea rosea, Apporectodea calliginosa* and *Dendrobena rubillus*). After the experiment, the stability of the soil aggregates (Bieganowski et al. 2018, Kemper and Rosenau 1986) , the amount of organic carbon in the soil, dissolved organic carbon, humus forms and microbiological activity of the soil were evaluated.

Based on this research it was noted that the aggregate stability is correlated mainly with soil texture. The applied additives had the most significant influence on the transformation of organic carbon in the soil. Soil organic carbon, which may be incorporated into the soil in the form of the organic-mineral colloids, is an essential element in the balance of the carbon in nature. Among the tested additives, organic carbon from compost, peat and compost with active bacteria cultures was in the highest amount associated with fine earth particles (about 36-48%). For comparison, only less than 8.5% of the organic carbon from the straw was incorporated into the mineral part of the soil.

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Cereal crop productivity in long term field experiment under changing climate

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Usually field experiments are conducted in a short time – 2-3 years with goal to get results as answers to the question which was held before starting the field experiment. Other problem in long-term field experiments is to grow the same varieties and the same crops in the crop rotation for longer time, because the ecological and socioeconomical ambient is changing, new more productively varieties of crops and technology's is coming. Valinava long-term experiment (55.22° N, 23.51° E) established in 1991 at the Institute of Agriculture, Lithuanian Research Centre for Agriculture and Forestry. The experiment is situated on the terrace of the Dotnuvele River and occupies 4.4 ha. Prevailing soil is sandy loam and light loam Endocalcari – Endohypogleyic Cambisol (CMg-p-w-can). Crops are grown in 4-course crop rotation: red clover, winter wheat, spring wheat and spring barley, under three levels of management intensity: a) conventional, b) integrated and c) organic.

Cereals in conventional and integrated agroecosystems were applied with herbicides, fungicides and insecticides and in organic system were grown without application of industrial fertilisers and plant protection measures.

The growing period of crops during the experimental years was warmer than the climate normal, with contrasting rainfall. Drainage water runoff measurements show that substantial part of precipitation (up to 310 mm) was lost during the non-growth period resulting in lower levels of ground water table and temporary moisture deficiency in crops. On average, the yield of winter wheat grown without fertilizers and pesticides was 67%, spring barley 70%, and red clover 124% of that under conventional management. But the climate change could effect the crop productivity and water deficit could be one of the main limiting factors. For this reason, used model DSSAT for water deficit in cereal crops simulations. Simulation showed that spring barley can be affected by climate change more negatively than winter wheat. The cereals crops grown under organic management can be effected less than grown under conventional management. However, it is still unclear if a range of conventional adaptive measures, such as changing of sowing time or varieties, can be effective in order to completely adapt spring barley and winter wheat to new climate conditions.

The analyses of the temperatures fluctuations in the strawberries cultivated in growing gutter in low tunnel system

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For the purpose of analysis and modeling of temperature changing distribution in the strawberry cultivation under roofs, the studies have been carried out in the period from 28-08-2018 to 21-11-2018. The temperature have been registered with the basic interval in every one minute in five spots under the foil roof: at the green strawberry biomass level, in the middle part of the coco substrate (root zone), in the measuring box under the gutter and on the surface of the geo-non-woven. Moreover, independently from the temperature measures, solar radiation intensity, ambient temperature and air moisture also have been registered, at a height of 4 meters so as to avoid the effect of roofs. Following a preliminary analysis of raw data, some observations have been noted. The geo-non-woven laid on the ground worked as non-inertial, heating up to 56°C on black and about 45°C on white, respectively, during direct radiation on this non-woven fabric, what is the consequence of the position of cultivated gutters. However, in diffuse radiation, after the passing the solar radiation through protective foil, the temperature of the non-woven decreased to 35°C, independently of its type.

