

ALEKSANDRAS STULGINSKIS UNIVERSITY

**Long-term Agroecosystem Sustainability:
Links between Carbon Sequestration in Soils,
Food Security and Climate Change**

INTERNATIONAL SCIENTIFIC CONFERENCE

AgroEco2016

PROGRAMME AND ABSTRACTS

AKADEMIJA, 2016

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PROGRAMME

4 October (Tuesday)

4th Building, Conference Hall (214 aud.), Universiteto str. 8a, Akademija,
Kaunas reg.

17 ⁰⁰ – 19 ⁰⁰	Registration and coffee
18 ⁰⁰ – 18 ³⁰	Meeting of International Conference Scientific and Organising Committees and Keynote Speakers Moderators prof. dr. Viktoras Pranckietis, prof. dr. Vaclovas Bogužas
18 ³⁰ – 19 ⁰⁰	Research Activities at Aleksandras Stulginskis University Moderators Vice-Rector dr. Romualdas Zemeckis, Research Manager dr. Zita Kriaučiūnienė, R&D Manager dr. Živilė Juknevičienė
19 ⁰⁰ – 21 ⁰⁰	Welcome evening (registration is necessary until 3th of October)

5 October (Wednesday)

Central Building (505 aud.), Studentu str. 11, Akademija, Kaunas reg.

8 ⁰⁰ – 9 ⁰⁰	Registration, poster mounting and coffee
9 ⁰⁰ – 9 ²⁰	Opening of the Conference Rector of Aleksandras Stulginskis University prof. dr. Antanas Maziliauskas, Chairperson of the Division of Agriculture and Forestry, Lithuanian Academy of Sciences prof. dr. habil. Zenonas Dabkevičius, Dean of ASU Agronomy Faculty prof. dr. Viktoras Pranckietis, Director of Department of Economics under the Ministry of Agriculture of the Republic of Lithuania dr. Vygantas Katkevičius
9 ²⁰ – 13 ⁰⁰	Plenary Presentations Chairs of the section: prof. dr. Vaclovas Bogužas, Aleksandras Stulginskis University, Lithuania; dr. Evelin Loit, Estonian University of Life Sciences, Estonia
9 ²⁰ – 9 ⁴⁵	Land use strategy for sustaining our soil resources and society Prof. dr. Takashi Kosaki, Tokyo Metropolitan University, Japan
9 ⁴⁵ – 10 ¹⁰	The diversity of biodiversities Assoc. prof. dr. Andrzej Bieganski, Institute of Agrophysics, Polish Academy of Sciences in Lublin, Poland
10 ¹⁰ – 10 ³⁵	Eco-inovation and water resource efficiency: Towards a knowledge driven agriculture Dr. Vasileios Takavakoglou, Aristotle University of Thessaloniki, Greece
10 ³⁵ – 11 ⁰⁰	Coffee break, photography of participants at central entrance of Central Building
11 ⁰⁰ – 11 ²⁵	Towards long-term objective of bioeconomy and bioenergy integration Prof. dr. Martin Kreeb, University of Hohenheim, Germany
11 ²⁵ – 11 ⁵⁰	Toward better quality and quantity of food Dr. Evelin Loit, Estonian University of Life Sciences, Estonia

