Tarptautinė mokslinė konferencija, skirta Lietuvos dirvožemininkų draugijos prie Lietuvos mokslų akademijos Žemės ūkio ir miškų mokslų skyriaus 50 – osioms metinėms paminėti

The conference is dedicated to commemorate 50 years anniversary of Lithuanian Soil Science Society at the Lithuanian Academy of Sciences

DIRVOŽEMIS TVARIOJE APLINKOJE

Lietuvos žemės ūkio universitetas
2008 m. rugsėjo 24–26 d.

SOIL IN SUSTAINABLE ENVIRONMENT

Lithuanian University of Agriculture
24–26 September, 2008

Akademija 2008

UDK 631.4(06)
Di317

Konferencijos organizacinis komitetas / Conference Organizing Committee

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Lietuvos Respublikos žemės ūkio ministerija
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ISBN 978-9955-896-31-9 Knygos brukšninis kodas: 9789955896319

Lithuanian Soil Science Society at the Department of Agriculture and Forestry in Lithuanian Academy of Sciences – 50

The society is voluntary public organization of people in Lithuania be engaged in soil science and plant nutrition. It was set up in 1958. In 2005 it was registered at the Department of Agriculture and Forestry in Lithuanian Academy of Sciences and unites more then 100 members from state universities, research institutes, land service organization, acts under leadership of board elected for a few years. It is associated member of International Union Soil Sciences (IUSS) and European Union Soil Sciences (EUSS).

The society takes care of soil cover in Lithuania, coordinates it's investigations, organises scientific conferences, seminars and expeditions, gives consultations, helps soil science and plant nutrition specialists to change in scientific information, keeps contacts with foreign Soil Science and Plant Nutrition Societies and Associations.

It published two books of "Lithuanian Bibliography of Soil Science, Plant Nutrition and Soil Cartography". The first one (1975) covered scientific and applied publications from the beginning till 1970 inclusive, the second – from 1971 till 2000 inclusive. Also two editions of "Small Systematic Dictionary of Soil Science in Five Languages" (1997), "Soil Science" hand book for universities students (in Lithuanian 1996, 2008), 12 monographs, collections of scientific articles and presentations. In 1999 has been prepared a new classification of soils in Lithuania harmonized with FAO-UNESCO document "World Reference Base for Soil Resources". The classification was published in two fundamental monographs – "Soils of Lithuania" (2001) and "Classification of soils in Lithuania" (2001). On this background has been prepared a new different scale soil maps for Lithuania, which has been used to prepare "Soil Atlas of Europe" (2005) published by Joint Research Centre of European Commission.

In 24–26 September, 2008 the Society celebrates 50 years anniversary by special international conference–expedition "Soil in sustainable environment" and a few publications.

President of the Society
Prof. Dr. Habil., Member expert of the Lithuanian Academy of Sciences
Algirdas Motuzas

Leidinys parengtas pagal autorių pateiktus straipsnių originalus
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Plenarinis posėdis

Dirvožemis tvarioje aplinkoje

Pirmininkė: akad. prof. habil. dr. **Veronika Vasiliauskienė**
Pavaduotojas: Lietuvos MA n. e., prof. habil. dr. **Algirdas Motuzas**

Žodinių pranešimų
laikas – 2008 m. rugsėjo 24 d. 10^{00}–13^{00} val.
vieta – LŽŪU IV rūmų konferencijų salė, 214

Plenary Oral Session

Soil in sustainable environment

Convener: LAS akad. prof. **Veronika Vasiliauskienė**
Conconvener: LAS m. e. prof. **Algirdas Motuzas**

Wednesday, 24 September 2008, 10^{00}–13^{00} h
in IV building of LUA, conference hall 214

Plenarinio posėdžio pranešėjai
Authors indexs of Plenary Session

New research concepts bridging between science and politics

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Sustainable land use is a complex task, based on the use of 6 main functions of soil and land by farmers, foresters, gardeners and others in a bottom-up approach, or by politicians and decision makers in a top-down approach. Sustainable land use is constantly endangered by 8 main threats, as exemplified by the European Thematic Strategy for Soil Protection of 2002 (COM(2002)179 final), such as sealing, erosion, contamination, loss of organic matter, loss of biodiversity, compaction, salinisation; inundations and landslides.

Under these conditions, it is of paramount importance to develop indicators which provide sufficient information for those who manage soil and land. This however is a task of science, and the question is, on which basis can science develop indicators which are useful for decision makers in a broad sense.

One basis is the DPSIR approach, which defines that each soil problem is characterised by a state (S). This state derives from driving forces (D), which create pressures (P), which are responsible for the state (S). Each state creates an impact (I), direct or indirect, and in order to alleviate or mitigate this impact, responses (R) are needed, which can be given by a land user at the grass-roots level, e.g. a farmer, as well as by a high-level decision maker or politician, because the DPSIR approach follows the cycle of decision making.

During the further elaboration of the European Soil Thematic Strategy, from 2002–2004, new research concepts were developed, based on DPSIR, distinguishing between 5 main research goals, 5 research clusters based on these goals and a determination of those sciences, which necessarily have to co-operate in order to find the right solutions.

Therefore, indicators based on this approach can bridge between science and technology on one side and stakeholders, decision makers and politicians on the other side, thus sharing knowledge between those who have it and those who need it.

Key words: sustainable land use, DPSIR approach, research concepts.

Yield and quality of spring wheat grain in relation to P-status of Podzoluvisol loamy sand soil and fertilizers

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The studies of spring wheat yield response to fertilizers in model field experiment with four different levels of mobile phosphates content (P_2O_5 70–117–200–393 mg kg^{-1}) in Podzoluvisol loamy sand soil contaminated with radionuclides of ^{137}Cs and ^{90}Sr had been conducted in 2005–2007 at Gomel region of Belarus.

The increase of phosphate content in all studied diapason was accompanied with the yield of grain enhance on fertilized treatment in average from 3,8 to 6,9 t ha^{-1} as well as with increasing content of crude protein. However the highest protein content in grain 13,8–14,0 % was observed at the 3-d level of phosphate supply while the grain yield and protein yield continued increasing up to phosphate content in soil ≈ 400 mg kg^{-1}. There was found significant improvement of amino acid's composition and biological quality of grain protein according to increase of soil P supply levels.

The efficiency of nitrogen fertilizer at rates $N_{60\text{-}90\text{-}110}$ and potassium fertilizer at rates $K_2O_{90\text{-}120\text{-}180}$ were positively correlated with all studied levels of P content in soil. The grain yield response per 1 kg of P_2O_5 applied was highest (10,5 kg) at 200 mg kg^{-1} level of soil phosphate supply reducing on 57 % at 4th level of soil phosphate content.

The combining effect of soil phosphate supply level increase in studied limits and well balanced fertilization ($N_{90–110}P_{60}K_{120–180}$) provided the wheat grain yield increasing up to 3 times simultaneously with reduction by factor 2 of the radionuclides ^{137}Cs and ^{90}Sr transfer from soil to grain. Profitability of tested fertilizers was increasing according to enhancement of soil supply with mobile phosphates, resulting in net return of 127 and 246 USD ha^{-1} respectively on 1st and 4th level.

Key words: soil phosphates, grain yield, protein content, radionuclides ^{137}Cs and ^{90}Sr.

Influence of rusty soil-forming process on physical and chemical transformation of the quartz grains surface

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The purpose of research was determination of quantative and qualitative physical and chemical transformations on the quartz grains surface (0,5–0,25 mm diameter) at the rusty soil-forming process.

The study were carried out in two profiles forest soils belong to haplic arenosols (WRB), developed from glacifluvial sands of White Forest. The research was conducted using Bull's method (1978) with employment scanning electron microscope (SEM) and qualitatively – quantitative microchemical analysis of chemical composition of quartz grains surface using microprobe EDS. Field work and basic analysis of soils were elaborated using methods commenly applying in soil science laboratories.

The rusty soil-forming process causes stronger and more differentiated chemical than physical transformations on the quartz grains surface in the majority of genetic horizons, only amount of physical transformations predominate in parent rock horizons. In the humus horizons among of chemical transformations processes on the quartz grains surface the etching and corrosion as „destruction" processes quantitatively predominate the amounts of incrustation and encrustation as „accumulation" processes. However, in the *sideric* horizons (Bv) distinctly and in smaller degree in parent rock the incrustation and encrustation quantitatively dominate the amounts of etching and corrosion. Microchemical analysis of chemical composition indicated the highest contents of aluminum, iron, magnesium and calcium on the quartz grains surface in the *sideric* horizons (Bv). The amounts of incrustation and encrustation (according of statistic analysis) is positive correlated with the content of free iron and amorphous iron and aluminum in the investigated soils.

Obtained results of research indicate influence of rusty soil-forming process, on ultrastructure of quartz grains surface.

Key words: Haplic Arenosols, ultractructure of quartz grains surface.

Carbon sequestration in Lithuanian soils: experiences from the Kaltinenai Research Station of the Lithuanian Institute of Agriculture

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The fundamental aim of the pilot-project 'Carbon sequestration in Lithuanian soils' (supported by the Leverhulme Trust, UK), was to provide a permanent 'benchmark' of the soil organic matter (SOM) and soil organic carbon (SOC) status of representative Lithuanian agricultural soils. Specific objectives included comparison and correlation of soil carbon and soil texture analytical methodologies between 'Eastern' (i.e. former-Soviet) and 'Western' (i.e. UK and US) systems. Analysis was based on sandy loam Eutric Albeluvisols at the Kaltinenai Research Station (KRS) of the Lithuanian Institute of Agriculture, on the undulating hilly topography of Western Lithuania.

Large archive databases of SOM/SOC widely exist in Lithuania and the other countries of Central and Eastern Europe. Difficulties of SOM data acceptance and comparison remain, where these results are presented for publication in international journals, due to methodological differences between laboratory protocols. The research programme included the correlation of selected SOM/SOC analytical methods. Between 21–30 May 2002, 92 samples were collected from topsoil (0–0,20 m: Ap, n=36; Ah, n=10) and subsoil (0,20–0,40 m: Bt, n=46) horizons of 46 long-term experimental field plots at the KRS. Each sample was then sub-sampled and analysed for SOM using dry combustion (by automatic elemental analyser), Walkley-Black (USDA), Tyurin photometrical, Tyurin titrimetrical and loss-on-ignition (LoI) methods (the latter performed, in parallel, in laboratories in both Lithuania and the UK). The analytical database is archived and published as a permanent 'snapshot' of the SOM and SOC status of Lithuanian agricultural soils in relation to specific land uses. The selected land uses were: crop rotation with

bare fallow, field crop rotation, grain-grass crop rotation, grass-grain crop rotation and perennial grasses for long-term use.

Linear correlation and paired regression equations were calculated between the SOM/SOC datasets. Correlation coefficients between the datasets varied between r=0,81–0,96 (from 0–0,20 m, n=46, P<0,001) and r = 0,76–0,98 (from 0,20–0,40 m, n=46, P<0,001). Based on the strength and significance of these relationships, it is proposed that simple linear or more complex paired regression equations can be confidently employed to recalculate SOM/SOC data between various analytical methodologies.

Since carbon-sequestration in soils is closely related to soil texture, pedo-transfer functions were developed between protocols used to analyse particle size by East European, UK and US methods, thus allowing direct comparison between soil properties using these analytical protocols. Using the same soil samples, as for SOM/SOC analysis, the database also contains results of 92 textures obtained by laser-diffraction, USDA and Katschinski methods and provides calibrations and correlations between soil textural classes analysed using the different systems. This allows direct cross-reference between East European, UK and US textural classifications. However, there is a need to expand the calibration of the soil textural properties using additional samples with more diverse textures.

Keywords: arable soils, soil organic matter, carbon sequestration, soil particle size, analytical methods, correlation-regression.

New developments in diagnosis and classification of Latvia soils

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International information exchange in many aspects is important also for soil-related issues. Number of EU documents related to the agricultural support schemes and environmental quality requires detailed locally-based soil information. Therefore national soil diagnosis, classification, interpretation, mapping and monitoring schemes should be adjusted to meet requirements for intensive and adequate information transformations.

Soil information standards recognized by EU includes FAO recommended soil diagnosis and description scheme (2006) and WRB 2006 soil classification. The first one is decided to introduce as the component of Latvia national soil resources inventory programs and adjustments to meet local conditions were done. These adjustments accommodate more detailed as well as additional parameters, having importance for the local use but at the same time fitted into the overall scheme and therefore not deranging the system. Some calibration and comparison activities were performed to make harmonization with previously obtained data.

Direct use of WRB in Latvia was decided to be inexpedient. WRB is supposed to be too broad to fit the local soil characteristics. Also national traditions and data sets already accumulated makes difficulties for complete shifting from genetic-based system on morphological one. Therefore dual approach is more convenient for new data accumulation, e.g. parallel use of both systems. For this purpose WRB 2006 translation in Latvian (only that part which is relevant for our situation) with comments and explanations was performed and revision of Latvia soil classification was done.

For the sake of information harmonization, revision of methods for soil physical and chemical analysis also was done. Parameters, necessary for implementation of soil diagnosis and use of both classification schemes should be performed based on one set of analytical methods – international ones. Therefore some previously employed methods and traditionally used parameters were changed.

Key words: WRB soil classification, analytical methods.

Functioning of soils in concordant with local pedo-ecological conditions - the main prerequisite for environment sustainability

KÕLLI Raimo, ASTOVER Alar, LEEDU Enn, LEMETTI Illar, REINTAM Endla, TAMM Indrek

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The optimizing of land use on the base of soil cover composition and properties may be analyzed on different spatial levels. The most detail level in precise agriculture is soil contour. The highest level for solving problems concerned to soils inside of country is whole country level. Between these two extremities the administrative (farm–>municipality–>county) and pedo-ecological (field->massive->landscape->eco-region) levels may be separated. From the other side, the soil use and management may be analyzed from the environmental, economic, societal and political aspects. The competent integrated analysis from these two aspects elucidates some contradictious situations needing regulations in the future. If for treating environmental problem more acceptable are the based on pedo-ecological situation divisions, then in solving political problems the most suitable are the administrative units. In connection with globalization the soil problems must be treated more widely – on European and global level. There are very big differences in pedo-ecological conditions, traditions of society and economical capability. It is conceivable to find out possibilities for joint acting in direction of similar interests and to elaborate compromises for overcoming dissimilarities. The fruitful collaboration may exist in circumstances when soil problems are well regulated at our own home. Under this we mean the awareness of whole society and stakeholders, availability of information about actual status of soils, presence of elaborated treatments for mitigation of soil degradation features etc. Many of these tasks belong by the issue to the soil service, which is not yet restored in our country. In actual situation the reduced society of soil scientists must to do their best for introducing these problems to policymakers. It is important to have not only a long time experience of our precursors, but as well to introduce into country the experience of neighbours working in pedo-ecologically equivalent conditions and the novelty of world soil science. In presentation some crucial problems on the base of last two decades developments in Estonia will be analyzed.

Key words: land use, soil in environment, soil management.

Specific pedogenesis in shallow soils on massive rocks: not enough fine earth to form a proper soil profile

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The shallow soils of East Fennoscandia on massive rocks under lichen and lichen-moss vegetation were studied. The rocks were represented by (i) nepheline syenite, (ii) amphibolites, (iii) metamorphized gabbro-diabase and (iv) their derivates. The key plots were located in the mountainous tundra, northern and middle taiga zones of Kola Peninsula and Karelia. The character and rate of the pedogenesis and weathering on massive rocks were predetermined here by lithological but not bioclimatic conditions. Besides such "soils" as litters on rocks and Podzols on sandy moraines, there was found the unique variant of soil formation as shallow (<5–10 cm) stony soils that were formed on the fine earth derived from hard rocks without any admixture. These soils are classified as Leptosol (WRB, 2006) and as "lepto-podboors" in Russian classification system (2004). Their recent pedogenic processes are: (i) transformation of soil organic matter *in situ*, (ii) formation and migration of R_2O_3-organic complexes, (iii) mineral disintegration. They are combined in one soil horizon as it is not enough depth and fine earth to form a proper soil profile. Phyllosilicates are present in the sola due to epigenetic ("pre-pedogenic") alteration of rock. The pedogenesis does not result in the phyllosilicates appearance if the latter are absent in the substrates. The admixture of moraine substrate with phyllosilicates even in the case of shallow soils is a reason of the soil profile differentiation. The soil organic matter is characterized by (i) low ration of C:N, (ii) predominance of labile fractions. It is because of the shortage of fine earth for organic substances to be fixed at. Thus, the pedogenesis in shallow soils on massive rocks is very specific due to the lack of fine earth the content of which is not enough for a proper soil profile can be formed.