For further analysis, raw data were aggregated in order to averaging observations for 10 minutes and 60 minutes. Based on such defined data, it can been found that temperature in the mat ranged from 10°C to 25°C from the lowest temperature of surroundings in the sunny days, when mean value of solar radiation intensity is above 400 W·m-2. Mean temperature in the substrate in the night was from 2°C to 6°C higher than the temperature of surroundings. But yet, in the daily range, this situation has been reversed and the mat have had lower temperature (2÷7 °C) comparing to the surroundings. The inertia of the substarates together with air temperature, enforces a phase shift of temperature within the substrate in the range of 2 hours for minimum and 5 hours for maximum (at 6 pm). The analysis has been carried out at the end of August, what is crucial, due to ratio of the day interval to the night.

Verification of the extent of organic soils on the basis of remote sensing data

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Organic soils are one of environmental elements of high sensitivity to climate change and anthropopressure. In recent decades, unfavorable impact on the broadly understood nature has been increasing, resulting in irreversible changes in the surface structure of soils in Poland. In this situation, it seems necessary to correctly determine the ranges of occurrence of organic soils, taking into account that their surface is systematically reduced.

Large-scale studies in the form of soil-agricultural and soil-habitat maps (scale 1: 5000) are available for the entire country. Many studies in the field of soil classification of land for the entire country, developed on scales corresponding to the land registry are also available in the State Geodetic and Cartographic Repository. The above materials, with all their advantages, are burdened with certain drawbacks, connected with relatively large simplifications related to both the soil classification system used and the need to generalize local phenomena; also the accuracy and precision of determining individual polygons differ from the standards accepted today. Due to the huge amount of work, it is currently impossible to verify in the field the extent of occurrence of organic soils. It is therefore necessary to use remote methods that automatically or semi-automatically allow verification of the occurrence of surface organic formations.

In this work, an attempt was made to use data from the Landsat satellite. It was assumed that organic formations have different thermal characteristics in relation to the environment, i.e. they remain cooler in the spring time for a longer time, while in the autumn-early winter period they remain warmer than the mineral soils in the neighborhood.

Data from the thermal channels of Landsat 7 and Landsat 8 satellites were acquired for the period 2005 – 2018. Scenes of the picture were taken from https://www.usgs.gov/land-resources/nli/landsat/landsat-science-products. The analyzed area covered the area of about 20,000 km2. Selected scenes were characterized by cloudiness below 10% and the date between October and March of the following year. For each scene, the LST (active surface temperature) values were calculated and the average values for the scene were determined on its basis.

On the basis of the soil-agricultural map, fifteen training polygons have been designated, constituting the allotments of organic soils, characterized by a favorable geometry for remote sensing, currently used as arable land and grassland. These polygons were divided into 10 classification samples and 5 validation samples. 10 surface areas were used as training fields in the process of classification of objects with similar thermal features, then an analysis of the correctness of the classification based on validation polygons was carried out.

The results of the analysis were then compared with the soil-agricultural map in the scale of 1: 5000 for the studied area. Excluding land used as forests and under buildings, the probability of occurrence of organic soil in the soil was determined and the correctness of the content of the soil-agricultural map was estimated.

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Abstracts: posters

Mapping soil stability with an on-the-go sensor

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Soil stability can be estimated by measuring readily dispersible clay (RDC). RDC is the part of the clay fraction in soils that is easily or potentially dispersible in water when small amounts of mechanical energy are applied. Dispersible clay is mobile in the soil environment. The amount of RDC has a significant importance for agriculture and environment because clay dispersion is a cause of poor soil stability in water which can lead to soil erodibility, mud flows, and cementation. To obtain a detailed map of RDC, many samples are needed. Unfortunately, RDC determination is time consuming. The aim of the paper is to present the use of a mobile visible and near-infrared (VIS-NIR) platform to map RDC at field scale. The RDC prediction was based on a calibration model using 10 representatives samples selected by a fuzzy logic algorithm. With RMSE = 0.35% and R^2 = 0.71, the model is of satisfactory quality and the resulting map is in accordance with our knowledge of the field (maps of soil organic carbon, soil texture, NDVI, RDC analyses) but also with the spatial variability observed by orthophotography. The results are promising and the method could help e.g. preventing soil erosion.