11 ⁵⁰ – 12 ¹⁵	<p>Importance of long-term experiments in agriculture: a case study from Latvia</p> <p>Prof. dr. Zinta Gaile, senior researcher dr. habil. Antons Ruza, prof. dr. habil. Aldis Karklins, researcher MSc Janis Gailis, researcher MSc Laila Dubova, assoc. prof. emeritus dr. Maija Ausmane, assoc. prof. emeritus dr. Andris Berzins, assoc. prof. dr. Liga Paura, prof. dr. Biruta Bankina, Latvia University of Agriculture, Latvia</p>
12 ¹⁵ – 12 ⁴⁰	<p>Cumulative after-effect of long-term contrasting soil management on soil physical quality</p> <p>Head researcher dr. Virginijus Feiza, senior researcher dr. Dalia Feizienė, junior researcher PhD student Agnė Putramentaitė, senior researcher dr. Irena Deveikytė, researcher dr. Vytautas Seibutis, Institute of Agriculture, Lithuanian Research Centre for Agriculture and Forestry, Lithuania</p>
12 ⁴⁰ – 13 ⁰⁰	<p>Soil organic matter changes and organic matter decomposing microbiota abundance in long-term experiment of soil tillage systems integrated with straw and green manure</p> <p>Assoc. prof. dr. Juratė Aleinikovienė, prof. dr. Vaclovas Bogužas, lect. dr. Romutė Mikucionienė, PhD student Vaida Steponavičienė, Aleksandras Stulginskis University, Lithuania</p>
13 ⁰⁰ – 14 ⁰⁰	<p>Lunch, poster presentations</p>
14 ⁰⁰ – 15 ³⁰	<p>Oral presentations</p> <p>Chairs of the section: prof. dr. Kęstutis Romaneckas, Aleksandras Stulginskis University, Lithuania; prof. dr. Zinta Gaile, Latvia University of Agriculture, Latvia</p> <hr/> <p>The effect of long-term mineral fertilization of mountain meadow on water-air properties of soil</p> <p>Dr. habil. Tomasz Zaleski, prof. dr. hab. Michał Kopeć, University of Agriculture in Krakow, Poland</p> <hr/> <p>Diversity of weed communities of winter wheat grown in conventional and organic systems</p> <p>Dr. habil. Jozef Tyburski, University of Warmia and Mazury in Olsztyn; dr. Grzegorz Makuleci, University in Warsaw; dr. hab. Arkadiusz Stepień, University of Warmia and Mazury in Olsztyn, dr. Krassimira Ilieva-Makulec, University in Warsaw, Poland</p> <hr/> <p>Transformations of Typical Soil Profile and Organic Matter in Western Lithuania Agroecosystems</p> <p>Assoc. prof. dr. Jonas Volungevičius, Vilnius University; assoc. prof. dr. Rimantas Vaisvalavičius, Aleksandras Stulginskis University; PhD student Kristina Amalevičiūtė, researcher dr. Ieva Jokubauskaitė, Lithuanian Research Centre for Agriculture and Forestry; lect. dr. Romutė Mikučionienė, Aleksandras Stulginskis University; head researcher dr. Alvyra Šlepėtienė, Lithuanian Research Centre for Agriculture and Forestry, Lithuania</p> <hr/> <p>Long-term effects of different crop rotation courses on weediness in soddy podzolic arable soil</p> <p>Head researcher dr. Livija Zarina, Institute of Agricultural Resources and Economics, researcher dr. Liga Zarina, University of Latvia, researcher MSc Dace Pilksere, Institute of Agricultural Resources and Economics, Latvia</p>

Effect of 50 year term crop rotations on soil organic carbon and other soil quality indicators

Prof. dr. Vaclovas Bogužas, assoc. prof. dr. Lina Marija Butkevičienė, PhD student Lina Skinulienė, assoc. prof. dr. Aušra Sinkevičienė, Aleksandras Stulginskis University; head researcher dr. Alvyra Šlepetienė, Institute of Agriculture, Lithuanian Research Centre for Agriculture and Forestry, Lithuania

Hemp (*Cannabis sativa* L.) new uses for Lithuania: challenges and future tendencies

Senior researcher dr. Ina Stuogė, Lithuanian University of Health Sciences; assoc. prof. dr. Vaida Jonaitienė, Kaunas Technology University, Lithuania

15³⁰ – 15⁵⁰

Coffee break, poster presentations

15⁵⁰ – 17⁰⁰

Oral presentations**Long term changes in duration of vegetation season of winter wheat under climate warming in North Lithuania**

Prof. dr. habil. Romualdas Juknys, assoc. prof. dr. Kanapickas A., assoc. prof. dr. Sujetovienė G., PhD student Martynas Klepeckas, Vytautas Magnus University; prof. dr. habil. Rimantas Velička, researcher dr. Zita Kriaučiūnienė, assoc. prof. dr. Ilona Vagusevičienė, assoc. prof. dr. Rita Pupalienė, Aleksandras Stulginskis University; researcher dr. Laura Masilionytė, Joniškėlis Experimental Station, Lithuanian Research Centre for Agriculture and Forestry, Lithuania