Key words: pedogenesis, soil organic matter, mineral composition.

The spatial peculiarities of Lithuania's soil cover structure in the landscape's context

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It is very topical to develop a general theory of soil science in the present time of overall integration and modernization of science. One of such branches is a further formation of the conception of the soil cover as an integral body, distinguishing itself by individual spatial structure, and a search of the ways to explore the structure. It is relevant not only to the development of the theory of soil science but to its knowledge appliance to the cognition of a landscape's structure, working and growth as well as to the solving of land management problems, too.

A territorial unit of a statistical grid is suggested as a foothold in methodology of soil cover structure's analysis. Due to the scale and particularity of the map under consideration, a statistical grid of 2x2 km was chosen.

The soil cover structure is considered as a spatial dispersion of soil cover diversity and contrast features, expressed in points, establishing them having evaluated the spatial dispersion of the cover's areal and linear elements.

The soil cover structure is also reflected by its general complexity and structurality.

A spatial variety of a territory's grain-size composition has the greatest influence on the degree of soil cover diversity while the degree of cover's contrast is caused by the territorial peculiarities of soil pH.

A distinctly higher complexity of soil cover is more characteristic to uplands than lowlands as well as more to the genetically heterogeneous territories of surface rather than to the homogeneous ones.

The soil cover structurality types, in which diversity is more expressed, are more characteristic to uplands (except the Medininkai upland) than to plains (except sandy plains). Meanwhile, the cover types where contrast is more expressed or territorial structurality is low are more characteristic to plains and deposits of a minor grain-size composition as well as to the territories affected by a periglacial weathering.

Key words: soil cover structure, diversity, contrast, complexity, structurality, landscape.

I sekcija

Dirvožemių genezė, klasifikacija ir kartografavimas

Pirmininkai: prof. **VAIČYS Mečislovas,**
prof. **SKLODOWSKI Piotr**

Žodinių pranešimų laikas –
2008 m. rugsėjo 24 d. $14^{00} – 16^{30}$ val.,
kavos pertraukėlė – $16^{30} – 16^{45}$ val., pranešimų tęsinys – $16^{45} – 17^{30}$ val.

vieta – LŽŪU IV rūmų posėdžių salė, 211 kambarys

Stendinių pranešimų vieta ir laikas
LŽŪU IV rūmų fojė, $17^{35} – 18^{00}$ val.

Symposium 1

Genesis, classification and cartography of soils

Conveners: prof. **VAIČYS Mečislovas,**
prof. **SKLODOWSKI Piotr**

The time of oral presentations –
Wednesday, 24 September 2008, $14^{00} – 16^{30}$ h, coffee break – $16^{30} –$
16^{45} h, prolongation of presentations – $16^{45} – 17^{30}$ h

The place – IV building of LUA, meeting room 211

The place and time of Posters session –
foyer of IV building LUA, $17^{35} – 18^{00}$ h

Pirmosios sekcijos pranešėjai
Authors indexs of Symposium 1

Ecological consequences of the afforestation of previously managed arable Arenosols

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The study was carried out in a long–term permanent experiment that was established in 1960 on arable Haplic Arenosols (ARh) (FAO–UNESCO, 1998). The soil chemical and biological properties were compared in 45–year–old Scots pine (*Pinus sylvestris* L.) plantations and abandoned (for the last 11 years) arable land.

After the afforestation of arable Arenosols with Scots pine, former plaggic Ap horizon became more acid, and the leaching of the mobile P_2O_5 and K_2O was intensified due to the accumulation and decomposition of forest floor. Meanwhile the nitrogen added with the fertilizers was leached, and the grasses of non–fertile soils with low nitrogen content were dominated in ground vegetation cover of abandoned land. If to compare with abandoned land, pine plantations increased the pool of soil organic carbon (SOC) due to the mineralization of forest litter and high root turnover. Moreover, the accumulation of SOC was decreasing in abandoned land because of the expansion of organic matter decomposing bacteria. However, according to the bacteria sequences of nucleotides and amino acids of the cytochrome P450, the bacterial diversity was higher in pine plantations.

Key words: Arenosols, Scots pine plantation, abandoned arable land, chemical properties, abundance and diversity of microflora.

Properties of deluvial soils in Poland and Lithuania and propositions for classification

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Name *deluvial* is used for a definition of deposits formed in result of geodynamic processes in hilly and undulating landscapes with scarce plant cover by natural and technogenic movement of topsoil or products of weathering down the slope and its accumulation. Properties and distribution of *deluvial* soils are important in agriculture history, soil erosion, water protection.

Deluvial soils are part of national soil classification systems, Poland and Lithuania (till 2001). In Poland *deluvial* soils are one of two orders within fifth division – *alluvial* and *deluvial* soils. From 2001 deluvial soils in Lithuania are in one unit with *fluvisols*, but it is incorrect because of lacking fluvial material. In France Germany the soils on similar deposits are distinguished as *colluvisols.*

Deluvial soils are mapped and it is necessary to distinguish them in first level of classification and diagnostic properties of deluvial horizon or material must be formulated. Instead of *deluvial soils*, *deluvial* the terms *colluvisols, colluvial, colluvic* can be used in international classification.

Propositions for diagnostic properties of *colluvisols* are given on the base of selected properties of *deluvial* soils in Poland and Lithuania: thickness of more than 30 cm, domination of sandy loam composition, very fine stratification and irregular distribution of organic carbon, location on the bottom part of slope in hilly and undulating landscape.

Key words: erosion, deluvial soils, colluvic material, granulometric composition, organic carbon.

Lithuanian Forest Arenosols: genesis and properties

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The detail researches of Lithuanian forest Arenosols carried out in 55 plots in 2001–2007 by the new soils classification of Lithuania (LTDK–99). In this research was estimated all five subgroups of second level of Arenosols which are in the new soils classification of Lithuanian. The data has obtained after mineralogical, texture and chemical soil samples analysis.

From 24 soils systematic units of third level of Arenosols were estimated only 11. The research data has showed that Albic Arenosols and Haplic Arenosols are dominant systematic units of Arenosols in the Lithuanian forests. In time of research were estimated three units of third level Arenosols which are not in new classification of soils. There are Bathihypogley-Rubi-Haplic Arenosols, Lamelli-Albic Arenosols and Cambi-Calcaric Arenosols.

The mane parent material of Lithuanian forest Arenosols are fluvioglacial, eolian, glacial and old alluvial sandy deposits.

The mineralogical analysis has show, that the main minerals of Arenosols are quartz (85,0 %) and field spate (6,6 %). There were estimated more than 30 minerals and their groups. The fractions of clay and silt were the less in Albic Arenosols. The mean of clay fraction was composed 2,0 %, silt fraction – 2,2 % and sand fraction – 95,8 %.

The biggest content of organic carbon and total nitrogen was estimated in the humus horizons (0–20 cm in depth) of Arenososls. While the content of organic carbon in this horizons varies from 0,11 % to 1,29 % and for the total nitrogen there was evaluated from 0,012% to 0,129 %. It was fixed that he content of organic carbon and total nitrogen was greatly the less in deeper horizons.

The less content of base cations was estimated in Albic Arenosols and the biggest in Calcaric Arenosols. Mean base saturation was 19,9 % in Albic Arenosols whereas in Calcaric Arenosols was close to 100 %.

Key words: forests Arenosols, nitrogen, organic carbon, soil minerals, soil texture.

The Evolution of the soil cover of Belarussian Poozerye as a constituent part of Baltic Lakelands

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Belarusian Poozerye is a solid natural formation along with Lake lands (Poozeryes) of Germany, Poland, Lithuania and Latvia as a large pedogeographic province. High structural and genetic diversity of natural complexes and spatial heterogeneity of their components are presented by two groups, which are sharply differed by its genesis, height state, peculiarities of relief, rocks lithology and soil cover structure. First group is connected with the widely spread of newest hilly morainal relief differed by a complicated alteration of hills and depressions, which have different vertical and lateral sizes and composed by variegated rocks lithology. Extreme heterogeneity of soil cover are caused by all of them. High variety of morphologic, hydrophysical, chemical and productive properties of soils are typical for the given territory. The cereal crops harvest amplitude is reached up to 10 times. This value for grasses is reached up to 3 times. Favorable conditions for the development of fluvial and agrotechnical erosion are lead to growing of eroded soils up to 20 % and more within some pedoecological regions. The soil cover characterizes by extreme dynamics of development. Soil cover image becomes more mosaic. The soil heterogeneity has exceed for 20–25 % during 40 years period and reaches a maximum of this value for Belarus. Contrast local differs inside of fields and plots, the variety of soils properties are growing. The humus content depletion records on the levels 0,2–0,5 %.

The group of natural complexes formed on flat glaciolacustrine lowlands are differed by highest conservatism and sustainability to the anthropogenic impact. It characterized by sharply defined hydromorphism, by relative homogeneity of basic properties and background structure of soil cover. Changes of upper layers of soil is occurred as a result of agricultural proceeding. The humus content is decreased for 0,4–0,6 %, physical density is increased up to 15–25 %. The soil cover diversity increase insignificantly (up to 5 %).

Key words: Poozerye, soil cover, evolution.

Spatial differentiation of acid soil layer in Lithuania

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The reaction is basic factor determining physical, geochemical, biochemical and biological processes in the soil. Consequently, the understanding about the thickness of acid soil layer is important. In the majority of studies carried out in European countries the main attention was paid to the soil pH value in soil profile. The understanding about acid soil layer and its spatial differentiation is weak.

The aim of this theoretical work was to determine the spatial differences of the thickness of acid soil layer and spatial regularities in Lithuania.

The thickness of acid soil layer (pH_{KCl}<5,5) has been calculated using the relationship between the depth of carbonate and the thickness of acid soil layer in moraine soils. According to the regression equations, the thickness of acid soil layer has been calculated. The map of acid soil layer has been compiled after the GIS database of Lithuania's soils on a 1:300 000 scale. The typology of the thickness of acid soil layer has been constructed, i.e. zero or very thin, thin, relative thick, mean thick, very thick.

It was revealed that very thick acid soil layer is in the Medininkai upland, mean thick in the Žemaitija and Baltija uplands, relative thick in the slopes of the Žemaitija and Baltija uplands and thin in the Central Lithuania lowland. The contours of acid soil layer repeat the contours of relief. The spatial differentiation of acid soil layer is consequent upon relief age.

Key words: acid soil layer, spatial differentiation, depth to carbonate.

The most recent investigations of water erosion on the slopes of the Žemaičiai Uplands

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According to soil erosion investigations on the undulating landscape of Western Lithuania the mean water erosion rate under field crop rotations varied from 6,43–20,5 m^3 ha^{-1} yr^{-1} on the slopes of 2–14°. The least loss was from the grass-grain crop rotation, and rates increased from 1,62 m^3 ha^{-1} yr^{-1} on the 2-5° slope to 4,65 m^3 ha^{-1} yr^{-1} on the 10–14° slope. These results were assessed by measuring the length and cross-sectional area of rills, to calculate soil loss volume.

The latest investigations were conducted by directly measuring soil losses using water and soil collectors. Experimental evidence from 72 tests (3 field experiments × 2 replications × 12 years) carried out at the Kaltinenai Research Station of the Lithuanian Institute of Agriculture suggests that soil losses were 11,21 Mg ha^{-1} y^{-1} from the plots covered by plants of the crop rotation containing bare fallow. The soil losses declined by 57,4, 71,4 and 86,3 % from the plots covered by plants of field, grain-grass and grass-grain crop rotations, respectively. Plants of long-term perennial grasses completely inhibited soil erosion. The smallest losses (0,44–4,49 Mg ha^{-1} y^{-1}) were from the slopes having the heaviest soil texture (i.e. silty clay loam). Somewhat higher soil losses (0,68–5,16 Mg ha^{-1} y^{-1}) were from slopes with a silt loam texture above silty clay. The highest water erosion rates (3,50–23,97 Mg ha^{-1} y^{-1}) were measured on the slope with the lightest soil texture: silt loam on the loamy sand.

The highest percentage of soil organic matter (SOM) after 12 years of investigations was found on the plots (n=6) covered by long-term perennial grasses (3,15 %), it was a little less on plots under the grass-grain (2,50 %) and grain-grass crop (2,38 %) rotations, and least on plots covered by plants of the crop rotation containing bare fallow (2,20 %), where highest erosion rates were also measured.

Key words: Žemaičiai Upland, soil erosion, long-term studies, soil loss, soil organic matter.

The effects of palm leaf geotextiles on the stabilization of roadside slopes in Lithuania

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Soil erosion is global environmental problem. There are many potential soil conservation measures for arable soils in Lithuania. However, specific strategies are required on industrial slopes, where plant clover is often destroyed by machinery and soil truncation may occur. Problems may arise due to exposure of deeper soils deficient in soil organic matter, which are thus especially vulnerable to water and wind erosion. Geotextiles are one of the methods suitable for soil conservation on such engineered industrial slopes.

Geotextiles constructed from the palm leaves of *Borassus aethiopum* and *Mauritia flexuosa* are investigated at the Kaltinenai Research Station of the Lithuanian Institute of Agriculture, which is participating in the EU-funded BORASSUS Project. Geotextiles are potentially excellent biodegradable and environmentally-friendly materials useful for soil conservation. Field studies on a steep (21–25^{o}) roadside slope suggest biogeotextile mats are an effective and sustainable soil conservation technique. Geotextiles have potential as a biotechnical soil conservation method for slope stabilization and protection from water erosion on steep industrial slopes and may be integrated with the use of perennial grasses to optimize protection from water erosion. The investigations demonstrated that cover of Borassus and Buriti mats improved the germination and growth of sown perennial grasses. The biomass of perennial grasses significantly increased by 52,0–63,4 % under cover of Borassus mats and by 18,6–28,2 % under cover of Buriti mats. The geotextiles (Borassus and Buruti, respectively) decreased soil losses from bare fallow soil by 90,8 and 81,5 % and from plots covered by perennial grasses by 87,9 and 79,0 %, respectively.

Key words: soil erosion, roadside slopes, vegetation cover, geotextiles.

Effect of silviculture amelioration on nutrient regime of meadow-chestnut soils in dry steppe

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Meadow-chestnut soils are the most fertile in a dry steppe region and occupy about 25 % of total area of solonetz soil complex in this region. The specific system of agrosilviculture was developed for soils of solonetz complex (Dzhanybec station of RAS, Northern part of Caspian lowland) in 1950. It included: (1) the deep ploughing with involvement of gypsum layer, (2) forest belt plantations for snow retention, and (3) annual tillage. This study was aimed to investigate the effect of silviculture amelioration on storage and composition of nitrogen, phosphorus and potassium compounds in meadow-chestnut soils.

It was found that the storage of total nitrogen in plough layer of meadow-chestnut soils comprised about 6 t ha after land reclamation and it was about 2 times lower than in the virgin soils. The N-losses amounted to 2 % per year. The agrosiviculture application initiated the decrease of storage of exchange potassium: from 56,9±4,4 kmol/ha in non-meliorate meadow-chestnut soil to 35,9±0,5 kmol/ha after 50-yers land reclamation. We also observed the changes in thermodynamic parameters of potassium status of meadow chestnut soils induced by agrosiviculture amelioration. The values of potassium potential calculated as $lgAR_{tg}$ were decreased from -2,19 to -2,97. It indicates the insufficient potassium supply of meadow-chestnut soils after land reclamation. The obtained results showed that the agrosilviculture application did not influence on the storage of easy nitrifying nitrogen, non-exchange potassium, total and labile forms of phosphorus. Therefore, the nitrogen and potassium regimes of meadow-chestnut soils hade become significantly worse after using of agrosilviculture system.

This study was supported by Russian Foundation for Basic Researches (project N 06–04–48076).

Key words: meadow-chestnut soil, silviculture amelioration, nutrient regime, soil fertile.

Changes in the organic carbon stocks of former croplands of Russia, 1990–2020

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Land use change effects significantly on amount of soil organic carbon stored. Since 1990 land use system in Russia has been considerably changed and more than 10 Mha of croplands were abandoned. The aims of present study were: (1) to quantify the alterations of carbon fluxes in abandoned lands after different periods of land use change, and (2) to estimate the carbon accumulation in Russian soils during 1990–2020.