Mobility of soil colloids depending on some basic physical-chemical and chemical properties of soil

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Displacement of mineral and organic soil particles, usually of colloidal size, may lead to gradual degradation of the top layers of the soil, especially in conditions of intensive eluvial process or the phenomenon of erosion. This is related to, the so called stability of colloids, i.e. their ability to persist in a dispersed state in soil solution. Such a condition potentially creates the possibility of soil colloids mobility and this is also one of the factors of great importance in shaping the eluvial process as well as the soil susceptibility to erosion.

The purpose of this work is to estimate the mobility of soil colloids in relation to selected physical, physical-chemical and chemical properties of the soils studied. The experiment was performed in light and heavy soil (in the natural material), and also in the same soil material, but after the removal of organic matter and after soil pH adjustment to the values of 3, 5 and 8. The study of soil colloids mobility was performed by centrifuge method in 3 replications using distilled water and a solution of peptizing properties (0.2% lithium carbonate).

The mobility (R), coagulation (K) and stabilization (St) coefficients, as well as the eluviation index (E) were calculated based on the amount of leached colloids of the studied soil materials.

The behavior of the colloidal fraction of both soils (light and heavy) was parallel: the removal of organic matter resulted in a significant increase in the amount of colloids leached from the soil. Also soil pH modification significantly affected the mobility of soil colloids: the highest colloid mobility was observed in soils with pH 3; as pH increased the mobility decreased. This regularity is related to the total surface area of the soil, which assumed the highest values in the acidic environment, whereas as the pH of the soil colloids increased, the surface area of soil colloids decreased.

Temporal fluctuations of soil water repellency in the pine forest Peucedano−−Pinetum affected by the surface fire

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Soil water repellency (SWR) causes reduced soil water storage, enhanced runoff, preferential flow paths and reduced ecosystem productivity. Understanding of the linkages between forest soils and water is fundamental in hydrological studies of the sustainable use of forest resources specifically in the context of its adaptation to climate changes. The aim of the studies was to assess the influence of the intensity of a fire in a Scots pine forest Peucedano-Pinetum in the surface layers of podzolized rusty soils on the occurrence of SWR and its perseverance, as well as spatial and temporal variability. The severity of SWR and its persistence was assessed by water drop penetration time (WDPT) test in a short and in the one year period time after fire. The obtained results allow us to conclude that during periods of drought in the temperate continental climate the hydrophobicity is a natural phenomenon. A statistically significant difference between median SWR values in the first and second measurement period was noted in the case of all study surfaces and layers. SWR in fire-affected plots is dependent on the intensity of the fire as well as displaying spatial and seasonal variability. The extremely repellent class was observed in strong fire plots in soil layers of up to 20 cm in a short period of time, and after one year time, the soil was found to be wettable. The highest variability in the occurrence of hydrophobicity was recorded in the soil plots affected by a weak fire. The obtained study results for control and weak fire plots in two age categories of trees proved that soil under an older pine tree stand (X and XI age class) induces higher water repellency, which in the 10-20 cm layer can persist even after the letting up of atmospheric drought. Characterizing and understanding the severity and persistence together are valuable when determining the effects of SWR on hydrological processes as they have different mechanisms.

Device for measuring of the soil granulometric composition with an integrated mixer with sample changer

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Developing a dynamometric method for determining the granulometric composition of soils, an attempt was made to integrate it with a mixer and a device for changing samples. A solution was chosen in which the measuring head equipped with a dynamometer, thermocouple and rotating mixer is moved in the X-Y plane between cylinders with soil suspension set at fixed points of the measuring table. Movement in the X-Y plane is provided by stepper motors driving the head through the rubber toothed belts. Movement of the dynamometer, with an attached float and thermocouple, in the direction of the Z axis is performed by another stepper motor built into the measuring head. The issue of moving the mixer was similarly solved. The mixer rotary motion provides a voltage-controlled electric motor with a reduction rotating gear. The developed software makes it possible to change the parameters of the mixing process such as: rotation speed, vertical stirrer speed, mixer positioning height, time and number of cycles in the mixing process. The quantity of cylinders in the measuring cycle can be freely defined using a simple user interface, as well as the number and dimensions of the measured fractions and the depth of measurements. After starting, the device performs measurements without the user's participation, simultaneously displaying information on the status of measurements and the results obtained so far. The measurement time for fractions in the range of 0.1 - 0.002 mm in the discussed method is around 4 hours. It is possible to delay the start of measurements so the device works at night when external disturbances are minimized. The report containing the measured parameters is generated in the form of pdf file (possible to edit in MS Excel or similar software) after the measurements have been completed.