Effect of long-term cultivation of loess slope on some soil properties diversity

Dr. Halyna Kozak, dr. Ryszard Mazurek, dr. habil. Tomasz Zaleski, University of Agriculture in Krakow, Poland

The long – term impact of reduced tillage systems on clay loam soil physical state under spring crop management conditions

Senior researcher dr. Aleksandras Velykis, researcher dr. Antanas Satkus, Lithuanian Research Centre for Agriculture and Forestry, Lithuania

Allelochemicals in *Brassica napus* L. residues decomposing in the soil

Researcher dr. Zita Kriaučiūnienė, junior researcher dr. Rita Čepulienė, prof. dr. habil. Rimantas Velička, prof. dr. Aušra Marcinkevičienė, researcher dr. Robertas Kosteckas, Aleksandras Stulginskis University, Lithuania

Farmers attitudes towards sustainable agriculture practices in Lublin and Mazovian province

PhD student Talal Saeed Hameed, University of Mosul, Iraq; prof. dr. Barbara Sawicka, University of Life Sciences in Lublin, Poland

17⁰⁰ – 17³⁰

Concluding remarks and discussions

Moderators prof. dr. Viktoras Pranckietis, prof. dr. Vaclovas Bogužas, Aleksandras Stulginskis University, Lithuania

18⁰⁰ – 22⁰⁰

Conference dinner with cultural program

6 October (Thursday)

Central Entrance of Central Building, Studentu str. 11, Akademija, Kaunas reg.

9 ³⁰ – 11 ³⁰	Visit to 9th forestry, hunt, fishing and husbandry technologies exhibition „Sprendimų ratas 2016“ / ‘Circle of Solutions 2016’ http://www.sprendimuratas.info Moderators prof. dr. Viktoras Pranckietis, prof. dr. Kęstutis Romaneckas, assoc. prof. dr. Rimantas Vaisvalavičius, Aleksandras Stulginskis University, Lithuania
11 ³⁰ – 12 ³⁰	Visit to ASU Experimental Station Moderators Director of ASU Experimental Station prof. dr. habil. Rimantas Velička, Researcher dr. Zita Kriauciūnienė, Aleksandras Stulginskis University, Lithuania
13 ⁰⁰ – 14 ⁰⁰	Lunch
14 ³⁰ – 17 ⁰⁰	Visit to Romualdas Majeras farm (Kaunas reg.)

Poster presentations

No.	Authors	State	Title of presentation
1.	E. Adamiak D. Szałczyńska	Poland	Response of two cultivars of winter triticale to long-term monoculture depending on chemical protection level of a cornfield
2.	A. Amšiejus A. Šaluchaitė	Lithuania	The comparison of bees wintering in Dadan-Blat and in multistorey bottomless hives
3.	B. Bankina G. Bimšteine A. Roga D. Fridmanis	Latvia	<i>Fusarium</i> spp. and <i>Oculimacula</i> spp. – the most important causal agents of wheat crown rot
4.	G. Bimšteine M. Narviļs	Latvia	Integrated control of potato foliar diseases
5.	V. Bogužas V. Pranckietis J. Aleinikovienė I. Pranckietienė	Lithuania	Transformations of agrarian landscape and of emissions from agricultural soils in Lithuania
6.	I. Deveikytė V. Feiza D. Feizienė V. Seibutis A. Putramentaitė	Lithuania	Weed flora as influenced by tillage and fertilization
7.	P. Duchovskis L. Duchovskienė	Lithuania	Effect of sustainable integrated pest management on carrots yield quality
8.	E. Eimutytė A. Adamavičienė R. Pupalienė E. Šarauskis M. Oksas R. Kimbirauskienė S. Čekanauskas K. Romaneckas	Lithuania	Impact of non-chemical weed control systems on weediness of organically grown sugar beet crop
9.	D. Feizienė V. Feiza D. Janušauskaitė I. Deveikytė V. Seibutis A. Putramentaitė	Lithuania	Agroecosystems productivity in relation to long-term soil management and soil chemical quality
10.	A. U. Friday O. O. Ademola	Nigeria	Biodiversity and ecosystem services in agroecosystems
11.	Z. Gaile L. Lapina L. Litke I. Alsina L. Dubova A. Senberga	Latvia	Whether yield increase is always guaranteed by beans' seed treatment with <i>Rhizobium</i> bacteria?