Carbon balance (CB) of cultivated soil under the fallow was compared with that of soils abandoned 4, 8, 13, and 28 years ago and converted naturally to permanent grassland (loamy Phaeozems, Moscow region, Russia). It has been shown that former croplands acted as a carbon sink and their C-balance constituted -56– (-240) g $C \cdot m^{-2} \cdot yr^{-1}$. Based on this field study we can conclude that the former croplands become a stable C sink after 4 years of land conversion to permanent grasslands. The average CB for abandoned lands was -191 g $C \cdot m^{-2} \cdot yr^{-1}$. Since the 90's the total C-sink for Russian territory may be estimated 277–970 Tg C due to the conversion of former croplands to permanent grasslands.

Based on own field studies and literature analysis, we have estimated the carbon accumulation rates for main soil types: sod-podzolic soil, grey forest soil, chernozem and chestnut soil. The carbon sequestration rate changed from 42 g $Cm^{-2}yr^{-1}$ to 484 g $Cm^{-2}yr^{-1}$ depending on soil genesis and period of abandonment. As a rule, C-accumulation rate was higher during the first years after land use change from arable to grasslands. For the first 15 years after abandonment, the mean C-accumulation rate in topsoil varied from 66±24 g $Cm^{-2}yr^{-1}$ in chestnut soils to 145±52 g $Cm^{-2}yr^{-1}$ in chernozems. The general average was 99±14 g $Cm^{-2}yr^{-1}$. The total C-accumulation induced by conversion of croplands to grasslands amounted to 184–673 Mt for Russian territory during 1990–2005 and can reach 282–1030 to 2020. The estimates obtained may be improved by force of the correction of areas of abandoned lands in Russian Federation.

This study was supported by RFBR (Project N 07–04–01333).

Key words: carbon balance, land use change, C-accumulation rate.

Estimation of fertility and ecological status of soils in the school greenhouse

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Soil fertility means the ability to supply the plants by vitally important nutrients, moisture, and air for their normal growing, development and fructification. Soil fertility is caused by content of humus and other nutrients in it. The aim of our study was to estimate the fertility of soils in the school greenhouse.

The greenhouse of gymnasium «Pushchino» is mostly used for the growing of annual and perennial flowers. Soil samples were collected from top layer (0–10 cm) in the 5 places of greenhouse. The content of total carbon and nitrogen, labile P and K, mineral nitrogen (NH_4^++NO_3^-) and pH-values were determined by methods generally accepted in the soil science and agrochemistry.

It has been shown that the soils in the school greenhouse were loamy. They had a good air- and water-permeability, and high water holding capacity. The pH-values of water extraction were close to optimal and varied weakly (from 5,9 to 7,3). The content of total carbon averaged 1,69±0,14 (coefficient of variation, CV=19 %) and was also close to optimal. The content of total nitrogen varied from 0,12 to 0,37 % and was characterized by the highest variability (CV=41 %). The concentration of labile K and P (0,2M HCl extraction) averaged 31,4±3,6 mg/100g of soil and 21,7±3,7 mg/100g of soil, respectively. It was twice as much as optimal level of labile K and P in soil. The content of mineral nitrogen was very high and essentially exceeded the optimal content (15–20 times). So high concentrations of labile nitrogen can negatively effect on growing and development of plants and cause the pollution of soils. Thereby, we found, that greenhouse soils were characterized by high concentration of labile K and P, and optimal C-content and pH-values. The excess of mineral nitrogen indicates the soil pollution and unfavorable conditions for plant growing.

Key words: soil fertility, humus, mineral nitrogen, labile P and K.

Content of chemical elements in soils and grassland vegetation of Gryfinski Polder within Lower Odra Valley Landscape Park

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The Miedzyodrze area in the Lower Odra Valley is filled with one of the larger peat deposits in Poland, whose fragments occur even in Szczecin agglomeration.

This vast and hardly accessible landscape of swamps and marshy meadows as well as rich diversity of flora and fauna species contributed to the establishment of Polish-German Landscape Park on the area of 60.09 km^2 in 1993.The Gryfinski Polder is situated in the centre of the Park.

The studies were conducted within the transect Gryfino-Mesherin on 6 study areas, drilled to determine the thickness of peat deposit. The composite soil samples (in two replications) from the depth of 0–10 cm and 10–30 cm, and the samples of grassland vegetation were also taken.

The studies showed that the surface layer of peat (0–30cm) is developed from muck with mud admixture and contains a varying amount of organic matter from 15,1 to 82,0 %. Reaction is mostly strongly acid (pH_{KCl} – 4,07–4,78) and C:N ratio – 11,2–13,8:1.

The content of elements soluble in HNO +HCIO in the 0-30-cm layer was, on average (g kg^{-1}): K–3,66; P–0,78; Mg–4,0; Ca–16,8; Na–0,9.

Heavy metal content (mg kg^{-1}) was, on average, as follows Cd–3,1; Pb–60,8; Zn–184,9; Cu–37,6; Ni–38,3; Mn–225,1; Co–8,1. Within the area under study the following grass communities were found: *Carex gracilis* with *Calamagrostis canescens, Calamagrostis canescens* with *Carex gracilis* and *Glyceria maxima*. *Glyceria maxima* contained the greatest amount of macroelements whereas *Carex gracilis* had the highest level of Cd, Zn, Ni and Mn.

Key words: organic soils, grassland vegetation, chemical elements content.

Soil mapping in Latvia according to the international FAO WRB 2006 soil classification. Problems and Solutions

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In Latvia, until nowadays in all agricultural areas soil mapping has been done with a scale of 1:10 000 and in 11 out of 26 administrative districts the agricultural land and forest soil maps with a scale of 1:100 000 have been produced. The international *FAO* soil classification was applied first time in Latvia producing the Soil Atlas of Europe with a scale of 1:2 000 000 (Soil Atlas of Europe, 2005).

It has been concluded from the previous experiences, that in soil description according to the genetic and international soil classifications, there are no possibilities to find out a unified key for the soil genetic classification transformation into international soil classification (Kārkliņš, 2005, 2006, 2007; Liepiņš et al., 2007).

The first step for the overall soil mapping of Latvia in accordance to the international soil classification is a selection of the scale and development of the proper methodology. A basic scale for the topographical map of Latvia is 1:50 000. This scale is being used for the regional planning and production of geological maps. It provides enough detailed information for natural resources and environmental problems.

Taking into account the above explained situation, the recommendable scale for the soil survey maps of Latvia is 1:50 000. For the soil mapping optimization in Latvia according to the *FAO WRB 2006* soil classification, at the initial stage it is recommended to perform soil mapping in pilot areas: glaciolimnic plain, hilly area of till, coastal sandy lowland and wavy plain of till. In 2007 the soil mapping at the scale 1:50 000 was done in Zemgale lowland.

Performing the soil mapping along with the description of the soil profiles, a data base of the soil samples need to be developed. In soil classification of Latvia according to *FAO WRB 2006* soil classification, the prior elements for laboratory tests of soil are: pH, saturation of basis, amount of organic matter and soil texture.

Key words: soil mapping, classification, FAO WRB, scale, pilot area.

Morphogenetic properties of turf-podzolic soils of Western Polissya of Ukraine

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Turf-podzolic soils of easy granulometric composition make the prevailing type of soils within the area of Western Polissya, which was formed on fluvioglatial dafnealuvial and the exterminated deposits and belong to wide weak wave plains. The comparative analysis of easy granulometric composition showed that under the action of agricultural and meliorative influence the most intensive changes are observed in upper horizons, that it is causet by plowing down of humus with a part of eluvial, colour changes, a cloggy flimsy structure appears, the degree of compression is increased, in the lower part of arable and eluvial horizons the processes of backing are intensified, that is expressed in the increase of amount of Fe-Mn of concretions and ochre spots. The use of turf – podzolic soils under conditions of the intensive farming causes change of basic indexes of their physical properties. The protracted ploughing draws to morphological degradation of aggregates, deep alteration of porous space and, reduction in general.

It is set by researches of general physical properties, that the protracted agricultural use of turf-podzolic soils causes change of indexes of their physical condition. Compactness of hard phase in soils under the forest and on plough-land slightly hesitates. Compactness of structure in humus horizon of turf-podzolic backed sandy loam soils under the forest is 1,36–1,44 g/cm^3, and on plough-land is 1,60–1,63 g/cm^3. With an increase the compactness of structure grows and in a maternal rock it is almost identical to all of the probed soils and makes 1,65–1,75 g/cm^3.

Low maintenance of humus is the characteristic feature of soil of easy granulometric composition. So in the upper humus accumulative horizon in soils under the forest this index is 0,99–1,20 % on plough-land – 1,20–1,46 % and it is maintenance diminishes downward on the type.

Key words: soils, granulometric composition, physical properties, humus.

Anthropogenic transformed soils of Belarus

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Soils of Belarus has been to date repeatedly investigated and mapped of different scales.

Systematization and analysis of occurring at different times research of fixed objects, as well as large-scale soil mapping materials, which have been held in the republic on three occasions, showed that in the conditions of accelerating economic development of the country, accompanied by involving in using more and more areas, the soil coverage has undergone significant anthropogenic transformation. It is developing due to rapidly industrial, and urban road construction, laying power lines and pipelines, mining (construction raw materials, peat, sylvinite etc.), and agro-hydromelioration and subsequent intensive, and, at times, and poor land use practices, high volume ameliorating and remediation, etc. In some cases, these activities are improving the quality of the soil, while others – degraded soil. Despite the direction of development processes (improvement or degradation), soils lose their taxonomic-diagnostic features, is forging new ground objects. As a result, topsoil is complicated territory.

Proof of this is a new classification of the soil in Belarus, which is developed on the basis of experimental data obtained in the course of research for the in-depth study of a soil cover over the past 25 years. According to this classification in Belarus has already allocated 52 against 17 types of soils in the current hitherto nomenclature list to 11, and - in the soil classification 1980.

For example, within the limits of agricultural land anthropogenic transformed soils already represent more than 3 % of their area, not counting the technological-contaminated.

Key words: soil classification, anthropogenic soils, Belarus.

Sediment and nutrient supply associated with soil erosion in the gully catchments

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Soil erosion processes have been studied intensively throughout the world due to necessity to reduce the rates at which soils are currently eroding. One of the topics of researches is evaluation of sediment and nutrient flux associated with soil erosion. Transferring of soil erosion products may have important on-site and off-site consequences (e.g. decreasing of soil fertility, reduction of crop yield, siltation of rivers etc.). At the same time it necessary to take into account that alteration in seasonal variations, amount and intensity of precipitation are taking place in Baltic region due to climate change. Modeling of this process forecasts an increase in annual precipitation and shortening return periods of extreme rainfall events in the NE Europe, including Latvia. Such changes of climate factors will trigger increasing of runoff and intensification of accelerated soil erosion by water in catchments susceptible to erosion. In its turn, the intensification of erosion will rearrange existing equilibrium of erosion/accumulation processes, first of all, in small catchments, and will increase sediment and nutrient transferring to recipient streams.

To evaluate the sediment and nutrient delivery associated with soil erosion, the study of the load transported by temporary streams was carried out in small gully catchments in the River Daugava Valley, SE Latvia. Results show (1) significant changes in duration of period with higher sediment production and supply due to warmer winter with very good delivery conditions resulting from high soil moisture level, formation of overland flow and bare fields; (2) shortened return periods of extreme rainfalls and increasing amount and duration of precipitation in summer intensify soil erosion and increase sediment load transfer from catchments due to more frequent formation of peak discharge runoff. Studies indicate that suspended sediment yield is up to 4300 kg d^{-1} and the total mass of eroded material transfered from a gully catchment reach values up to 102 kg d^{-1} ha^{-1}, nutrient load yields the delivery up to 48 kg d^{-1} of N-total and up to 2,7 kg d^{-1} of P-total to the River Daugava.

Key words: soil erosion, climate change, gully catchments.

Problems of genesis and classification of Lithuanian sandy soils

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Almost one-fifth of the Lithuanian territory is covered by sandy sediments of various origin formed by glaciers and their meltwater; on these territories very specific, often most infertile soils have formed. Therefore, it is only natural that the major part of such soils is covered by coniferous (for the most part pinewoods) stands, and the areas of sandy soils used for agricultural purposes do not exceed 13–14 % of the whole area of Lithuanian soil cover. According to the new Classification of the Soils of Lithuania 1999, all our soils formed on sandy sediments are grouped into 11 out of 12 soil major groups; it is based on their development degree, humidity regime and the character of combination of various diagnostic horizons, calcareous properties and skeletic characteristics. Besides, in this classification a new group of Arenosols is distinguished. It should be reminded that in the old soil classification used until 1996 absolute majority of sandy soils were also explicitly grouped and included into one type of Podzols. Due to such complicated and confusing classification of these soils it is often very difficult to determine the limits between, for example, Proti-Haplic Arenosols and Arenic Regosols or between Gleyic Podzols and Dystri-Endohypogleyic Arenosols. On the other hand, the issues regarding differenced in fertility of these soils arise.

In order to avoid this confusion in classification and economic evaluation of sandy soils, it would be very helpful to consider the main conclusions of the research performed in 1961–1986 on automorphic (water-level > 3 m) relatively unstratified sandy pinewood soils of diverse genetic origin (Шлейнис, 1987). These investigations had demonstrated that diversity, fertility and reaction to mineral fertilizers of all our pinewood sandy soils (44 % of the whole forest area) are mainly determined by lithologic peculiarities of the sandy sediments, i.e. their mineralogic and granulometric composition.

Finally, we think that while further perfecting the classification of sandy soils the attention should be primarily given to the percentage of physical clay and silt particles, their calcareous properties, amounts of mica, glauconite and heavy-fraction minerals.

Key words: sandy sediments, granulometric and mineralogic sand composition, Arenosols.

Snapshots of soil acidification research

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After decades of regular liming stopped in 1990, at present about 18,7 % of agricultural lands are acid and approx. 1 billion hectares disposed to acidify and seriously at risk from chemical degradation. Ecological functions of such damaged soils (buffering, filtering, storage function) is weakening. Selection of lime requirement criteria's and optimal lime rates determination concerning to soil acidity indices interactions as an important question to maintain ecological functions of these acidifying landscapes discussed.

Field and laboratory experiments were conducted at the LIA Vokė Branch during 1972–2006. The experimental plots were established in sandy loam on carbonaceous fluvial-glacial gravel soil, Haplic Luvisols (LVh). Results of experiment proved that in Lithuanian climate conditions for light textured soils formed on calcareous parent materials liming having long-term effect. Liming effect on very acid soils with 1,0 rate (or 7,18 t ha^{-1}) $CaCO_3$ according H persist for 34 years. Fastest restoring (after 17–20 y) to previous levels indicated by pH, slower (20–25 y) for hydrolytic acidity and absorbed bases. Mobile Al restoring dynamic is slowest. After 34 years since limestone (1,0 r.) application, mobile Al concentration in soil was almost twice lower then before liming. Lower concentration of mobile Al after primary liming had positive effect on plant production.

Our research on soil acidification in regularly limed soil continued shorter than in primary limed one – just 20 years. Periodical soil liming changed soil pH from 4,4–4,5 to 5,7 or 6,4 depending on lime rates. During 20 years period soil pH in soils above 5,5 declines by 0,5 unit and downgrade was close to those in primary limed soil. But amount of absorbed bases and mobile Al increased much slower. Practically, after 20 years since last liming which led to decline of mobile Al to 2 mg kg^{-1} it was stabilized. Slower restoration of mobile Al – is substantial difference compare to primary liming. Regular liming is more intensively changing structure of exchangeable acidity. Significant changes of acidity structure in periodically limed soil are limiting an option to evaluate real soil acidity from pH value.

Experience of Western Europe countries, where long-term liming practice essential and soil acidity optimized suggest that in Lithuanian conditions in soils with mobile Al below 10 mg kg^{-1}, for stabilizing of acidification processes balance method can be applied.

Key words: acidifying soils, liming, mobile Al.

Vertical migration of fine dispersion fractions in agricultural and forest soils of different genesis and texture

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According to the generalized research of granulometric composition carried out with 564 soil samples taken from different layers of soil, the smaller fractions of soil, the more intensive is their rinsing into different layers of soil horizons under the same precipitation conditions. The process depends greatly on the friability of the soil and the amount of precipitation. Under the effect of rinsing, superficial horizons of the soil become lighter and the middle part of the profile becomes heavier (Bt horizon). Migration of tiny dispersion fractions can be judged on the collection of optically orientated clays in gaps, pores, former root paths. Building of them greatly depends on changes in humidity and drying.

Our research has shown that luvisols form in friable rocks superficial levels of which have carbonates and Ca ions rinsed out, and environment becomes less acid. Gradual shift from El horizons to Bt is characteristic to luvisols, while in case of albeluvisol and podzols this process is much faster. In sandy luvisols thin curvy or straight so called pseudofibrids form, where fractions of clay and silt, iron compounds and orientated clays accumulate. In sands, loamy soils of moderate and great heaviness, in clays rinsing off of harder fractions (claying out) is low. In carbonate-rich soils (cambisols) dispersion fractions coagulate and hardly migrate in the boundaries of a profile.