The impact of different mulching materials on soil water contents

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Keywords: mulch, TMS3, soil water content

Soil mulching can influence evaporation, soil temperature, soil erosion and weed growth. In this study, we focused on the effects of several mulch materials on soil water contents of the surface soil layer. The experiment was established in 2015 at the university experimental station in Prague-Troja. The soil type was classified as the Haplic Fluvisol. Before the experiment, the area was commonly cultivated and used for crop production. An experimental plot was divided into 27 patches (3x1.5m) where perennials were planted. Three patches were not covered by any mulching material. The other 24 patches were covered by eight types of mulch materials (3 patches for each): 10 cm thick layer of bark chips bark, wood chips, and wheat straw, agrotex EKO+ (decomposable brown foil - 150g/m^2), ecocover (decomposable matting - 900g/m2), cardboard (200g/m^2) in three layers, nonwoven fabric (50g/m^2) covered by 3 cm thick bark chips layer, 10 cm thick layer of crushed stone (basalt 3 cm). Soil moisture sensors TMS3 (Tomst, Czech Republic) were installed at each patch to monitor soil-water contents of surface layer (0-11 cm). Soil water contents were recorded every 15 minutes.

The data showed large differences between soil water contents under various mulches. At the beginning of the experiment the highest water contents were measured under the crushed stone and ecocover, and the lowest soil water contents were monitored under the wood chips and agrotex EKO+. During the second year, differences between the soil water contents monitored under the different mulches decreased. The reason could be degradation of some mulching materials (mainly bark chips, nonwoven fabric covered by bark chips, agrotex EKO+). No changes in trends of soil water contents were observed under the crushed stone.

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Uptake of pharmaceuticals from sewage sludge amended soils by spinach

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Key words: pharmaceuticals, root uptake, sewage sludge, bioaccumulation

Sewage sludge from wastewater treatment plants is often used as amendment to increase organic matter and nutrients contents in soils. On the other hand, sewage sludge may contain various contaminants, such as organic and inorganic substances, pathogen organisms etc. The significant pollutants that widely occur in sewage sludge are pharmaceuticals, which may be uptaken by plants. This study therefore focused on the uptake of pharmaceuticals from 7 soils amended with the sewage sludge from two wastewater treatment plants (A and B) by spinach plants. The largest bioaccumulation in roots and leaves was observed for sertraline, tramadol, and carbamazepine and its metabolite carbamazepine 10,11-epoxide. The large bioaccumulation in root was also found for telmisartan, and miconazole. The statistical analysis showed that uptake of compounds (mainly sertraline, amitriptyline, mirtazapine, metoprolol) from 3 soils (Stagnic Chernozem Siltic, Haplic Chernozem and Greyic Phaeozem) and following translocation and transformation significantly differed from that from the other 4 soils (Haplic Luvisol, Haplic Cambisol, Dystric Cambisol and Arenosol Epieutric). The BAF values of carbamazepine and carbamazepine 10,11-epoxide were in all tissues negatively related to the cation exchange capacity. The negative correlation between BAF and CEC was also proven for tramadol (A-roots and B-leaves), citaloporam (B-roots), and telmisartan (B-roots), or between BAF and clay content for tramadol (B-roots and A-leaves) and venlafaxine (B-roots).

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The effect of biochar addition to the soil (*Haplic Luvisol*) on Water Holding Capacity

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Biochar (charcoal) is defined as a biomass that has been pyrolysed in a zero or low oxygen environment. Forest fires are a main source of biochar in natural ecosystems. The advantages of using biochar in fields was appreciated by Amazon Indians several thousand years ago. They probably observed soils enriched by biochar remain better productivity for longer than different soils of this region. This fact has prompted pre-Columbian inhabitants to produced black soils called Terra preta, and contemporary researchers to focus on the mode of activity and effectiveness of biochar as an additive to the soil.