12.	E. Jarienė N. Vaitkevičienė S. Žaldarienė D. Levickienė S. Mikulionienė	Lithuania	Accumulation of phenolic compounds in the alternative plant raw materials for food
13.	M. Jastrzębska A. Saeid M. K. Kostrzewska M. Wyciszkievicz K. Treder P. Makowski	Poland	Content of selected potentially toxic trace elements in wheat grains as influenced by phosphorus biofertilizers from renewable raw materials
14.	D. Janušauskaitė D. Feizienė V. Feiza	Lithuania	After-effect of long-term tillage and N application on winter wheat physiological performance
15.	G. Juozapaitienė A. Dikšaitytė	Lithuania	Below-ground carbon sequestration under climate change
16.	Ž. Kadžiulienė L. Šarūnaitė	Lithuania	Changes in biodiversity of short and long- term use of grass-legume grazing swards
17.	B. Kalisz A. Łachacz P. Sowiński P. Urbanowicz	Poland	Sorptive properties of agriculturally used organic soils
18.	L. Karimova I. Talanov	Russian Federation	Ecological value of fodder beans in increasing of soil fertility
19.	M. Kopeć K. Gondek T. Zaleski	Poland	Variation in soil carbon, nitrogen, and sulphur contents in long-term fertilisation experiment in Czarny Potok
20.	H. Kozak R. Mazurek T. Zaleski	Poland	Effect of long-term cultivation of loess slope on some soil properties diversity
21.	B. Krochmal-Marczak B. Sawicka H. Danilčenko E. Jarienė	Poland Lithuania	Genotypic and environmental variance of macroelements in tubers of coloured potato varieties
22.	J. Kulaitienė J. Černiauskienė Ž. Juknevičienė	Lithuania	Quality parameters of pumpkin seed oil from different cultivars grown in Lithuania
23.	H. Madsen L. Talgre V. Eremeev D. Sánchez de Cima A. Luik	Estonia	The effect of farming system on soil microbial hydrolytical activity
24.	S. Maļeckā S. Zute	Latvia	Weed species occurrence in cereal sowings in Kurzeme region

25.	A. Marcinkevičienė V. Bogužas L. M. Butkevičienė I. Auželienė	Lithuania	The changes of weed ecological groups in the winter rye monocrop
26.	A. Marcinkevičienė M. Keidan R. Velička R. Pupalienė Z. Kriaučiūnienė L. M. Butkevičienė R. Kosteckas S. Čekanauskas	Lithuania	The impact of bio-activators and non-chemical weed control systems on winter oilseed rape productivity and soil properties
27.	N. Maršalkienė B. Karpavičienė	Lithuania	Influence of genotype and meteorological conditions on seed productivity of flat pea (<i>Lathyrus sylvestris</i>)
28.	L. Masilionytė S. Maikštėnienė D. Jablonskytė- Raščė	Lithuania	Floral composition and effect of different catch crops on crop weediness in alternative farming systems
29.	O. Mikša L. Baležentienė	Lithuania	Agroecosystems contribution to seasonal carbon exchange in temperate climate of Central Lithuania
30.	D. Miškelytė A. Dikšaitytė J. Žaltauskaitė G. Sujetovienė I. Januškaitienė G. Kacienė R. Juknys	Lithuania	C4 weed <i>Echinochloa crus-galli</i> interference with pea increases under elevated CO ₂ and temperature
31.	R. Mockevičienė R. Velička A. Marcinkevičienė R. Pupalienė Z. Kriaučiūnienė L. M. Butkevičienė R. Kosteckas S. Čekanauskas	Lithuania	The effect of non-chemical weed control on soil biological properties in the spring oilseed rape crop
32.	S. G. Murtazina L. G. Gaffarova M. G. Murtazin I. M. Serzhanov	Russian Federation	Free and indispensable amino acids in the Forest Steppe zone of the Volga region and effectiveness of chelate microfertilizers
33.	J. Niedźwiecki G. Debaene D. Pikuła	Poland	Near-infrared spectroscopy as a tool to apprehend soil fertility