Researching vertical migration of fractions of granulometric composition, and comparing data from eluvic, iluvic and carbonate-rich horizons, it has been found, that transportation of clay fractions from eluvic to illuvic and carbonate- rich horizons is most vivid in light loamy soils, it is not so vivid in sandy loams and sandy loams on sands. In sands, loamy soils of moderate and great heaviness, in clays rinsing off of harder fractions is low.

Key words: soils, dispersion fraction, soil texture, vertical migration.

II sekcija

Dirvožemio naudojimas ir savybės besikeičiančioje aplinkoje

Pirmininkai: prof. **MOTUZAS Algirdas,**
prof. **KÕLLI Raimo**

Žodinių pranešimų laikas –
2008 m. rugsėjo 24 d. $14^{00} – 16^{30}$ val.,
kavos pertraukėlė – $16^{30} – 16^{45}$ val., pranešimų tęsinys – $16^{45} – 17^{30}$ val.

vieta – LŽŪU IV rūmų konferencijų salė, 214

Stendinių pranešimų vieta ir laikas
LŽŪU IV rūmų fojė, $17^{35} – 18^{00}$ val.

Symposium 2

Use and properties of soil in changing environment

Conveners: prof. **MOTUZAS Algirdas,**
prof. **KÕLLI Raimo**

The time of oral presentations –
Wednesday, 24 September 2008, $14^{00} – 16^{30}$ h, coffee break – $16^{30} – 16^{45}$ h, prolongation of presentations – $16^{45} – 17^{30}$ h

The place – in IV building of LUA, conference hall 214

The place and time of Posters session –
foyer of IV building LUA, $17^{35} – 18^{00}$ h

Antrosios sekcijos pranešėjai
Authors indexs of Symposium 2

Content of heavy metals in lettuce as a result of crop fertilisation with sewage sludge and soluble salts of heavy metals

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The aim of this research was to investigate an accumulation of heavy metals (HM) in lettuce when the crop is fertilised with sewage sludge and industrial waste containing heavy metals. Two vegetative experiments were carried out using sandy loam and medium loam soils. Soil in control variant was not treated. Variant No.2: sewage sludge rate was calculated based on the requirement that 40 kg ha^{-1} of phosphorus would be applied. Sewage sludge rates in variants No.3 and 4 were multiplied by 6, soil in pots of variant no. 4 was additionally treated with HM soluble salts at such rates that the total content of HM would be equal to: Cr–400, Cd–20, Pb–750, Ni–30, Zn–2500 and Cu–100 mg kg^{-1} of soil. HM content in soil was determined in aqua regia and 1M ammonium acetate extractions using the absorption spectrometry method.

The samples of natural humidity lettuce collected in the variant No.2 contained higher concentrations of Cr, Ni and Pb (95–143 %), and variants No.3 and 4 – Pb and Ni (320–341 %). Because of addition of HM salts the accumulation of Cd increased 105 times in 2006 and 73 times in the next year of the experiment, Pb–27 and 10 times respectively. Accumulation of other HM in lettuce was less intensive.

The highest coefficient of HM uptake by lettuce from soil (based on the total content of particular HM in soil) was calculated for Zn and Cu, especially in the first year. If the content of HM soluble in 1M ammonium acetate is the basis for calculation, then Ni and Cr coefficients are the highest ones, because the salts of these elements are more soluble in this extraction. Thus, the effect of sewage sludge on the plants depends on the HM presence in it, soil properties and the form of HM applied to the soil.

Key words: heavy metals, lettuce, soil.

The effect of tree species on microbial properties of sandy mine soils

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Microbial communities are of crucial importance for proper functioning of soils developing in reclaimed post-mining areas. The objective was to compare microbial properties of mine soils afforested with different tree species. Soil samples (0–5 cm) were taken in reclaimed areas of "Szczakowa" sand mine under thirty years old pine, larch, birch, alder, mixed birch-alder and mixed pine-alder stands. The samples were measured for texture, pH and organic matter content (OM). The considered gross microbial properties included basal respiration (RESP) and microbial biomass (C_{mic}). Community level physiological profiles (CLPPs) were studied using Biolog® Ecoplates. The tree species affected OM contents and soil pH as the highest OM content (3,32 %) and the lowest pH (3,5 and 4,7 in water and in KCl, respectively) were determined under the alder stand. The lowest OM contents were measured under the larch and pine stands (1,29 % and 1,42 %, respectively). Gross microbial properties were affected by the tree species. The highest C_{mic} (213,7 μg g^{-1}) and RESP (1,18 μM CO_2 g^{-1} $24h^{-1}$) were determined under birch stand whereas the lowest were found under the larch (101,44 μg g^{-1} and 0,57 μM CO_2 g^{-1} $24h^{-1}$, respectively) and the pine stand (120,64 μg g^{-1} and 0,58 μM CO_2 g^{-1} $24h^{-1}$, respectively). Principal component analysis of Biolog® data indicated that CLPPs only slightly differed between the stands. The largest difference was found between the alder and larch stands. The soil microbial communities under the mixed stands tended to be more active on the Ecoplates and the microbial community under mixed pine-alder stand was significantly more diverse than communities under all remaining stands. The results suggest that in afforested mine soils tree species affects significantly gross microbial properties whereas functional diversity of soil microbial communities depends upon the tree species to a lesser extent.

Key words: mine soils, tree species, soil microbial biomass, microbial diversity.

Changes of the content and qualitative composition of humus in sandy loam soil

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The trials were conducted on sandy loam on calcaric gravel haplic luvisol (LVh) with different humus level (1,5 %, 2,3 %, 3,3 %). The effect of fertilization (without fertilizes, mineral fertilizes, mineral fertilizes with manure) on the content, qualitative composition, balance of humus were studied.

During the period of two crop rotations (10 year) in the soils with different humus level unequal changes of the content of humus and its qualitative composition were determined. Mineral fertilizers had no negative effect on the content of humus only in the soil with a low humus level (1,5 %). Mineral fertilizers with manure increased the amount of humus in all mentioned soils. The highest per cent of mobile and labile humus substances in the humus composition was in the soil with a low humus level (30–31 % and 18–19 % respectively) and the least in the soil with a high humus level (25–26 % and 14–15 % respectively). A larger amount of humic acids bound with calcium was in the soil with a high humus level. The amount of fulvic acids and its fraction extracted in 0,1 N H_2SO_4 decreased in soils by increasing the amount of humus in the soil. Mineral fertilizers with manure increased the ratio of humic acids to fulvic acids: in the soil with a low humus level from 0,62 to 0,74, in the soil with medium humus level from 0,81 to 0,93, in the soil with a high humus level from 1,00 to 1,07.

A positive balance of humus was in all the studied soils when mineral fertilizers with manure had been applied, but the amount of humus increased differently: 9,9 % from initial amount of humus in the soil with a low humus level, 5,1 % – in the soil with a medium humus level, 2,1 % – in the soil with a high humus level. A stronger directly correlation was determined between the crop yield and the amount of labile humus substances and labile humic acids as compared with the amount of total humus in the soil.

Key words: humus, qualitative composition.

Influence of land use on heavy metals dynamics in soils around the copper smelter as observed in 34-year-long cycle of monitoring investigation

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The most serious environmental problem of copper industry in Lower Silesia region of SW Poland is chemical degradation of soils surrounding two large smelters. Concentration of trace elements in soils around the copper smelter Glogow has been continuously observed since smelter opening in 1972. Permanent sampling sites are located at various directions and distances from the emission source. Soil are sampled every year in June, at the depth 0–20 cm, in four replicates. Unfortunately, the results are comparable among sites only to a limited extent, as the smelter is situated at the contact of river valley and loess hilly-land covered with soils varying strongly in texture and chemical properties. Total concentration of copper, lead, and zinc is determined after sample mineralization with aqua regia or concentrated perchloric acid. An analysis of 34-year-long cycle showed significant initial increase of metals amount (up to 400 mg kg^{-1} of Cu, 340 mg kg^{-1} of Pb, and 517 mg kg^{-1} of Zn) followed by its relative stabilization, and continuous slow decrease, typically observed in arable soils. However, in soils afforested with poplar trees within so called “sanitary zone”, a significant secondary increase of copper (up to 464 mg kg^{-1}) and lead (up to 137 mg kg^{-1}) concentrations was observed.

Results of long-term monitoring confirm a great reduction of heavy metals emission from smelter, “phytoremediation” effect of a common cultivation with arable plants, as well as secondary concentration of heavy metals retained from air by fast-growing trees planted in an immediate proximity of the smelter.

Key words: soil monitoring, heavy metals, copper smelter.

The effects of soil and meteorological conditions on nitrate concentration in soil water

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The findings of the long-term lysimetric tests (1991–2003) carried out on different soil types suggest that nitrate concentration in lysimetric water was significantly affected by the site from which soil samples were delivered, i.e. on soil genesis. During the experimental period, average nitrate concentration in lysimetric water was found to be the highest (60,2 mg l^{-1}) for the arenosol delivered from Trakai Vokė, which was by 58,4 % higher than that in the lysimetric water of haply-albic arsenal delivered from Perloja. The lowest average nitrate concentration (29,2 mg l^{-1}) in the lysimetric water was found in orthi-haplic podzol delivered from Juknaičiai, which made up 76,8 % compared to the nitrate concentration in lysimetric water of albic arsenal delivered from Perloja.

Comparison of nitrate concentration in lysimetric water according to soil texture showed higher nitrate concentrations (51,1–60,2 mg l^{-1}) to be present in sandy loam soils, except for the podzol delivered from Juknaičiai (29,2), clay – 44,6, loam – 39,2–48,6, light loam – 32,6–47,0, and sand – 38,0 mg l^{-1}.

Mathematical analysis indicates that both nitrate concentration and amount of nitrates leached were more markedly affected only by the meteorological factors, especially by the amount of water percolated through the soil. While analysing the effects of soil type on nitrate concentration in lysimetric water and the amount of nitrates leached from the soil it was found that the contents of both clay particles and humus in the soil had greater effect on light-textured soils. Although the effect of growing plants on nitrate concentration in lysimetric water was not more marked, the correlation obtained was significant at 95 % probability level.

Key words: NO_3^-, concentration, lysimetric water.

The relationship between crop residues chemical composition, decomposition in the soil and environmental conditions

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The experiments of decomposition of crop residues were carried out in the Experimental Station of the Lithuanian University of Agriculture in model field experiment during the period of 2003–2005. The soil of experimental site is *Endocalcari-Epihypogleyic Cambisol* (*sicco*) (CMg-p-w-can). Investigated decomposed in the soil for the different duration (from 3 to 26,5 months) above and below ground residues of these crops: winter oilseed rape, spring oilseed rape, winter wheat, and red clover. The aim of the investigation has been to establish oilseed rape residues decomposition intensity in the soil and dependence on residue chemical composition also environmental conditions in comparison with wheat and clover residues.

Experiment data show that decomposition in the soil of stubble and roots of winter and spring oilseed rape is slower, because of the higher content of lignin as compared with their threshing remains or stubble and roots of winter wheat and red clover.

It was estimated positive correlation (r = from 0,497* to 0,944**) between decomposition intensity of winter and spring oilseed rape and average temperatures of weather and soil, also sum (≥5°C) of these temperatures. Decomposition intensity of oilseed rape roots positively correlated (r = from 0,571** to 0,848**) with these indices also precipitation.

Decomposition intensity of oilseed rape threshing remains and clover stubble negatively correlated (r = from -0,693** to -0,753**) with the content of lignin. Correlation between these indices in decomposing roots of wheat and cover was r =-0,486* and r =-0,563*, accordingly.

Key words: crop residues, decomposition intensity, meteorological conditions, lignin, correlation.

Biological nitrogen fixation in acid soils of Lithuania

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Soil reaction is one of the most important factors influencing legumes and *Rhizobium* symbiosis. The greater concentration of H^+ ion increases the solubility of Al, Mn, and Fe, and these elements may become toxic to legumes and their symbiosis. The results of this study indicate that *Rhizobium leguminosarum* bv. *trifolii* was widely distribution in slightly acid soils with pH_{KCl} 5,6–6,0. The average amount of rhizobia was $540{,}0 \cdot 10^3$ cfu g^{-1} of soil. Less *Rhizobium legiminosarum* bv. *viciae* and significantly less both *Sinorhizobium meliloti* and *Rhizobium galegae* were found. *Rhizobium* significantly declined in acid soils pH_{KCl} 4,1–5,0.

The optimal soil pH_{KCl} for different species of *Rhizobium* was unequal. The rhizobia of clover had best grown at pH_{KCl} 5,6-6,0, rhizobia of viciae and alfalfa at pH 6,6–7,0 and rhizobia of goat's rue – at pH above 7,0.

The most of biological nitrogen rhizobia was found at soil pH_{KCl} 6,1–7,0. In this instance *Rhizobium galegae* had fixed nitrogen from 196 to 289 kg N ha^{-1}, when rhizobia of alfalfa and clover were less and it depended on strain efficiency and soil pH.

The soil liming had a positive impact on nitrogenase activity of red clover. In limed soil it was fixed nitrogen 36,93 μM N g^{-1}, when in acid soil it was 2,9 μM N.

In limed soils associative diazotrophes in non legume rhizoplane have fixing biological nitrogen too. Our study showed that most nitrogen in rhizoplane of barley and timothy had accumulated *Rhizobium leguminosarum* bv. *trifolii*, *Agrobacter radiobacter* and *Arthrobacter mycorens.* They fixed nitrogen from 11,0 to 20,4 kg N ha^{-1}. It should be noted that clover rhizobia strain 348a had distinguish not only for efficiency symbiosis, but also make up active association with cereal crops.

Key words: *Rhizobium,* distribution, nitrogen fixation, nitrogenase activity, soil acidity, associative diazotrophes.

Occurrence and numbers of N_2-fixing bacteria In Polish soils

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Using a sand pouch–plant infection method populations of several species of root-nodule bacteria (rhizobia) were enumerated in eighty soils collected throughout Poland. *R. leguminosarum* bv. *viciae* (symbionts of pea, faba bean, vetch) and *R. l.* bv. *trifolii* (symbionts of clover) were detected in 77 and 76 soils, respectively. Most of these soils contained moderate and high numbers of these rhizobia. Symbionts of beans, *R. l.* bv. *phaseoli*, were assessed in 76 soils; of this number 15 soils had no detectable populations of bean rhizobia and in 40 soils high or moderate numbers of these bacteria were found. *Bradyrhizobium* sp. (*Lupinus*), rhizobia nodulating lupine and serradella, were absent in 19 soils, out of 80 tested, and 34 soils were colonised by high or moderate populations of bradyrhizobia. *Sinorhizobium meliloti*, symbiont of alfalfa, were sparse in the examined soils; with 56 soil containing no detectable numbers of *S. meliloti* and only 6 soils harbouring high or moderate populations of this species. Basic chemical and physical properties of the examined soils were also determined and correlated with numbers of rhizobia. Soil populations of alfalfa and clover rhizobia were positively correlated with soil pH and clay contents, while negative correlation coefficients between these parameters and populations of lupine rhizobia were shown. The genus *Azotobacter* comprises aerobic, free-living diazotrophic (with the ability to use N_2 as the sole nitrogen source) soil bacteria, occurring also in other habitats, e.g. water. The genus *Azotobacter* includes 6 species, with *A. chroococcum* most commonly inhabiting various soils all over the world. In temperate climate soil populations of *Azotobacter* spp. rarely exceed several thousands cells per gram of neutral or alkaline soils and in acid (pH<6.0) soils these bacteria are generally absent or occur in very low numbers. The occurrence and numbers of *Azotobacter* spp. in 31 Polish soils were assessed and it was found that almost 52 % of the soils tested were colonised by *Azotobacter* spp.. When present, numbers of these bacteria varied widely from several to almost 10 000 cfu g^{-1} of soil.

Key words: *Azotobacter,* rhizobia, occurrence, Polish soils.

Pedobiological assessment of remedied soils

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Human economic activity is permanently disturbing the equilibrium of soils as natural ecosystems. Remediation of destroyed and damaged soils contributes to formation of new soils. Each soil type and biotope is characterized by specific group composition of soil organisms and their functional interrelations. From the environmental point of view, it is important to evaluate the impacts of human economic activity on the soil biota and to forecast their consequences on the future processes of soil formation.