The addition of biochar to the soils has been proposed as a means to improve soil fertility and mitigate climate change. Change of soil physical properties is the first effect after biochar application. Several studies revealed that biochar can improve two of the main parameters, which affect soil structure and water-air ratio: total porosity and Water Holding Capacity (WHC). It is especially important during the drought. Biochar is also important source of stable organic carbon.

The aim of this study was determine the effect of biochar addition to Haplic Luvisol soil from fallow fields and to investigate the changes of WHC and TOC in tested soils five years after biochar application.

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The effect of reduced tillage on soil organic carbon in clay loam soil in Lithuania

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The research was carried out in 2015–2016 at the Joniskelis Experimental Station (56º21′ N, 24º10′ E) on a clay loam soil in the experiment, established in 2006, in order to evaluate the long-term effect of tillage intensity as well as its combinations with practices for soil improvement on soil organic carbon and physical properties in different soil layers. The following tillage systems were investigated: deep mouldboard ploughing (DP); ploughless tillage (PT); ploughless tillage with lime sludge incorporation (PT+LS); cover crop for mulch without autumn tillage (NT+WM). The content of soil organic carbon (SOC) and soil bulk density was measured in the soil samples, collected from 0–10, 10–20 and 20–30 cm layers. Compared to DP, the applied reduced tillage systems have led to an increase in SOC content in the 0–10 cm layer, but the trend of SOC declining was observed in deeper layers; also a higher content of clay fraction C was found in 0–10 and 10–20 cm layers, which indicates an increase in SOC stability due to reduction of tillage intensity. However, due to reduced tillage, the physical properties of the soil have deteriorated: soil bulk density increased more than 2 times in 10–20 and 20–30 cm layers, the amount of plant available water has decreased in all layers.

The obtained results showed that long-term reduced tillage determines the stratification of SOC and worsens the physical properties of the clay loam soil.

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Temporal changes of soil hydraulic properties in soil columns with green pea plants

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Keywords: soil structure, soil hydraulic properties, temporal variability

Soil structure and corresponding soil hydraulic properties of arable soils considerably vary in time due to soil consolidation, root growth, soil swelling and shrinking, etc. This study therefore focused on short-term changes of these properties after sawing. Experiment was carried out under greenhouse conditions. Soil was taken from the surface horizon of the Haplic Chernozem at the university experimental field in Prague-Suchdol, Czech Republic. Soil was packed in 4 plastic columns (with a diameter of 15 cm and a height of 21 cm) at the same bulk density. Three seeds of green pea (Pisum sativum L.) were sawn into each column. Samples were regularly irrigated with tap water. Three 100-cm3 undisturbed soil samples were taken from one of the large soil columns 16, 23, 30 and 41 days after the sawing. These soil samples were used to measure the bulk density and soil hydraulic properties (parameters of van Genuchten functions) using the multistep outflow experiment performed in Tempe cells and numerical inversion with HYDRUS-1D. The characteristics describing the soil porous system were calculated.

In general, the shape of the soil water retention curves measured during the vegetation period changed, which indicated soil porous system rearrangement due to the soil material consolidation and root growth. Variabilities of the bulk densities and porosities measured after 16 and 23 days were larger than those after 30 and 41 days. The porosities and saturated soil water contents increased. The initially gradual shapes of the soil water retention curves changed in time into the step-like shapes (i.e., parameters alpha and n decreased and increased, respectively). This means that retention capacity between pressure heads 0 and -70 cm considerably increased in time. The saturated hydraulic conductivities decreased, which is likely related to the reduction of few large pores at the beginning and forming a larger amount of structural capillary pores.

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Bulk density of soils after a fire in the Kampinos National Park

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Fire is an important factor influencing the change of conditions in ecosystems. Fire has the potential to be one of the most destructive agents to soil and vegetation. The degree of degradation depends on many factors as: range of fire, temperature, duration of fire, which determine severity of the fire.