34.	K. Orzech M. Wanic A. Stepien M. Michalska	Poland	Influence of compacting and land cultivation systems on soil compactness and yields of crops in the rotation system
35.	M. Orzechowski S. Smółczyński P. Sowiński	Poland	Anthropogenetic transformation of soils in young glacial landscape in Northern-Eastern Poland
36.	A. Paulauskienė V. Pranckietis Ž. Tarasevičienė T. Barčytė	Lithuania	Effect of storage conditions on the chemical composition of <i>Actinidia kolomikta</i> fruits
37.	S. Raudonius D. Jodaugienė K. Romaneckas V. Bogužas	Lithuania	Response of crops yield to long-term reduced soil tillage and direct sowing
38.	A. Rehilevich H. Milosta P. Bogushevich	Belarus	Productivity of aromatic varieties of hop in Belarus and dependence of its quality on bitter acids content
39.	A. Ruža D. Kreita M. Katamadze	Latvia	Grain yield and yield quality depending on soil tillage
40.	B. Rychcik M. Marks A. Łachacz	Poland	Impact of long-term cultivation of maize on physicochemical soil properties
41.	M. Ryżak M. Beczek A. Sochan R. Mazur C. Polakowski A. Bieganowski	Poland	Particle size distribution of splashed material on different distances for soil samples derived from Endogleyic Umbrisol (Arenic)
42.	N. Sabienė	Lithuania	Evaluation of soil quality and degradation in the agroecosystems according integrated index of chemical, biochemical and biological features
43.	A. Satkus A. Velykis	Lithuania	Seedbed quality and spring crop emergence under clay loam soil reduced tillage conditions
44.	B. Sawicka A. H. Noaema B. Bienia D. Skiba	Poland	The influence of foliar fertilization with macro- and microelements on the content of magnesium and calcium in potato tubers
45.	V. Seibutis I. Deveikytė V. Feiza D. Feizienė	Lithuania	Effect of crop rotation on weed infestation and crop yield in different tillage systems

46.	A. Stępień R. Pietrzak-Fiećko K. Wojtkowiak K. Orzech	Poland	The fat yield and fatty acid profile of winter rapeseed grown in monoculture and in crop rotation under different agricultural production systems
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48.	Ž. Tarasevičienė A. Velička A. Kieltyka-Dadasiewicz A. Paulauskienė V. Jurevičienė	Lithuania Poland	Aroma profile and colour of fresh and processed different species mints
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50.	J. Tyburski S. Sienkiewicz A. Grnastedt	Poland Sweden	Consequences and prevention of potassium deficiency on organic farms – case studies from Poland
51.	V. Vitunskienė D. Jazepčikas E. Šimkus	Lithuania	Extent and causes of food waste in Lithuania
52.	I. Voor E. Loit	Estonia	Wheat yield quantity and quality depending on nitrogen transporter genes
53.	A. Walkiewicz M. Brzezińska	Poland	Methane consumption in arable soils – selected aspects of fertilization
54.	A. Žebrauskienė	Lithuania	Mulching effect on yield and quality of asparagus (<i>Asparagus officinalis</i> L.)
55.	L. Žilėnaitė A. Šaluchaitė	Lithuania	The growth peculiarities of false flax (<i>Camelina sativa</i> (L.) Crtz.) and Abyssinian mustard (<i>Crambe abyssinica</i> Hochst.)