The present investigation was carried out in 2004–2006 in a naturally regenerating soil 14–16 years after the end of intensive cultivation and in a gravel quarry remedied with sewage sludge in the 14th–16th years of remediation (variant I: the sludge was scattered on the soil surface; variant II: the sludge was inserted into the soil by disking the soil surface; an unfertilised quarry slope served as a control variant).

It was found that in the self-regenerating soil, the average microarthropod abundance was higher (88,5 ± 31,35 thou ind m^{-2}) than in the remedied gravel quarry (variant I 70,4 ± 36,45, variant II 62,0 ± 26,05, control variant 70,7 ± 34,59 thou ind m^{-2}).

Data analysis showed that regeneration of soils impoverished by many years of cultivation through formation of natural forest is a long-lasting process. Only in 16 years, microarthropod communities typical of natural ecosystems start to develop. Examination of microarthropod complexes and intensity of successions of Oribatida mites in the quarry soil remedied with sewage sludge showed that sewage sludge stimulated faster succession of some microarthropod groups and increased their abundance. The total microarthropod abundance in the soils remedied with sewage sludge was by 8–10 times higher but species composition poorer than in the naturally regenerating soils.

Key words: soil, sewage sludge, microarthropods.

Development of agrochemical properties in Lithuanian soils after regaining of independence

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Comparison of pH_{KCl} data obtained in 1995–2006 with the results of soil testings carried out on the same fields in 1985–1990 revealed the alterations in the area of soil acidity: the share of conditionally acid (pH<5,5) and slightly acid (pH 5,6–6) soils has increased, whereas the share of soils with pH>6 – decreased. The most intensive acidification process takes place in Western Lithuanian soils – these soils were very and average acid before the intensive liming activities were started. An approach to the liming issues cannot be based only on pH value. Soils in Western Lithuania with pH 4,6–5 contain low contents of Al – 0,42–1,76 $mmol^{+}kg^{-1}$. Exchangeable cations were determined in soils of arable fields limed 4–5 times in 1965–1990, forest outskirts limed 1–2 times and forests – not limed. According to the data obtained, the average content of exchangeable cations in field soils with pH 4,1–5 were 31–49, forest outskirts soils – 14–27, forest soils – 11,8–16,7 $mmol^{+}kg^{-1}$. Content of exchangeable cations in arable soils with pH 4,1–4,5 were in the range of 10,1–63, and pH 4,6–5 – 10,9–133 $mmol^{+}kg^{-1}$. Amount of plant available P_2O_5 in soil increased when soil pH was >6, soil was fertilized annually with the P_2O_5 rate >40 kg ha^{-1}, when the crop yields were average. In 1995–2006, if compared to 1985–1990, the share of soils conditionally rich in phosphorus (P_2O_5 >150 mg kg^{-1}) increased by 9,1 %. Amount of plant available K_2O in soil increased when soil was fertilised annually with K_2O rate >120 kg ha^{-1}.

When plants were not fertilised at all or fertilized only with NK fertilizers since 1971, plant available sulphur content in 0–20 cm layer of soil was only 0,9–2,3, in case of NPK fertilization – 8,2–16,4 mg kg^{-1}, but the sulphur that was not assimilated by plants was leached into the lower layers of soil. In layer 61–90 cm sulphur content was – 7.5–14.5 mg kg^{-1}.

Key words: pH, available P_2O_5 and K_2O, sulphur, soil, fertilizer.

Polyphenoloxidase and peroxidase activity in *Luvisol* loamy sand soil

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Maintenance of soil fertility status and monitoring of SOM content are important tasks especially for light texture soils wide spread in Belarus. The objective was to establish the relationships between important soil quality parameters (total organic carbon and C_{hwe} content) and activities of soil enzymes characterizing lignine transformation (polyphenoloxidase and peroxidase).

Long-term field experiment treatments: without FYM, 8 and 16 t ha^{-1} FYM in crop rotation. At all treatments NPK-fertilization was studied. Total organic carbon (TOC) content was determined by modified Tyurin method. For the characterization of SOM active fraction the content of hot water extractable carbon (C_{hwe}) was used. Biochemical soil status was estimated by activities of polyphenoloxidase and peroxidase.

It was found that soil FYM amendment (8 and 16 t ha^{-1}) resulted in the increase of TOC content up to 1,96 % and 2,42 % compared with 1,68 % at control.

Soil organic amendments affected the content of C_{hwe}. Maximal C_{hwe} content was observed at treatment with application of 16 t ha^{-1} FYM. NPK-fertilization was found to provide approximately the same diapason of C_{hwe} content at all studied treatments. The increase of N-rate (60–120 kg ha^{-1}) as well as K-fertilization rate (60–180 kg ha^{-1}) significantly affected C_{hwe} content in soil.

The addition of FYM increased ligninolytic activity of soil. Mineral fertilizer induced the same effect. Lignines are considered as important humus forming substances (Kononova M, 1963), which constitute significant share (15–30 %) of plant residues dry matter. Lignines are characterized by stability to decomposition. However lignines are capable of quickly humification as a result of activity of microbial oxidases.

Close correlations were found between TOC content and peroxidase activity ($P \leq 0,05$, $r^2=0,92$) as well as polyphenoloxidase activity ($P \geq 0,05$, $r^2=0,72$). Regression analysis indicates that polyphenoloxidase and peroxidase activities may serve as early diagnostic parameters for characterization of stable SOM changes and as soil quality indicators.

Key words: polyphenoloxidase and peroxidase activity, total organic carbon, hot water extractable carbon.

The rehabilitation of polluted by heavy metals soil and ecological utilization of the plants grown therein

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The aim of one-year (2007) screening investigations was determine and to evaluate the possibilities to rehabilitate Albeluvisol polluted by heavy metals and to search for the ecological utilization of the plants grown therein.

The vegetative and modeling experiments set up in order to validate theoretically and practically the efficient facilities to clean up polluted by heavy metals soil in the safe chemical way in consistent with the biological remediation via plant growth.

The most important practical achievement – successfully tested chemical oxidation method which allow to bind mobile heavy metals forms in the soil to immobile ones (insoluble compounds). That fore, chemical materials on the background of metal sulfides (*Me*S) might be used theretofore it's needed amount calculating by stechiometry according to heavy metals mobile phase concentration in polluted soil. The efficiency of the method applied in the polluted *Albeluvisol* was confirmed by following indicators – the partially restored soil living status (plant growth and development betterment) as well the increase of biological soil activity (enzymes and soil respiration) observed.

Key words: soil, heavy metals, pollution, rehabilitation.

Experimental Study on Soil Microbial Communities and Enzymes change under the Conditions of Catastrophic Soil Pollution with Heavy Metals

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In order to simulate heavy metals migration and accumulation in soil profile, a special modelling columns system designed and filled up with natural monoliths of Calcari–Endohypogleyic Luvisol. Three of them were experimentally contaminated with heavy metals (mixture of Pb, Cu and Zn acetates) at the level of sorption capacity, whereas soil monolith in the fourth column saturated with distilled water. The experiment has demonstrated a great potential of the modeling *Luvisol* to accumulate extremely high concentrations of different HM fractions. In particular, catastrophic pollution of Ap horizon (in upper 0–10 cm layer) observed: Pb – up to 839, Cu – 773 and Zn – 844 mg kg^{-1}.

Such a high pollution level reduced counts of all investigated microbial groups: organotrophic, spore forming, mineral nitrogen assimilating, oligonitrophylic bacteria, actinomycetes and micromycetes. The decrease of soil biological activity observed in a following order: dehydrogenase (95–98 %) → urease (65–97 %) → sacharase (57–77 %) → soil respiration (38–65 %). Nevertheless, the susceptibility of microbial groups and their adaptable possibilities to survive were related not only to HM concentrations in the soil but also depended on biological peculiarities of specific microbes group. Such a different microbes response to HM indicate a pathway for further search on more tolerant microorganisms under the stress environmental conditions.

Key words: soil, heavy metals, pollution, microorganisms, enzymes.

Microbial diversity and soil ecological processes

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Soil microorganisms regulate major ecosystems processes and play important role in the terrestrial ecosystems productivity. The diversity and abundance of species (however defined) in soils may be greater than the number of above–ground species. But still little is known about number of microbial species needed to make an ecosystem stable and how much damage to taxonomic diversity resulting from different pollution or climate changes, can withstand soil ecosystem without losing its functionality.

The most of soil species are functionally redundant and replaceable with other species without any change in general soil function. This is because, more than one group of soil microbes can perform the same metabolic function e.g. carbon turnover. Thus, the omission of species from the community (by species extinction, etc) does not result in change in ecosystem process rates, since another species will replace their role. Most processes are associated with functions carried out by trophic rather than taxonomic groups. According to other theories, there is no evidence about this functional redundancy and differences among species are sufficient enough to produce specific impacts on ecosystem functioning when one or some of microbial groups disappears because of strong and acute stress impact. Some proved, that the decrease in taxonomic diversity in metal-polluted soils can reach 99,9 %, with most of the eliminated species belonging to rare taxa, but the functional importance of these rare taxa for soil nutrient cycling and ecosystem resilience is unknown. Other authors pointed out that changes in the relative diversity and functional characteristics of microbial communities might have unpredictable consequences for nutrient cycling and productivity and structure of natural plant communities.

Currently, a range of novel methods allow to assess several soil microbial diversity measures: functional, taxonomic and genetic. The new data potentially improve our knowledge of microbial diversity effect on the rate of soil processes and soil ecological function and also about factors determinate soil microbial community structure. Examples of the relationships between the microbial communities diversity and soil functions will be discussed.

Key words: soil microbial community, diversity, soil processes, functional redundancy.

Response of moraine loam soil structure to anthropogenic load

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Good soil structure is important for the movement of water, gases and plant roots and as such is the prime regulator of water and nutrient supply to plants. Soil structure can be greatly affected by anthropogenic load, such as crop rotation, fertilization, liming and soil tillage.

This study aim is to illustrate how soil (Dystric Albeluvisol, texture – moraine loam) structure differs between contrasting long term liming and fertilization management in Western Lithuania (Vezaiciai branch of the Lithuanian Agriculture Institute) in 1996–2005. The deficiency in clay fraction, cations of Ca, Mg and organic colloids is the key factor influencing a low stability of moraine loam structure. The improvement of this soil structure is the strategic direction of research with the aim to validate the level of anthropogenic load. With that end in view the effect of long term liming applied at different intensity (at a rate 0,5 (3,8 t ha^{-1} CaCO3) and 1,0 (7,5 t ha^{-1} $CaCO_3$) every 7 years; 1,0 and 2,0 (15 t ha^{-1}) every 3–4 years) as well as the effect of maintenance liming (for keeping soil pH_{KCl} at follow levels: 5,3–5,5; 5,8–6,2 and >6,7) in combination with annual mineral fertilization (by one and two NPK rates) on soil aggregate composition and its stability in crop rotation was investigated.

It was revealed that moraine loam structure was under the effect of anthropogenic load. The high variation of agronomically-valuable structural aggregates 0,25–5,0 mm (from 60 to 72 %) and water stable aggregates >0,25 mm (from 40 to 79 %) was determined. The largest amount (76–79 %) of water stable aggregates >0,25 mm was obtained in the soil with pH_{KCl} 5,8–6,2 after perennial grasses harvesting. Intensive periodical liming (1,0 and 2,0 rates every 3–4 years) by dust limestone (to pH_{KCl} 6,8–7,2) on the background of primary and repeated liming by slaked lime did not have any significant positive effect on the soil structure. Mineral fertilization has positive effect on acid moraine loam structure and any effect on limed soil structure.

Key words: soil structure, anthropogenic load, liming, fertilization.

Effect of Organic Farming on Agrochemical Characteristics of Loamy Soil in Mid-Lithuania

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Research of the effect of organic farming on the agrochemical soil characteristics was carried out in the period of 1997–2004 on the farm of organic production of the Agorecological center at Lithuanian University of Agriculture in the loamy soil of moderate heaviness Endohypogleyi-Eutric Planosols (PLe-gln-w). Tests were performed in a hexafield rotation field with the following sequence: winter wheat, summer crop, legume crops for seed an green fertilizer, summer grain, + additional seed sown into cereal crops, perennial grasses of the 1st year of use, perennial grasses of second year of use. In 1997 five monitoring areas of 100 m^2 (10×10 m) were established, later each of them divided into four areas of 25 m^2. Soil samples for analysis were taken from each area from four separate squares. Soil samples were taken with a soil drill out of the depth of 0–20 in 6–8 different places and the total sample was composed. No nitrogen, phosphorus and potassium fertilizers were applied to plants and legumes were grown to increase the nitrogen amount in the soil rotation.

It was found that as the result of organic farming, the amount of organic carbon and total nitrogen decreased 0,33 and 0,009 percentual units, the amount of active phosphorus and potassium decreased 44,2 and 49,5 mg kg^{-1} respectively, the amount of calcium and magnum decreased 11,5 and 2,59 mgekv kg^{-1}, however, the amount of active sodium increased 0,13 mgekv kg^{-1}. Effective exchange acidity and effective sorption receptivity decreased in soil, however, potential exchange acidity and potential sorption receptivity increased. The sum of exchange cations decreased. pH value of soil decreases 0,20 units and base-richness of soil decreased 0,01 percentual units.

Key words: organic farming, soil, agrochemical characteristics.

Influence of organic mulches and different thickness of mulch layer on soil properties

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Mulching has become increasingly common during recent decades not only in commercial horticulture. Mulching is especially important in organic farming. An organic mulch on the surface of the soil usually intercepts solar radiation, reduces soil temperature, maintains soil moisture at higher levels than bare soil, reduces losses of nitrate, sulfate, calcium, magnesium, potassium, increases soil organic C and nutrientes content, microbial biomass.

A two–factor field experiment was carried out in the Pomological Garden of Lithuanian University of Agriculture in 2004–2007. The soil type – Calc(ar)i-Endohypogleyic Luvisol. Scheme of the experiment: Factor A – mulches: 1) without mulching; 2) chopped wheat straw; 3) peat; 4) sawdust; 5) grass. Factor B – thickness of mulch layer: 1) 5 cm; 2) 10 cm.

The aim of this investigation was to evaluate the effect of different mulches and different thickness of mulch layer on soil properties.

All examined mulches reduced soil temperature. The tendency of lower soil temperature in plots covered with 10 cm thickness mulch layer compared with plots covered with 5 cm thickness mulch layer was established. Soil moisture in mulched plots was established significantly better in comparison with soil moisture in plots without mulch. Higher soil moisture was evaluated in plots mulched with 10 cm thickness mulch layer compared with plots covered with 5 cm thickness mulch layer. All mulches increased the amount of available potassium and phosphorus in the soil. Grass mulch had the biggest positive effect on available potassium and available phosphorus in the soil. Thicker mulch layer increased content of available potassium, but decreased content of available phosphorus in the soil.

Key words: organic mulches, soil moisture, soil temperature, available potassium, available phosphorus.

The influence of conservation primary tillage on soil physical properties and sugar beet yield and quality

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Effect of different conservation primary soil tillage on sugar beet was investigated at the Experimental Station of the Lithuanian University of Agriculture during the period of 2001–2006. The aim of the trial was to establish the influence of reduced soil tillage intensity on some soil physical properties, sugar beet yield and quality, weed infestation. Treatments of the trial: 1. conventional (22–25 cm) ploughing with a mouldboard plough (CP); 2. shallow (12–15 cm) ploughing with a mouldboard plough (SP); 3. deep (25–30 cm) cultivation with a chisel cultivator (DC); 4. shallow (10–12 cm) loosening with a disc harrow (SL); 5. zero tillage (ZT).

Reducing of primary soil tillage intensity increased soil bulk density and the amount of moisture in soil surface layer before pre-sowing soil tillage. Field germination of sugar beet seeds in differently tilled soils was similar despite different moisture conditions during the period of germination. Germination of directly sowed seeds mostly was poor because of problems with sowing machinery. The sugar beets that had been sown into zero tilled soil produced similar yield of roots with similar qualitative indices irrespective of the lower crop density. However, decrease of soil tillage intensity increased fanging of roots.

Reducing of soil tillage intensity and refuse of full-scale herbicides increased weed density in sugar beet crop during four years. The number of perennial weeds increased 6 times in the soil after deep ploughing, 7 times - after shallow ploughing, 3 times – after deep cultivation and shallow loosening, 6.5 times – after zero tillage. The increase of total weeds density in zero tilled soil was significant in comparison with weed density in the soil after deep ploughing.

Key words: conservation tillage, sugar beet, soil properties, yield, quality.