The aim of the study was to assess the impact of fire on the bulk density. It was assumed that in the central part of the area covered by fire the intensity of the fire was higher than in the peripheral zone, which caused a stronger incineration of plant material and could have an impact on soil properties, especially bulk density.

The study was conducted in Kampinos National Park, central Poland. The study covered the dune area with the plant complex Peucedano-pinetum at the age of 60 to almost 200 years. This area is partially under active protection and partly under strict protection. The geological formations in this area are aeolian sands, with loose sands texture. The research was carried out a year after the fires - one surface fire in May 2015, the second one in June 2015. The total area of both fires was about 11 hectares.

A year after the second fire, research sites with an area of $100m^2$ each were established. There were selected 11 sites in the center of burnt area (Central Fire), which in this study were treated as the most burnt. Next sites were established along the line delimiting the fire area from the area not covered by fire: 11 sites of Peripheral Fire on the burnt side and 11 Control sites on the unburned side, obtaining a total of 30 research plots. On each of them, samples were taken in 3 replicates with $100cm^3$ cylinders from the surface layer of soil 0-10 cm. Bulk soil density was determined by standard methods. The results were compared by statistical methods using the Statgraphics 4.1 program.

The study showed no significant differences between the sites, although the highest average value 1.44 $g \cdot cm^{-1}$ was found in soil in the area of the Central Fire, slightly lower 1.40 $g \cdot cm^{-1}$ in the Peripheral Fire zone and the lowest 1.37 $g \cdot cm^{-1}$ in the non-fire zone - Control. There was not a statistically significant difference amongst the medians.

Impact of soil pollution by petroleum substance on soil water evaporation

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Keywords: diesel, evaporation from bare soil, pollutants, soil hydrophobicity, water drop penetration time test

Petroleum substances introduced into the soil cause changes in its physical and chemical properties and have a negative impact on plant growth, living organisms as well as poses a threat to groundwater, which is a source of potable water. In this study, the impact of soil pollution by diesel fuel on soil water evaporation process and soil wettability were investigated.

For this purpose, a laboratory experiment in small glass columns filled with a sandy soil was carried out. The soil layer contaminated with diesel oil was added on the top of each columns. The podzolic soil with the composition of fine sand, collected from a soil profile located in the dry coniferous forest habitat from the town of Czeremcha (Podlasie province, Hajnówka poviat) was considered. The contaminated layer had different concentrations of diesel fuel (3, 5, 10 and 20% by weight) and different thicknesses (5 mm and 10 mm). Evaporation was monitored by the weighting of soil columns during a period of 3 weeks. In order to assess the soil's wettability, the water drop penetration time test was applied.

The performed research indicated that the diesel oil polluted soil layer reduces the evaporation intensity and increases the soil hydrophobicity (soil water repellency). A 20% concentration of diesel fuel in polluted soil layer caused an higher evaporation reduction, while for 3, 5, 10% the evaporation level were similar. Contamination by diesel reduces soil wettability. Soils contaminated with diesel fuel with a concentration of 3, 5 and 10% can be classified as slightly water repellent, while a soil contaminated with petrol with a concentration of 20% can be classified as severely water repellent. No effect of the thickness of the contaminated layer was observed when using diesel concentrations of 3, 5 and 10%, compared to a concentration of 20% where the effect of the layer thickness was noticeable.

Long-term impact of reduced intensity tillage systems, straw and green manure combinations on soil physical properties

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Keywords: tillage intensity, catch crop, residues, soil physical properties

Since 1999, a long-term field experiment has been done at the Experimental Station of Vytautas Magnus University Agriculture Academy (former Aleksandras Stulginskis University) at 54°52′50 N latitude and 23°49′41 E longitude. The soil of the experiment site is Epieutric Endocalcaric Endogleyic Planosol (Endoclayic, Aric, Drainic, Humic, Episiltic) according to WRB (2014), texture at 0–20 cm depth is silty medium loam (33.7% sand, 50.3% silt, 16.0% clay), at 20–40 cm depth – silty light loam (35.4% sand, 51.1% silt, 13.5% clay). The objective of our investigations was to assess the long-term impact of reduced intensity tillage systems, straw and green manure combinations on soil physical properties.