ABSTRACTS

RESPONSE OF TWO CULTIVARS OF WINTER TRITICALE TO LONG-TERM MONOCULTURE DEPENDING ON CHEMICAL PROTECTION LEVEL OF A CORNFIELD

Ewa Adamiak, Dagmara Szalczyńska

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Cultivation of cereals in long-term monocultures results in the decrease of their yielding. The size of grain losses depends on cereal variety, and agro-ecological and agro-technological conditions. In scientific literature the response of winter triticale to long-term monoculture is less identified.

The studies on response of winter triticale to the cultivation in monoculture were carried out in the years 2011÷2015 at University in Olsztyn, Poland. The yielding assessment of two cultivars of winter triticale in crop cultivation and in 19÷23-year monoculture depending on chemical protection was the object of the studies.

The studies included three factors concerning winter triticale: I. Crop sequence system: a) the cultivation in 6-field crop rotation, b) the cultivation in 19÷23-year monoculture. II. Chemical protection level: 0 – without protection; H - protection with herbicides; HF – protection with herbicides and fungicides. III – triticale cultivars: Pigmej and Cyrkon.

Among the cultivar the Cyrkon has shown a higher yield of grain than Pigmej one, in the crop rotation by 18.1% and in the monoculture by 26.9%. It has also shown weaker response to cultivation in monoculture, decreasing the yield in the object without protection by 33.4%, in the object protected with herbicides by 13.1% and in the object: HF - by 17.5%; on average by 21.1%. The yield losses concerning Pigmej cultivar were higher and amounted to as follows: by 42.2%; 21.4% and 17.2%; on average by 26.6%. The intensification of chemical protection increased the grain efficiency of winter triticale, the higher increase of yields was achieved in the monoculture (H – by 40.2 and HF – by 49.0%) than in the crop rotation (H – by 5.5 and by 11.6%). It was shown that the selection of a cultivar and the intensification of chemical protection can be decreased the yield losses of winter triticale in the monoculture.

Key words: winter triticale, cultivars, crop cultivation, monoculture, protection.

SOIL ORGANIC MATTER CHANGES AND ORGANIC MATTER DECOMPOSING MICROBIOTA ABUNDANCE IN LONG-TERM EXPERIMENT OF SOIL TILLAGE SYSTEMS INTEGRATED WITH STRAW AND GREEN MANURE

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Organic matter improves soil quality and in some cases reduces negative tillage impact in soil. Though, soil management variables are controlling the quality of organic matter as well as organic compound decomposers. Aim of this study was to evaluate long-term impact of tillage within application of straw and green manure on soil organic matter and organic matter decomposing microbiota. Surface (0-20 cm in depth) soil from long-term no-tillage and tillage plots in field experiment of Aleksandras Stulginskis University were characterized for soil biochemical and microbial parameters. It was estimated that long-term (15 years) straw application increased soil organic carbon content. Reduced tillage systems without primary tillage have been even effective, organic carbon content in soil increased by more than 20%. However, reduced tillage systems with primary tillage had no effect on soil organic carbon pools. Thus, no-tillage and catch cropping for green manure significantly increased the pools of organic carbon by 28.9-32.7% and 31.7-33.3%, respectively, in the plots with and without straw. Continuous straw application either has by 22.7% increasing the mobile humus substances. It was estimated that due to increased soil microbial abundance there have been the tendency to intensify soil organic matter decomposition in reduced tillage systems without primary tillage. Even though microbial abundance (especially abundance of micromycetes) has been higher, reduced tillage increased the total microbial biomass. Thus, reduced tillage leads to higher soil organic carbon potential turnover rates. Reduced tillage, especially without primary tillage and integrated with straw and green manure ones, in long-term period considerably reduce risks of soil organic matter lost compared with conventional ploughing.

Key words: long-term experiment, no-tillage, conventional and reduced tillage systems, soil organic matter, microbial biomass and abundance.

Acknowledgement: the research was supported by the Research Council of Lithuania (grant No. SIT-9/2015).