Accumulation of soil carbon and soil nitrogen in abandoned land of Russia

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At present the abandoned area of previously managed agricultural land in Russia reached about 28 mln. ha (Romanovskaya, 2004; 2006). The cease of agricultural management of ploughed soils leads to the change of physical, biological and chemical soil characteristics affecting biogeochemical cycles of the main elements (carbon (C) and nitrogen (N). In our study the change of C and N stocks in abandoned land in Russia were investigated by the example of soils of Moscow region, Sverdlovsky region and Stavropolsky krai in Russia. The experimental and modeled results (model RothC) were used to estimate the total accumulation of C and N in abandoned soils in Russia.

In 2005, 2006 and 2007 we collected samples of soddy- podzol (sandy and clay) and grey forest soils in Moscow region; soddy-podzol and chernozem podzolic in Sverdlovsk region; chernozem ordinary and chestnut soils in Stavropol region. Sampling was done in different districts of each region. For every investigated district we sampled presently ploughed soil, abandoned soils of 3 ages (≤5 years, 8–12 years and 15–20 years after abandonment) and forest soil (no less of 50 years old). The choice of sampling plots was based on maximal closeness of sampled soils together. The average soil samples were collected from 10 replications of each horizon of soil. Nitrogen and carbon content was determined by wet combustion method. Experimental data on the total C content in each horizon used for model (RothC) verification.

Results show that for all investigated districts soil C and N stocks increase in following order: ploughed soil – abandoned soil – forest soil. Average N stock in all soil types increased by 1,72 t N/ha during 15 years. Average annual change of C in abandoned land was 1,16 t C/ha per year during 1990–1999 and 1,0 t C/ha per year during 2000–2005. We estimated total C accumulation in abandoned soils in Russia as high as 245,8 ± 26,3 mln. tones of C during 1990–2005, and N accumulation obtained around 27.9 ± 6,4 mln. tones of N for that period.

Work supported by Russian Foundation for Basic Research, projects number 07–04–01333 and 07–05–13549–ofi–z.

Key words: soil carbon, soil nitrogen, natural abandoned land, Russia.

Application of different soil criteria for the assessment of contamination of Polish arable soils with polycyclic aromatic hydrocarbons (PAHs)

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Different countries apply different approaches to the policies, standards and regulations regarding the soil quality criteria (SQC) for PAHs. Dutch regulations are one of the first example based on multifunctional character of soil. Such approach has been applied by other European countries including Poland. The aim of the study was to compare the evaluations of PAHs contamination of Polish arable soils using different soil quality criteria.

The data set embraced 216 soil samples collected in the year 2005 within the country–wide programme "Monitoring of the chemical properties of the arable soils in Poland". Samples were collected from the soil upper horizon (0–30 cm). Forty different soil characteristics were investigated. PAH analysis were carried out for 16 individual compounds from US EPA priority list.

Three different SQC were employed do assess the contamination status of Polish arable soils. In the proposition of Institute of Soil Science and Plant Cultivation five limit levels of soil contamination were distinguished on the basis of the content of Σ13PAH normalized to organic matter (OM) content. In Polish regulations the limit value of 1 $mg \cdot kg^{-1}$ for Σ9PAHs for the arable soils upper horizon (0–30 cm) was applied and only two classes of soil contamination were recognized. Internationally known Dutch regulations, based on the content of Σ10PAHs with target values of 1 $mg \cdot kg^{-1}$ and 40 $mg \cdot kg^{-1}$ normalized to 10 % of OM content, distinguished three soil contamination levels.

The soil materials under investigations were typical for majority of Polish soils: acidic (median pH value of 5,3) and low clay and organic matter content (median values of 4 % and 1,67 %, respectively). The median contents of the Σ16PAHs, Σ13PAHs and Σ9PAHs were 395, 350 and 260 $\mu g \cdot kg^{-1}$, correspondingly. Regardless of the applied criteria, no less than 90 % of the data set can be classified as unpolluted soils.

Key words: polycyclic aromatic hydrocarbons, soil pollution, SQC.

Micromycete changes in the rhizosphere of long-lived pot-plants growing in peat substrate

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In 2006 in Kaunas Botanical Garden of Vytautas Magnus University the rhizosphere of 4 genus and species of pot-plants of different ecological needs was researched: *Ficus elastica, Cyclamen persicum, Hibiscus rosa-sinensis, Euphorbia trigona* (ten pots of each species). Plants were grown for six months in sphagnum peat substrata of medium separation higher type, saturated with slowly melting mineral fertilizers.

In the rhizosphere of all plants every month mycological researches of substrata were made, micromycetes of 82 species ascribed to 30 genera isolated in total. From the rhizosphere of *Ficus elastica* were isolated 40 species belonging to 14 genera, from *Hibiscus rosa-sinensis* – 29, 15, *Euphorbia trigona* – 27, 13, the smallest number – from *Cyclamen persicum* – 24 species, 8 genera. Complexes of micromycete species functioning in the rhizosphere of investigated plants have differed, calculating T. Siorensen's coefficient the reliable distinction among micromycete complexes of plant rhizosphere of four investigated species (K_S, 7,84–11,76 %) was found. During the researches (monthly investigations) – the number of detected micromycetes species in the rhizosphere of all plants varied from 2 to 15 species in one sample. The least detected were the number of micromycetes propagules in the rhizosphere of plant succulent *Euphorbia trigona* $4 \cdot 10^4$–$6 \cdot 10^4$ in 1g of the absolutely dry substratum (g/dry weight), the most from – *Ficus elastica* ($9 \cdot 10^4$–$14 \cdot 10^4$ g/dry weight). The inverse correlation (r) was detected between the quantity of some nutrient value in substrata and the number of micromycete colonies.

At the end of the research (after six months) the amount of nutrient value in a flowerpot was sufficient for plants of that species. Plants were at a good condition, pathogenic fungi in the rhizosphere were not detected.

Key words: pot-plants, rhizosphere, micromycete, nutrient value.

The effect of land use on soil carbon, total and extractable SOM

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Soil carbon (C) and soil organic matter (SOM) play a fundamental role in sustaining soil and environmental quality. However, there is little experimental evidence on C and both total and extractable SOM in differently used agricultural and natural land, especially describing changes resulting from land use conversion. One of the main objectives of this work was to study the effects of land use on carbon changes and SOM content and composition. Soil samples were collected in western and central Lithuania and represented Albeluvisol and Cambisol.

Carbon content in the soil samples was determined by a dry combustion method using an automatic analyzer Vario EL III. Grassland soil was found to contain by 8–14 % more carbon (in relat. values) compared to fallow land. Extractable SOM was determined using sodium pyrophosphate solution. Our experimental evidence suggests that land use conversion had both positive and negative effects on soil total and extractable carbon and SOM. Soil organic matter content in grassland soil (Albeluvisol) was by up to 6 % higher (rel. values), compared to fallow land. In the soil under a long term pasture (Cambisol) SOM content was by up to 42 % and extractable carbon content by up to 80 % (rel. values) higher compared to arable soils.

Key words: carbon, SOM, Albeluvisol, Cambisol, land use, grassland, fallow.

Physical characterization of a clayey soil under the incorporation of organic and mineral amendments

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In contemporary agriculture the soil must be resistant to all degradation factors. The application of new crop cultivation technologies raise higher requirements for soil physical properties.

Experiments to improve clayey soil physical properties were carried out at Joniskelis Experimental Station of the Lithuanian Institute of Agriculture over the period 1997–2003 on a glacial lacustrine clay loam on silty clay, lying on morainic sandy loam, Endocalcary-Endohypogleyic Cambisol. Amendments of organic and mineral origin for soil improvement: farmyard manure – 60 t ha^{-1}, green manure – 27 t ha^{-1} and lime-mud – 10 t ha^{-1} incorporated by a moldboard and segment plought at 25 and 40 cm depths, respectively were investigated. Possibilities of reduced ploughless soil tillage at 25 and 15 cm depths after incorporations of amendments also were evaluated.

Incorporation of amendments resulted in decrease of soil bulk density, improvement of soil aeration and water conductivity. The improvement influence on soil physical condition lasted longer from farmyard manure and lime-mud, shorter – from green manure. With incorporation of amendments by a segment plough at 40 cm depth, subsoil physical properties: bulk density, total porosity, water conductivity improved. Lime-mud was more effective for subsoil improvement. However, the segment ploughing resulted in a worsening of topsoil properties due to a mixing clayey subsoil layer with topsoil. Reduced ploughless tillage determined the decrease of soil porosity, worsening the soil structure and seedbed quality. Incorporation of amendments, especially farmyard manure, helps to avoid or lessens the negative effect of reduced tillage on the clayey soil physical condition.

Key words: Clayey Gleyic Cambisol, amendments, reduced tillage, soil physical properties.

The influence of long-term application of mineral fertilizers on soil biological activity

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Biological activity of soil is an important factor of productivity from agriculture and ecology standpoint as well as sensitive indicator of anthropogenic impact. Such as enzyme activity, microbial biomass and soil respiration respond more quickly to change in crop management practices or environment conditions than agrochemical characteristics in soil. They are one of the most important indicators that give the most exact description of biological activity.

For determine biological activity of different genesis soils the long-term fertilization trials were established on moraine sandy loamy Cambisol in 1971 and limnoglacial silty loamy Cambisol in 1990. Experimental data of the period 1999–2002 show, that in the soil developed on different glacial deposits the enzyme activity and respiration intensity are different, In limnoglacial silty loamy Cambisol urease and dehydrogenase activity is higher, while in moraine sandy loam are higher – sacharase activity and soil respiration intensity.

In sandy loamy Cambisol with application annual of 180 kg ha^{-1} phosphorus in combinations with nitrogen and potassium fertilizers increases the amount of available phosphorus in soil from 43–61 to 499–503 mg kg^{-1} and lowers the activity of enzymes and urease in silty loam – the change of available phosphorus amount in soil is significant, therefore, the changes of urease activity are slight.

In sandy loamy Cambisol mineral fertilizers slightly influence the sacharase activity, while in silty loam – the tendency of sacharase activity weakening has been revealed. Mineral fertilizers inhibit the dehydrogenase activity in soils.

Soil hydrolases activity is higher soil under cereal crops, while that of oxidoreductases – under roots crops. The highest respiration intensity has been established in soil under sugar beet crops.

The calculation of dependence of available P accumulated in soil on urease activity, respiration intensity show strong relations (η=0,65–0,68, η=0,68–0,70).

Key words: enzyme activity, soil respiration, mineral fertilizers.

III sekcija

Žemės ūkio augalų mitybos optimizavimas

Pirmininkai: prof. **VAIŠVILA Zigmas,**
prof. **POZNAK Stepan**

Žodinių pranešimų laikas –
2008 m. rugsėjo 24 d. $14^{00} – 16^{30}$ val.,
kavos pertraukėlė – $16^{30} – 16^{45}$ val., pranešimų tęsinys – $16^{45} – 17^{30}$ val.

vieta – LŽŪU IV rūmų 204 auditorija

Stendinių pranešimų vieta ir laikas
LŽŪU IV rūmų fojė, $17^{35} – 18^{00}$ val.

Symposium 3

Optimization of agricultural plants nutrition

Conveners: prof. **VAIŠVILA Zigmas,**
prof. **POZNAK Stepan**

The time of oral presentations –
Wednesday, 24 September 2008, $14^{00} – 16^{30}$ h, coffee break – $16^{30} – 16^{45}$ h, prolongation of presentations – $16^{45} – 17^{30}$ h

The place – IV building of LUA, auditorium 204

The place and time of Posters session –
foyer of IV building LUA, $17^{35} – 18^{00}$ h

Trečiosios sekcijos pranešėjai
Authors indexs of Symposium 3

Effect of sewage sludge and soluble salts of heavy metals on agrochemical properties of soil

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Sewage sludge is used for fertilisation as well as recultivation of soils. The aim of this research was to investigate the effect of heavy metals (HM) brought to the soil with organic fertiliser (sewage sludge) and in the form of salts on soil contamination level. In 2006 two vegetative experiments were set in sandy loam and medium loam soils. HM concentrations were determined in aqua regia and 1M ammonium acetate (AAc) extractions (pH 7.0). Control variant was not treated. Variant No.2: sewage sludge rate was calculated based on p level 40 kg ha^{-1}. Sewage sludge rates in variants No.3 and 4 were multiplied by 6, variant no.4 was additionally treated with HM soluble salts in such at the rates ensuring that the total content of HM would be equal to Cr–400, Cd–20, Pb–750, Ni–30, Zn–2500 and Cu–1000 mg kg^{-1} of soil.

Due to the application of different rates of sewage sludge the content of P_2O_5 in soil increased by 73–323 %, K_2O by 5–73 % and organic carbon by 7–123 %. Cr, Zn, Cu and Cd concentrations in soils of variants No.3 and No.4 exceeded the MPC limits. The least soluble HM in AAc extraction of soil treated only with sewage sludge were Ni (0,10–1,80 % of total content), Cr (0,81–5,45 %), Pb (0,08–8,67 %), the most soluble – Cd (0,01–28,42 %) joined by Zn (3,16–13,40 %) in 2007. As for soil treated with sewage sludge and HM salts, Cd was the most soluble in AAc extraction (35,65–48,28 %), and the least soluble were Cr (2,61–7,17 %) and Ni (1,41–21,04 %).

The larger part of heavy metals present in soil is dissolved by weak (ammonium acetate) solvents, the higher is an environmental threat – the possibility of leaching increases as well as an uptake of HM by plants, the highly contaminated soil might even become unsuitable for crop production. Part of the more soluble forms of HM within the two years period turned into the less soluble compounds, yet the share of ammonium acetate–soluble Cd and Pb decreased very little.

Key words: heavy metals, soil, sewage sludge.

Soil properties, crop yield and weed seed bank under reduced tillage systems

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In crop growing technology soil tillage requires quite large part of energy and labour expenses. The possibility change classical soil tillage (stubble cultivation and mouldboard plough) and sowing technology to the more economical reduced tillage and sowing systems, in Central Lithuanian on sandy loam soils was studied in the stationary field experiments at the Lithuanian Institute of Agriculture in 2003–2007. Field experiment consisted of a four course rotation: winter wheat–spring wheat– spring barley– field pea.

The Endocalcari–Endohypogleyic Cambisols sandy loam soil was prepared in different ways: 1. stubble cultivation to 10–12 cm depth, mouldboard ploughing to 21–23 cm depth and tillage with a precision seedbed cultivator to 3–4 cm; 2. stubble cultivation to 10–12 cm and tillage with a precision seedbed cultivator to 3–4 cm; 3. stubble cultivation to 10–12 cm; treatments 4 and 5 no tillage before drilling. Herbicides glyphosates in reduced tillage systems for weed control were used every year after harvesting of crop. In treatments 1 and 2 cereals were sown with disc drill "Saxonia", in treatments 3 and 4 with sowing aggregate DS–3 and sowing aggregate "Amazone" in treatment 5.

It was determined, that soil moisture was lower at 0–5 cm depth in treatment, where ploughing and tillage with a precision seedbed cultivator have been done. In all treatment soil bulk density increased and air dry porosity decreased through vegetation of cereals at 5–20 cm depth, except of field pea. Soil total and air–filled porosity varied from 45,7 to 56,4 and from 21,1 to 42,5 %, respectively. The most stable cereals grain yield was when stubble cultivation and ploughing was applied.

The amount of soluble phosphorus and potassium was higher in top 0–10 cm soil layer in reduced and no tilled treatments. The amount of seeds of *Chenopodium album, Stellaria media* and total number of weeds seeds significantly higher was in reduced and no – till systems in the layer of 0–10 cm.

Key words: soil tillage, soil physical properties, crop yield, weed seed bank.

The influence of lakes sapropels on the properties in sandy loam Cambisol

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The feasibility of using lakes sapropels as fertilizer has been studied at the Voke Branch of the Lithuanian Institute of Agriculture in 1994–2004. Experiments were carried out on a sandy loam Cambisol on two backgrounds of mineral fertilizers in the crop rotation with the application of calcareous (25 t ha^{-1}), organic (10, 40 t ha^{-1}) and siliceous (25, 100 t ha^{-1}) lakes sapropels their mixtures with manure and limestone. Organic fertilizers were applied only to the first crop (maize) in the rotation.

Before carrying out the experiment the acidity of soil was pH 6,1–6,5, mobile phosphorus 155–178 mg kg^{-1}, mobile potassium 161–186 mg kg^{-1}, humus 1,67–2,01 %.