A short crop rotation was introduced: winter wheat, spring barley, spring rape. The results were obtained in 2013-2015. According to two factor field experiment, the straw (factor A) was removed (R) from one part of the experimental field and on the other part of the field all straw yield was chopped and spread (S) at harvesting. As a subplot 6 different tillage systems (factor B). The trials were replicated four times. The treatments were arranged using a split-plot design. The total size of each plot was 102 (6 × 17) m^2 and net size was 30.0 (2.0 × 15) m^2. The soil samples have been analysed in the Agro biological laboratory of Vytautas Magnus University Agriculture Academy.

Long-term application of reduced tillage results in a significant increase in soil penetration and soil shear resistance. The lesser the tillage depth, the higher the soil penetration and soil shear resistance. The effect of plant residue spreading is lower. Long-term tillage of different intensities and plant residue spreading as well as catch crop cultivation for green manure did not have significant effect on soil structure. Meanwhile, soil structural stability was highly dependent on soil tillage. Shallow rotovating before sowing increased soil structural stability by up to 1.8 times, incorporation of green manure of white mustard into the soil by a rotovator before sowing increased it by up to 2.0 times and direct drilling by up to 1.9 times, compared with deep ploughing.

Changes in the basic properties of selected organic soils after 10 years of impact of the dewatering barrier around open pit mine Tomisławice

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The paper presents the morphology and basic properties of organic soils (histosols). The first part of the research was carried in 2008 on grasslands located within the prospective depression cone of the planned brown coal open pit mine Tomisławice.
In 2018 - after ten years of impact of the dewatering barrier, repeated tests were made in the same areas. Some of the most important changes were presented on the example of 2 soil units.
In particular genetic horizons were determined such properties as: organic matter content, soil density, particle density, total porosity, moisture, and pH.
After 10 years of progressive decession, it was found: a decrease in the organic matter content, progressive moorshing of peat layers, an increase of particle density, a decrease in total porosity, and a slight decrease in pH. Observed changes indicate fast evolutionary processes induced by the anthropogenic factor.

Water stability of soil aggregates under the different fertilization systems

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Soil management itself can influence the changes in soil stability and productivity. The questioning of farmers in Lithuania have indicated that in agricultural practice short crop rotation of three-course (45 %) and 4-year crop rotation (36%) with more nutrient exhausting crops are the most dominant. Under such conditions, when organic matter inputs are very low, along with humus decline soils also tend to have a less stable structure.

Analysis of water stability of soil aggregates (at a depth of 0-20 cm) was examined according to the method of N. Savinov. In addition, Retsch wet sieving apparatus was used however water stable soil aggregates in this case were determined only from dry sieved 1 to 2 mm fraction (whereas fractions in diameter of 7; 5; 3; 2; 1; 0.5 and 0, 25 mm are used in N. Savinov's method).

Our research revealed that the number of water stable aggregates in the soil using different fertilizer systems did not differ much (Figs 1–2), however the tendency was that more of these aggregates were formed under the organic fertilizing system. This indicates that the structure of the soil and its water stability in crop rotation are determined mainly by the soil cover homogeneity and the soil treatment method that was applied in accordance with the indicators of soil density and porosity.