THE COMPARISON OF BEES WINTERING IN DADAN-BLAT AND IN MULTISTOREY BOTTOMLESS HIVES

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The aim was to evaluate the pros and cons of bee wintering compared Dadan-Blat and multistorey bottomless hives. The object of research was the bees. Investigations were carried out Algirdas Amšiejaus apiary for the period 2010-2013. All bee mothers were Algirdas Amšiejaus breeding apiary. Maternal race - *Apis mellifera carnica*. Bee wintering evaluated by the following indicators:

1. Consumed during the winter the amount of food.
2. The number of dead bees in the winter.
3. Bee diarrhoea.
4. Hive humidity.
5. Pupae in spring

The data obtained showed that bee wintering indicators for the bees overwinter better in Dadan-Blat hives. They are wintering bees three indicators (the amount of food consumed, amount of brood, diarrhoea point) is better than multistorey hives. But in multi-storey hives bee colonies perished 24.5 % less than in Dadan-Blat hives. Multistorey hives humidity was 8.0 %. Due to the open bottom of the bees hibernate drier slots.

According to the bee wintering indicators show that the bees overwinter better in Dadan-Blat hives. They are wintering bees three indicators (the amount of food consumed, amount of brood, diarrhoea point) is better.

Key words: Dadan–Blat hives, multistorey bottomless hives, wintering indicators.

***FUSARIUM* SPP. AND *OCULIMACULA* SPP. – THE MOST IMPORTANT CAUSAL AGENTS OF WHEAT CROWN ROT**

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Wheat stem base (crown) and root rot is devastating disease, which is difficult to control. Different names of this disease existing in world literature, because it could be caused by different pathogens, in many cases it is complex infection and symptoms are unspecific.

The objectives of this investigation is to identify causal agents of wheat crown rot under different soil tillage methods and after different pre-crops. This is only one part of complex long-term trial, which has been conducted at the Peterlauki Study and Research farm of the Latvia University of Agriculture.

The incidence of wheat stem base and root rot was determined after wheat harvesting, during 2012 - 2015. Causal agents of stem base and crown rot were identified by morphological features of pure cultures and results were confirmed by sequencing of the Transcription Elongation Factor (TEF) region and subsequent phylogenetic clustering of acquired DNA sequences along with TEF region sequences.

The average incidence of crown and root rot fluctuated from 37 till 88% depending on year. Soil tillage method and plant rotation did not influence spectrum of pathogens. Proportion of each causal agent was affected by year mostly, however fungi from genera *Fusarium* and *Oculimacula* were recognized as most important. *F. avenaceum* and *F. culmorum* were found more frequently. Both species of *Oculimacula* – *O. yallundae* and *O. aciformis* were determined in our trials. All others pathogens were found only in some cases.

In general, the most important causal agents of wheat stem base and root rot were *Fusarium* spp. and *Oculimacula* spp. under conditions of intensive wheat production.

Key words: disease, stem base, root rot, soil tillage.

Acknowledgement: the research was supported by the State research programme “Agricultural Resources for Sustainable Production of Qualitative and Healthy Foods in Latvia” project No 1 SOIL.

THE DIVERSITY OF BIODIVERSITIES

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The term biodiversity is very popular now. Descriptions of biodiversity investigations can be found in many scientific publications. However, what it is very important from the point of view of financing the science, biodiversity is one of the key issues with political priorities. Its consequence is the relatively big numbers of projects which should deal with the biodiversity problem. There are calls for such projects both at the international and national levels.

The question arises: what does the biodiversity really mean? There are plenty of definitions – they can be found in encyclopedias, dictionaries, publications, and on different websites. A review thereof can lead to a conclusion that a majority of them takes into account first of all the diversity of species of living organisms. However, it seems that sometimes the understanding of the term “living organisms” is limited to higher animals and plants. Such understanding is really too narrow.

The idea of this presentation is to encourage soil scientists to participate in events that deal with biodiversity. A way to obtain the aim is the promotion of wider understanding of the importance of soil as an element of the biosphere.

The word "biosphere" seems to be the key because soil can be treated as living itself or can be an environment for very different forms of life. Regardless of which one of these two above options of the understanding of the role of soil will be accepted, we can and should talk about biodiversity. Such arguments (presented unfortunately not too often) can already be found in the discussions about biodiversity.