Experimental evidence suggests that calcareous sapropel and limestone declined soil acidity, whereas organic and siliceous sapropels had no effect on soil acidity. Only the higher rate of organic (40 t ha^{-1}) and siliceous (100 t ha^{-1}) sapropels increased the content of total nitrogen in soil by 0,002–0,021 and that of humus by 0,53 percentage units. Fertilization with mineral fertilizers compensated for the amount of mobile phosphorus and potassium in the soil.

The application of lakes sapropels had a positive impact on the quality of sandy loam cambisol physical properties. Organic and siliceous sapropels increased the soil moisture content and porosity and declined soil bulk density to a higher degree than calcareous sapropel. Calcareous sapropel improved the afore-mentioned soil physical characteristics to a greater extent compared with limestone.

All rates of organic sapropel gave a crop yield increase of 4–24 %, 10 t ha^{-1} of sapropel with 25 t ha^{-1} of manure gave a yield increase of 24–33 %, and 50 and 100 t ha^{-1} rates of siliceous sapropel a yield increase of 42–48 %.

Key words: sapropel, soil properties, crop yield.

The changes of biogenic element amounts in pasture soil under long–term liming and fertilisation

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Long–term mowed sward ecosystems are under plant cover, therefore, least affected agrogenically. Soil under sward ecosystems is not tilled and the influence of agricultural implements is only superficial. Mineral fertilisers not only increase the productivity of sward coenosis, but also result in changes of soil chemical properties. Little information has been available in Lithuania so far on the processes, which occur in sward ecosystem soils and processes that influence soil chemical indicators under fertilisation with natural substances. It was expected, that agrogenically formed different soil pH_{KCl} and mineral fertilisation levels would change soil chemical properties, main biogenic elements (N, P, K) would accumulate in different soil layers.

Soil chemical indices were determined in 2003–2006 on 12–14 years of use sward agroecosystem situated in Western Lithuania (55º43‘ N and 21º30‘ E). The soil was Haplic–Luvisol (LVh), medium on light loam. Four soil pH_{KCl} levels: 5,1–5,5; 5,6–6,0; 6,1–6,5 and 6,6–7,0 and two fertilisation backgrounds: $P_{60}K_{60}$ and $N_{120}P_{60}K_{60}$ were formed by liming and fertilisation. Ammonium nitrate, bonemeal and potassium magnesium were applied.

Average data shows, that the highest amounts of considered biogenic elements accumulated in sward ecosystem’s 0–10 cm soil layer. When soil pH_{KCl} changed from 5,1 to 7,0, total nitrogen amount varied within 0,12–0,17%, mobile P_2O_5 – 84–176 mg kg^{-1} and mobile K_2O – 89–157 mg kg^{-1}. When going down the soil profile, amounts of considered biogenic elements in soil decreased. The highest amount of total nitrogen and mobile P_2O_5 were determined in soil limed to 6,1–6,5 pH_{KCl} level. However, the highest amounts of mobile K_2O accumulated in soil limed to 6,1–6,5 and 6,6–7,0 pH_{KCl} levels. Mobile P_2O_5 and K_2O amounts in soil under $N_{120}P_{60}K_{60}$ fertilisation were lower than those under $P_{60}K_{60}$ fertilisation.

Keywords: permanent meadow, liming, fertilisation.

The effect of amino acids on the quality parameters of winter cereals

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Amino acids activate nitrogen uptake, affect the activity of respiration, photosynthesis and water circulation, increase the concentration of ascorbic acid in plants at initial development stages and accelerate protein synthesis. The objective of the study was to estimate the efficacy of liquid amide nitrogen fertilizer with amino acids for winter wheat and rye.

The experimental findings suggest that amino acids activate nitrogen uptake. Its content in winter wheat at heading stage correlated moderately with the concentrations of amino acids in the fertilizer ($\acute{\eta}$=0,56) and varied according to the second degree regression equation y=1,579+0,4336x–0,1119x^2. Maximal nitrogen content in winter wheat was accumulated having applied it with the fertilizer containing 2,0–2,5 % of amino acids. Theoretical nitrogen maximum was determined at 1,94 % amino acids concentration. Liquid amide nitrogen fertilizer with amino acids reduced the content of water soluble carbohydrates in winter wheat vegetative mass. Amino acids slightly increased winter wheat productivity elements. The highest grain yields and significant yield increases (1,07–1,24 t ha^{-1}) were obtained having fertilized winter wheat with amino acids solutions of 0,5–2,0 % concentration. Under the effect of 1 and 1,5 % amino acids the content of protein significantly increased, while sedimentation values were significantly increased by 0,5→3,0 % amino acids concentrations. Under the effect of amino acids the values of wet gluten declined.

Higher yield of winter rye was produced having fertilized the crop with amino acids solution of 0,5 % concentration. Medium strong (r=0,70) correlation was determined between the concentration of amino acids solution and grain yield. Under the effect of amino acids, changes occurred in the parameters of grain technological properties. Higher protein contents in grain were accumulated having fertilized rye with liquid fertilizers containing 0,5 and 2,5 % of amino acids.

Key words: amino acids, fertilizers, winter wheat, winter rye.

Active pool of organic substance of soil as criterion of quality of organic fertilizer

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It is traditional, for restoration of balance of organic substance (OS), as a rule, covering manure of large horned livestock is used in the soil. However, existing disproportions in modern agrarian manufacture have led to sharp curtailment of production of manure that has made necessary search of alternative sources of organic fertilizers. In Ukraine the most popular substitutes of manure are straw and green fertilizers – siderats.

In connection with application of green fertilizers (as in the nature there is no mechanism of hit of unripe growing plants in soil), there are some questions, in particular, conformity of structure of their organic part to power and metabolic needs of saprotrophic block of soil microflora which carries out catabolism of soil ecosystem. It is also known, that green unripe weight of plants contains a certain quantity of biologically active substances – biocydes, that can negatively influence microflora of soil and its function.

An objective estimation of siderats efficiency as organic fertilizers, is possible only at a detailed estimation of their influence on quantity and quality of soil OS, especially its active pool (APOS), controllable by saprotrophic biota.

For an estimation of soil APOS especially informative was a method, based on alkaline hydrolysis of N–containing substances (A.P.Shcherbakov, Y.Y. Kislykh, 1990) and modified by one of the authors, as a method of differential nitrogengrams (MDN).

Using MDN, essential reduction, on comparisons with covering manure fertilizer (10 t/hectares), content of APOS of grey forest soil is shown at the ploughing of 30 t/hectares of green weight of a oil radish. Essential distinctions in seasonal dynamics of content of APOS of various variants of organic fertilizer have been established, changes of its qualitative structure, especially in a zone of easily hydrolized forms have been noted.

Use of nitrogengrams allows to carry out the control over transformation of organic substances in the soil and to estimate efficiency of organic fertilizers, to predict their quality.

Key words: organic substance, soil, siderats, alkaline hydrolysis, nitrogengrams.

The effect of long-term anthropogenic load on the agrochemical properties of Albeluvisol

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Experiments designed to measure the contents of biogenic elements (P_2O_5, K_2O) in the soil were conducted during the period 1976–2005 at the Lithuanian Institute of Agriculture's Vėžaičiai Branch on a Bathihypogleyi-Dystric Albeluvisol (ABd-gld-w) differing in soil acidity and applied with different mineral fertilizer rates. The topsoil before establishment of the experiment was acid pH_{KCl} 4,1–4,4, hydrolytic acidity 47–59 meq kg^{-1}, base saturation level 28-37 %, mobile aluminium 50–77 mg kg^{-1} soil. The soil was low in phosphorus and high in potassium: 95–104 and 255–267 mg kg^{-1} soil, respectively, humus content about 2 %. By liming we aimed to adjust very acid soil to such planned level pH_{KCl} (factor A): 1) Not limed, 2) 5,2–5,7, 3) >6,7. Such soil acidity levels were achieved after incorporation of 3.4 and 44.1 t ha^{-1} pulverized limestone into the soil in 1976. Seeking to maintain the planned soil pH levels, experimental plots were additionally limed after each rotation in the autumn. Mineral fertilizers – ammonium nitrate, superphosphate and potassium chloride in these experimental plots were used according to the following design (factor B): without fertilizers, $N_{45}P_{39}K_{57}$ and $N_{135}P_{117}K_{171}$. Under the effect of long-term (30-years) anthropogenic load the soil accumulated different contents of biogenic elements.

Soil samples for agrochemical analyses were taken from the soil with a different acidity (pH<4,7; 5,2–5,7; >6,7) and different mineral fertilization (without fertilizer, $N_{45}P_{39}K_{57}$, $N_{135}P_{117}K_{171}$), from the 0-20 cm ploughlayer. In the soil applied with $N_{45}P_{39}K_{57}$ and $N_{135}P_{117}K_{171}$ mineral fertilizer rates the content of available P_2O_5 increased, whereas that of available K_2O increased only in the soil treated with $N_{135}P_{117}K_{171}$ mineral fertilizer rate. Intensive land use with no fertilizer inputs inevitably results in soil degradation and productivity reduction. In unfertilized soil, over a 30-year period the content available P_2O_5 declined by 23–49 mg kg^{-1}, and that of available K_2O by as much as 137–150 mg kg^{-1}.

Key words: soil, anthropogenic load, agrochemical properties, biogenic (P_2O_5, K_2O) elements.

Kinetic analysis of the effects of fertilisation systems on the productivity indicators of Gleyic Cambisols

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The field experiment to study the efficiency of fertilisation systems on the productivity indicators of soil were carried during the period 1996–2005 at the Lithuanian Institute of Agriculture`s Joniškėlis Experimental Station located in the northern part of Central Lithuania Lowland. The soil of the experimental site is characterised as Endocalcari-Endohypogleyic Cambisol (CMg-n-w-can), according the texture – clay loam on silty clay, whose parental rock is glacial lacustrine. The effect of different fertilisation systems – mineral, organic–mineral and organic – on the agrochemical and agrophysical properties of soil, the farm nutrients balance and the productivity of rotation crops was studied in a long -term field experiment.

It was found that in the mineral fertilisation systems an average annual rate was $N_{56}P_{48}K_{60}$ the soil humus content over two rotations remained close to the initial level. In the organic–mineral fertilisation systems incorporation of different farmyard manure rates 40; 60 and 80 t ha^{-1} were applied once per rotation to sugar beet and NPK as much as in the mineral fertilisation system resulted in a significant increase in humus (11,5–14,5 %), available phosphorus (22,4–36,3 %) and potassium did not change significantly over two rotation. In the organic fertilization system application of 80 t ha^{-1} of farmyard manure gave increase in humus content 13,2 %. In the organic-mineral and organic fertilization systems positive changes in humus and other agrochemical indicators had a considerable effect on the soil structure. The content of the most valuable soil structural aggregates 5–0,25 mm in size, was by 13,7; 14,4 and 14,4 % higher, compared with the unfertilized treatment and 5,5; 6,2 and 6,2 % higher compared with the mineral fertilisation. The content of metabolisable energy of the crop rotation plants was directly dependent on the contents of phosphorus (r=0,97) and nitrogen (r=0,86) incorporated with organic and mineral fertilisers.

Key words: clay loam Gleyic Cambisol, fertilization systems, agrochemical properties, soil structure.

Nitrate leaching control in light loam Cambisols

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The Nitrate Directive (EEC, 1991) encourages farmers to turn to more sustainable land and fertilizer management. Increased levels of nitrate in drainage and ground water can be caused because of surplus in nitrogen balance. However, when good agricultural practice is maintained, N leaching may be not well predicted by balances (Salo, Turtola, 2005).

The study was carried out in 2001–2007 on Endocalcari Endohypogleyic Cambisol (CMg-n-w-can) medium textured, with a soil acidity pH_{KCl} 7,6, humus 2,0–2,2 %. Experimental polygon was constructed in 1991 Separate drainage systems under arable crop rotations were managed as follows: three without mineral N fertilizer (organic farming), crops in two systems (conventional) received the rates of NPK calculated using the fertilizer normative and program for target yield (Švedas, Tarakanovas, 2001), and four systems (integrated) received by 35–40 % lower NPK rates. One system, originally used for arable crops, in 2001 was converted to permanent grassland by sowing with mixture of red clover and timothy. Separate system was under long-term permanent pasture and grazed by milk cows. Drainage and ground-water were sampled and analysed periodically for nitrate and ammonium content.

The average data show that nitrogen surplus, defined as the difference between input (mineral fertilizer and estimated remains of clover) and output (yield) was +24,9 for integrated, -2,1 for conventional, -11,1 for ecological and -36,6 kg ha^{-1} for grassland. The concentrations of NO_3 in drainage water from arable crops generally were below but often exceeded 50 mg l^{-1}. On contrary, under permanent grasses it was much lower. In ground water concentrations of nitrate did not exceed 50 mg l^{-1} guideline value. Our study suggests, that control of N balance by targeting mineral fertilization to yield level is an important measure, however, aiming to reduce levels of NO_3 in waters substantially, the increase in ratio permanent grasses/arable crops should be considered.

Key words: arable crop rotation, grassland, fertilization, nitrate.

Soil organic carbon pools in former arable Chernozems

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Abandonment of cultivated lands led to vegetation succession, restoring of soils, and was accompanied by the qualitative changes in organic carbon pools and microbial community. This study was aimed to quantify the different carbon organic pools (total, labile, stabile, and microbial) in the former croplands depending on the period of abandonment.

Our investigations were carried out in 2007 on arable soil under winter wheat and soils abandoned 5, 11, 21 and 77 years ago after land use change from crops to permanent grassland (ordinary Chernozems, Rostov region, Russia, 47°27'N, 39°35'E). The total soil organic carbon (C_{total}, dichromate oxidation method), carbon immobilized in microbial biomass (C_{mic}, fumigation-extraction method), labile and stabile C (after 7 week incubation at 20°C and 60 % of water holding capacity) were determined in the former plough-layer of soil (0–20 cm).

It was found that C_{total} and C_{mic} in soil studied were increased proportionately to the age of abandonment. The share of C_{mic} in C_{total} averaged 1,2 %. The total carbon-losses for the 10 weeks incubation period were highest in arable soil and soil after 5 years abandonment. The restoring of soils resulted in increase of stable fraction in the soil organic carbon pool: 20,6 mg C/g in arable soil vs. 28,6 mg C/g in 77-yrs old abandoned land. The mean residence time of stable C in soils after 11–77 years of abandonment was 1,9–2,2 times higher than that in arable soil. The labile C was decreased from 0,25 mg C/g in arable soil to 0,12 mg C/g in soil after 77 years of restoring. Therefore, we can conclude that the carbon accumulation in soils after land use change from arable to permanent grassland was mainly caused by the sequestration of stable C pools.

This study was supported of DAAD, Russian Foundation for Basic Researches (project N 07–04–01333), and Program of Presidium of RAS N16.

Key words: land use change, chernozems, carbon accumulation, C-pools.

The dependence of the spring barley productivity from fertilization systems in the four-course crop rotation

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In order to choose a fertilization systems for a crop rotation productivity importantly to sum up factors, determinant not only on plant productivity but and soil potential. The arm at this paper is a view to determine the effect of different fertilization system and coefficient of hydrothermal (HDK) on the spring barley productivity in the 4-years crop rotation.

Since 1966 the long-term fertilization trials has been carrying out in experimental station of Lithuanian University of Agriculture on light sandy loam over moraine clay Calc(ar)i-Epihypogleyic Luvisols. Organic fertilizers (farming manure 50 and 100 t ha^{-1}) were applied once per rotation to rape, pre-crop of spring barley. In the system of mineral fertilization was used $N_{30}P_{40}K_{60}$, $N_{80}P_{60}K_{60}$ fertilizers rates, in the organic-mineral – the combination of the manure (50 t ha^{-1}) with the mineral fertilizer rate ($N_{30}P_{40}K_{60}$).

The obtained data of ten rotations show that yield barley not add up to 3 t ha^{-1} on unfertilizing treatment. In the organic fertilization system the productivity of the barley crop depended on inserting quantity of farming manure and in addition to crop formed respectively 0,745 t ha^{-1} or 24,7 % and 1,02 t ha^{-1} or 37,5 % application 50 and 100 t ha^{-1} of manure, compare with initial level. The mineral fertilization system compare with the organic, given on equivalent amount of nutrition, the mineral fertilizers increased the better of the yield. The least of mineral fertilize rates ($N_{30}P_{40}K_{60}$) productivity increases 1,26 t ha^{-1}, or medium ($N_{80}P_{60}K_{60}$) -1,8 t ha^{-1}. The organic-mineral fertilization system not advantage over the mineral, because did not have significant influence on crop additive. The correlation ratio between the yield of grain barley by application rate of $N_{80}P_{60}K_{60}$ fertilizers or 50 t ha^{-1} of manure and coefficient of hydrothermal was η=0,44, respectively η=0,22–0,30 in other fertilization system, given $P<0,05$.