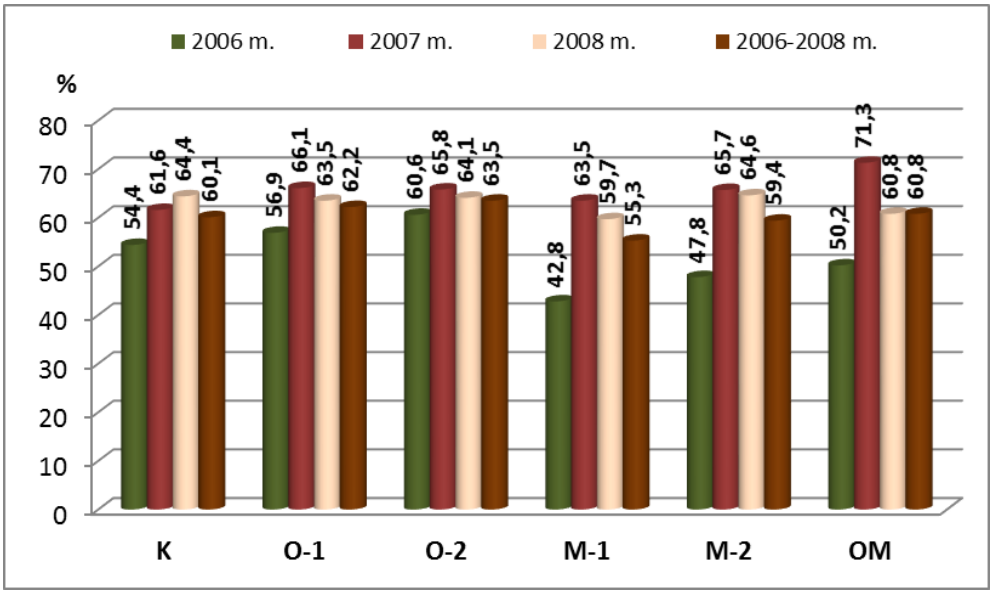

Fig. 1. Impact of fertilization systems on water stability of soil aggregates (in the Experimental Station of former Aleksandras Stulginskis University, 2006–2008).

K – Control (no fertilization applied); O – organic (1–50 t ha^{-1}, 2–100 t ha^{-1} manure once per rotation); OM – organic-mineral; M – mineral (1 – $N_{31}P_{38}K_{75}$, 2 – $N_{79}P_{65}K_{90}$) fertilization systems.

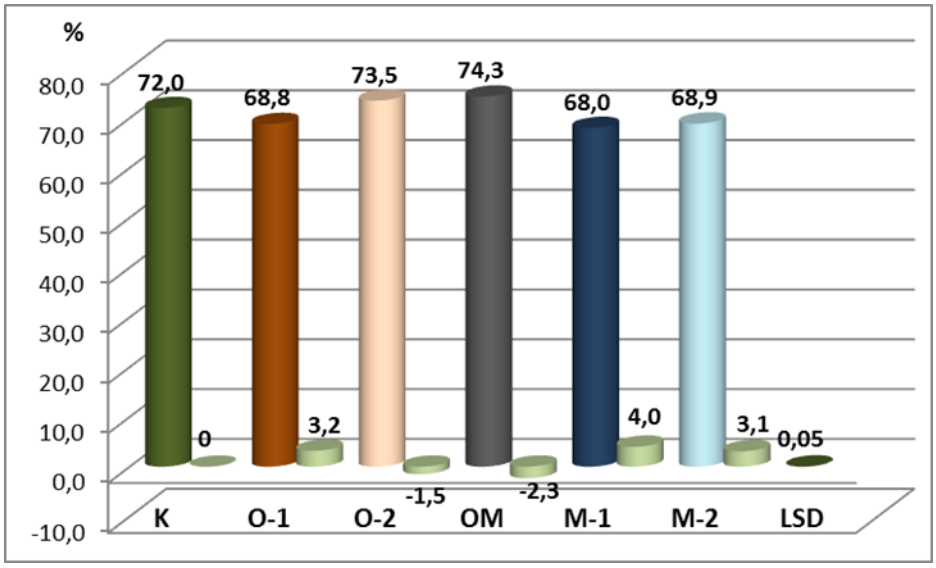

Fig. 2. Residual effect of fertilizer systems on water stability of soil aggregates (in the Experimental Station of former Aleksandras Stulginskis University, 2016).
K – Control (no fertilization applied); O – organic (1–50 t ha^{-1}, 2–100 t ha^{-1} manure once per rotation); OM – organic-mineral; M – mineral (1 – $N_{31}P_{38}K_{75}$, 2 – $N_{79}P_{65}K_{90}$) fertilization systems.

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