Key words: crop rotation, barley, fertilization systems, soil.

The use of cover crops in cereal-based cropping systems to control mineral nitrogen content and nitrate leaching in clay loam soil

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Seeking to estimate the effects of biological measures – various cover crops in combination with different straw incorporation methods on the reduction of soil mineral nitrogen and nitrogen leaching complex research was contucted at the Lithuanian Institute of Agriculture's Joniskelis Experimental Station on clay loam Endocalcari-Endohypogleyic Cambisol during the period 2003–2007. Undersown legume crops during the post-harvest period gave the largest reduction in mineral nitrogen in the soil: red clover (*Trifolium pratense* L.) – 15,1 %, white clover (*Trifolium repens* L.) and Italian ryegrass (*Lolium multiflorum* Lamk.) mixture – 16,4 %, compared with the treatment without cover crops. However, having incorporated by a stubble breaker not only stubble but also straw and having applied nitrogen fertiliser (N_{45}) for its mineralization, the content of mineral nitrogen increased by 15,2 %, compared with the treatment where the plots were stubble-broken without straw. Having incorporated straw with the addition of mineral nitrogen fertiliser, 9,2 % lower N_{min} content in the soil was found in the treatment where cover crop white mustard (*Sinapis alba* L.) was sown as post-crop. In heavy-textured Cambisols in spring, higher contents of N_{min} in the soil and filtration water were found in the treatments where nitrogen-rich biomass of legume crops was incorporated in the autumn. Having incorporated it together with straw, N_{min} content in the soil significantly declined (9,8 %).

Key words: clay loam soil, cover crops, mineral nitrogen, nitrogen leaching.

Influence of crop rotation and catch crop on Nitrogen balance in Organic Farming

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Field experiment was carried out in organic sertificated field of the Experimental Station of the Lithuanian University of Agriculture in 2003–2007. The soil type – Calc(ar)i Epihypogleyic Luvisol (LVg-p-w-cc). Nitrogen balance was evaluated after 4 years from the beggining of experiment. Four 6-year crop rotations with different proportion of nitrogen fixing crops are compared: I–50 % (grass-clover; grass-clover; winter wheat; spring barley; peas; winter wheat); II–50 % (grass-clover; winter wheat; peas; spring barley; grass-clover; winter wheat); III–33 % (grass-clover; potato; out; spring barley; peas; winter wheat); IV–17 % (grass-clover; winter wheat; potato; spring barley;winter rape; winter wheat). Catch crop was 1) included; 2) not included in rotations. The objective of our study was to evaluate influence of crop rotations with different nitrogen fixing crop percentage and catch crop on nitrogen balance in organic farming.

The smallest nitrogen loss (from 1,87 to 4,58 kg ha^{-1}) due to leaching to deeper soil horizons were established in the soil in II and IV crop rotations, in grass-clover and winter rape crop. The biggest nitrogen loss (from 40,7 to 74,8 %) were established in the soil of I crop rotation in peas crop and in in the soil of III crop rotation in peas crop without catch crop theretofore. Catch crop for green manure reduced nitrogen leaching by 94,9 % in the soil of III crop rotation in comparison with nitrogen leaching in the soil in the same (III) crop rotation without catch crop. The amount of nitrogen leached to the deeper soil layers depended on nitrogen amount in the soil.

During the experiment negative nitrogen balance was established in the soil of all crop rotations: from -46,69 to -145,13 kg ha^{-1}. The nitrogen balance in the soil was influenced by nitrogen taken from soil ($r=-0,77$, $P<0,05$). Obtained data show that biological nitrogen suppliers are very important in organic farming.

Key words: nitrogen balance, crop rotation, catch crop, organic farming.

The use of clinoptilolite - containing nitrogen fertiliser reduces N leaching on a light loam Cambisol

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Natural zeolite as clinoptilolite possesses special physical and chemical properties, therefore it has been used to improve soil fertility, develop slow-release fertilisers, and ameliorate the buffer capacity of soils (Cuvanova et al., 2005). Inherent pores make zeolites ideal for ammonia sorption.

The agronomical effects of clinoptilolite containing nitrogen fertiliser (N+c) were studied during 2005–2007 in pot and field trials on Endocalcari Endohypogleyic Cambisol (CMg-n-w-can) medium textured, with close to neutral soil acidity, humus 1,9–2,2 %. The experimental batch of N+c was produced by AB *Achema*. The pots (20 cm in i.d. and 30 cm in height) were filled with ploughlayer's soil. N+c and conventional nitrogen fertilisers were surface – applied. The pots were wetted every day. Mineral N content as the sum of $N\text{-}NH_4$ and $N\text{-}NO_3$ was analysed in the leachates several times before and after fertiliser application. The experimental data showed that the amount of mineral N leached from N+c applied pots was up to 16,4 % lower than that in the other pots. At the end of this experiment the spring barley was sown and pulled at the tillering stage. The weight of dry mass of plants, grown in N+c applied pots was by 18,1 % higher compared with ammonium nitrate applied pots. In the field trials winter wheat was applied with $N_{90,\ 120}$. At the wheat flag leaf stage the content of mineral N in soil 30 cm layer was up to 30 % higher in N+c applied plots compared with conventional nitrogen fertiliser plots. After harvesting the same regularity was obtained. The yield of winter wheat fertilised with N+c tended to increase compared with conventional fertilizer treatments. As a result, it would be environmentally sound to reduce N leaching using clinoptilolite containing nitrogen fertilizer. This should be verified in further studies.

Key words: pot and field experiments, mineral N, soil.

Effect of organic and intensive farming on NPK balance in soil

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Effect of organic farming on balance of NPK was researched on the farm of organic production of the Agroecological Center at Lithuanian University of Agriculture. Having calculated NPK balances of field crop rotations I and II on the farm in the period of 1997–2004, NPK balance was found negative. With organic production more nitrogen has been imported in the field of rotation I, which had been fertilized with manure, while amounts of imported phosphorus and potassium were greater in field rotation II, where legumes were grown and no manure applied. In cases where certified potassium and phosphorus fertilizers had been applied, a positive balance of phosphorus and potassium was obtained. Application of a 40 t ha^{-1} of litter manure once every four years does not ensure a positive nitrogen balance.

Effect of intensive farming when plants are fertilized with different rates of NPK fertilizers on balance of nutritional materials in plants was researched in the period of 2001–2005 in Elmininkai (region of Anyksciai) in phosphorus and potassium rich soils. Having calculated fertilizer rates in crop rotations (wheat, potatoes, barley, perennial grasses) and with the account to amounts of nutritional materials found in soil ($N_{50}P_{23}K_{51}$ + 60 t ha^{-1} of manure once every crop rotation) their balance was close to zero. Application of average rates of this fertilizer ($N_{51}P_{60}K_{78}$ + manure) with no account to agrochemical indexes, a positive NPK balance was obtained. As the result of this, nutritional materials unused by plans can be washed out and pollute the environment.

Key words: organic and intensive farming, NPK balance.

The effect of biologically active substances on soil biological activity and spring rape productivity

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Biological activity is agronomically and ecologically significant component of soil fertility and a sensitive indicator of the anthropogenic effect. At present, increasing intensification of agricultural production and inadequate farm management practices result in the deterioration of soil physical and chemical properties. A partial solution to this problem could be the use of humic acids in the system of crop fertilization.

The objective of this research was to study the effect of humic and fulvic acids (humus acid fertilizer) on soil biological activity, available P_2O_5 and K_2O the variation in spring rape productivity and to determine the relationships between the parameters studied. Our experimental evidence suggests that humic and fulvic acids (humus acid fertilizers) significantly increased the activity of urease (0,03–0,07 mg NH_3 per 24 h). The activity of saccharase significantly increased (4,5 mg glucose per 48 h) having used 1,67 kg of humic acid, and that of dehydrogenase (1,8 mg formazane per 24 h) having used 3,3 kg of humic acid. A significant seed increase of 0,32–0,46 t ha^{-1} in spring rape was obtained under the effect of humic and fulvic acids. The highest yield (2,72 t ha^{-1}) and yield increase (0,46 t ha^{-1}) were obtained when humic and fulvic acids had been spray-applied to the rapeseed crop at the bud formation stage. A linear correlation (y=2,1069+0,0129x) was identified between the yield of spring rape seed and available variation of phosphorus during the crop growing season (r=0,88*). A medium strong correlation (r=0,71) was determined between rapeseed yield and available potassium variation in the soil.

Humic and fulvic acids significantly increased the yield of crude fat (0,94 t ha^{-1}). The highest content of crude fat was recorded after the humic and fulvic acid treatments at the bud formation stage of spring rape. Under the effect of these fertilizers glucosinolate content in rapeseed increased but did not exceed the allowable level.

Key words: biological activity, humus fertilizer, rape.

Microelements in soils of Belarus and their effective application in plant growing

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The important condition in obtaining of high and steady yield of agricultural crops is the supply of them by all necessary macro-and microelements that allows to adjust processes of enrichment of production by the certain elements necessary for normal ability to live of the person and an animal. Necessity of microfertilizers use for plant growing of Belarus is caused by the insufficient contents in soils mobile forms of some microelements. The average mobile copper contents in arable soils of the republic makes 1,89 mg/kg, a boron – 0,60, zinc – 3,32 mg/kg, and a share of soils of the first and second groups of supply by these microelements, where is necessary the application of microfertilizers, is being varied on areas within the limits of 77,6–91,2 %. It is even more distinction on areas, economies and separate fields.

Microfertilizers need under the basic agricultural crops of the republic is very high. Undoubtedly, it is necessary the differentiated system of application of each kind of microfertilizers. Now microfertilizers under agricultural crops are used on 30–40 % from need. Optimization of system of microelement crops nutrition has allowed to estimate action and interaction of separate elements in multifactorial field experiences, to establish agrochemical and economical the most effective dozes of microfertilizers under the basic agricultural crops, cultivated on sod-podzol sandy and loamy soils. Results of our long-term researches have shown, that at application of a boron, copper, zinc, manganese, iodine and cobalt in the form of not root top dressing in optimum dozes are reached about the same parameters of efficiency of agricultural crops, as at their application into soil. Thus, not root top dressing of plants by microelements provided the greatest economic benefit and ecological safety.

On the basis of an experimental material the system of microelements application is developed in view of soil–agrochemical conditions, biological crops features, kinds and forms of microfertilizers, correlation of the prices for production and microfertilizers.

Key words: soil, microelements, application, plant growing.

Mineral nitrogen leaching loss following application of green manure to sandy loam soils

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Different organic fertilizers, with improve the physical and chemical properties of soils, are often used for increasing the fertility of light-textured soils. However, in the process of organic fertilizer decomposition, the soils are enriched with various nitrogen compounds, including nitrates, which easily migrate along the soil profiles.

The aim of the studies was to investigate the migration of mineral nitrogen in the 0–100 cm layer in the soil profile after incorporation green manure and cereals straw. The experiments were performed at the Voke branch of Lithuanian Institute of Agriculture in 1997–2005. The experimental plots were established in sandy loam on carbonaceous fluvial-glacial gravel ordinary eluviated soil, Haplic Luvisols (LVh).

It was determined that in comparison with the incorporation of barley stubble alone into soil, the application of summer green manure crops (lupine or first-year red clover aftermath) increases the leaching of nitrogen in subsoil horizons (25–100 cm) in October and November on average by 43,7–69,1 and 29,3–36,2 kg ha^{-1} N, respectively.

Green mass of lupine in soil is mineralized more rapidly than that of red clover aftermath, therefore on applying lupine the content of mineral nitrogen in the 0–100 cm layer in October was on average by 15,5 % (29,0 kg ha^{-1} $N_{min.}$) and in November by 13,8 % (32,7 kg ha^{-1} $N_{min.}$) higher as compared to mineral nitrogen content after ploughing under red clover aftermath.

Catch crops are ploughed into soil before its freezing, and it essentially reduces the autumn period of organic mass destruction and the risk of leaching of nitrates in to subsoil horizons. In comparison with the ploughing under of cereal stubble, incorporation of oil radish and undersown red clover in the autumn period increased the content of mineral nitrogen statistically not reliably (on average by 28,5–26,1 kg ha^{-1} N in the soil layer of 25–100 cm).

Key words: green manure, mineral nitrogen migration, soil profile.

Effect of mineral fertilisers with different composition on yield, grain size parameters and quality of malting barley

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The experiments were conducted in Experimental Station of Lithuanian University of Agriculture in 2004–2006. The soil of the experimental site was medium textured loamy carbonaceous leached soil – IDg8-k (Calcari-Epihypogleyic Luvisols (LVg-p-w-cc).

The aim of this research was to investigate the effect of single and combined application of simple, complex and leaf-feed fertilisers on yield, grain size and quality of malting barley under different annual climatic conditions. According to the results obtained, the most significant grain yield increase (0,35 t ha^{-1}) of malting barley was obtained when the crop were complementary fertilized with complex fertilizer *Cropcare 13-0-13* on the background of complex fertilizers in combination with leaf feed fertilizers *Delfan/Aton AZ* – at the end of tillering phase and *Fainal K* – at the beginning of flowering phase. The grain size depended mainly on climatic conditions during the grain formation and ripening, and not so much on mineral fertilization. The grains of malting barley plants fertilised either with simple or complex fertilisers and complementary – with leaf-feed fertilisers did not exceed the protein content limit, set for malting barley. Different combinations of fertilisers had no significant effect on protein content in grains; a square dependence of grain richness in proteins on hydrothermal coefficient during the grain formation and ripening was determined. The content of non-nitrogen extractable matter (NEM) in spring barley grains depended on protein, fat, fibre and ash content in the grains and was inversely proportional to the grain richness in proteins. Different combinations of mineral fertilisers had no significant effect on NEM content in grains. Complementary fertilisation with the leaf-feed fertilisers *Delfan* and *Aton AZ*, and *Fainal K* resulted in an increased content of fat in grains. The content of fibre and ash in malting barley grains was more dependent on the annual climatic conditions than on the different combinations of fertilisers.

Key words: spring barley 'Pasadena', simple, complex and leaf-feed fertilisers, hydrothermal coefficient.

Mineral nitrogen in Lithuanian soils

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According to the data obtained from the country-wide monitoring in 2005–2007, testing activities carried out in Lielupe basin in 2007 and long term fertilization experiments, an accumulation of mineral nitrogen in soil (0–30, 31–60, 61–90 cm layers) is dependent mainly on fertilization, cultivated crop, climatic conditions (precipitation, temperature, soil frosting) and soil texture. N_{min} content in soil in spring strongly depends on climatic conditions. After the rainy autumn, in spring of 2005 average N_{min} content in 0–60 cm layer of soil was 52,6 kg ha^{-1}, and after the dry and warm autumn in spring of 2006–62,5 kg ha^{-1}. Due to the warm winter and weak soil frosting in 2006–2007, in spring N_{min} content in 0–60 cm layer of soil was even lower than in spring of 2005 (52 kg ha^{-1}). Difference in climatic conditions in various Lithuanian regions was reflected by N_{min} content in soil. Because the winter precipitation in Western Lithuania was about 50 % higher than in Middle and Eastern Lithuania, in spring of 2007 N_{min} content in 0–60 cm layer of Western Lithuanian soil was approximately 7 kg ha^{-1} less, and in 31–60 and 61–90 cm layers of soil – twice less than in Middle Lithuania.

Due to the weak soil frosting in winter of 2007 N_{min} content in 0–60 cm layer of soil of experimental plots not fertilized with nitrogen decreased by 59–61 %, when compared to the autumn data, plots fertilised with N_{90} rates – 154–323, N_{180} rates – 172–370 %. Extremely large N_{min} losses in spring, when compared to the autumn data, were determined in 61–90 cm layer of soil fertilized with nitrogen; when soil was fertilised only with PK fertilizers, N_{min} losses were 43–59 %.

Large share of the nitrogen left in soil after harvesting was not found in spring, because the climatic conditions were favourable for nitrogen leaching into the ground waters.

Key words: N_{min}, fertilisers, soil, climatic conditions.

TURINYS / CONTENT

SL 399. 2008 09 ??. Sp.l. 7,?. Tiražas 200 egz. Užsakymas Nr. ??. Išleido ir spausdino LŽŪU Leidybos centras – 2008. Studentų 11, Akademija, LT–53361 Kauno rj.

Printed by Printing Department of Lithuania University of Agriculture, 2008. Studentu 11, LT–53361 Akademija, Kaunas r., Lithuania.