However, and this is a new approach, I propose going one step further. If i) the soil is an effect of different factors of soil formation and, ii) one of these factors are the living processes that occur in the soil and, iii) on the basis of these factors there are different soil types - it is possible to accept the diversity of soil types, which can be also treated as biodiversity.

Soil scientist should be bolder and more often apply for projects related to biodiversity.

Key words: soil, biodiversity, biosphere, grants and projects.

INTEGRATED CONTROL OF POTATO FOLIAR DISEASES

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Potato is still one of the four most growing plants crop in Latvia. The important factor for getting higher yield is to keep potato foliar green as long as possible, during the growing season. For reaching result, certificated seed material, considered crop rotation and the use of fungicides have to be used. Integrated diseases control is the most sustainable, environmentally friendly and economically beneficial method of potato foliar protection.

Field observations of potato foliar disease development during vegetation period and comparison of different diseases control strategies were carried out at Latvian Rural Advisory and Training Centre arranged demonstration field, during the years 2015-2016.

The two varieties – ‘Laura’ and ‘Verde’ were used. Control variant (without fungicide usage) were compared with four different variants where fungicides were used based on potato grower’s experience, based on computer prognosis model, based on expert decision (integrated model) and based on used fungicide activity. Potato foliar diseases (potato late blight, potato early blight) assessment was started during the row closing. Appearance of first symptoms, diseases development during the season, disease severity at the end of season, and yield were compared and analysed.

The observations of first symptoms of potato foliar disease depend on meteorological conditions and from effectiveness of used control strategy. The time of first symptoms appearing is different from year to year. In the year 2015 the dominant potato foliar disease was early blight caused by *Alternaria* spp. Potato late blight caused by *Phytophthora infestans* also was observed but only in control variants for both compared varieties. On potato variety ‘Verdi’ there was observed potato late blight stem form that is more difficult to control. The potato late blight severity did not exceed 8 %. The part of used fungicides was applied also for control of potato early blight. Spread of early blight in control variants in variety ‘Verdi’ was 30% and in variety ‘Laura’ 95%. The used fungicide technical effectivity was between 46 – 60%. In the year 2015 the potato early blight was more common than late blight. The used control strategies for control potato foliar diseases were effective only for 46-60%.

Key words: potato diseases, *Alternaria*, *Phytophthora infestans*, integrated control.

Acknowledgement: the project “Integrated plant protection for control potato harmful organism” supported by Latvian Rural Advisory and Training Centre.

TRANSFORMATIONS OF AGRARIAN LANDSCAPE AND OF EMISSIONS FROM AGRICULTURAL SOILS IN LITHUANIA

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Landscape, as live and pulsating natural and anthropogenic system, experiences complex transformations. The agrarian landscape is determinable as separate anthropogenic landscape functional type. It is the dominant part of the Lithuanian landscape, because agricultural land currently occupies over 60% of the country. The agrarian landscape is mostly affected by human's agricultural activity and especially apparent transformations are in recent decades. The aim of the work is to disclose causes and problems of agrarian landscape and emissions from agricultural soils transformations, which arise after the restoration of the independence of Lithuania in 1990. Transformations of the agrarian landscape during the period after the restoration of the independence of Lithuania are determined by: a) changes of the property forms, b) market conditions and agricultural overproduction, c) use and extent of EU targeted support for agriculture, d) outcomes of farming activities, e) water management problems, f) social causes, g) climate change and biological invasions. The agrarian landscape in Lithuania is being improved by emerging farming culture, positive changes taking place in the structure of land – increasing sizes of private land and average plot area. Direct and indirect emissions of CO₂ equivalent from agricultural land in 2015 decreases accordingly 44 and 49 % to compare with 1990 situation. Management of abandoned lands and unemployed agricultural production buildings regulation, adequate care of drained land and further development of organic farming would let cardinaly improve Lithuania's agrarian landscape. This requires improving the legal bases. It is necessary to uniform the support for agricultural production across the EU. The unification of competitive conditions for all EU countries in the agricultural sector would let to restore the previous potential of livestock and would let to improve farming culture. While at the same time it would let to stabilize direct and indirect emissions from agricultural soils and to improve an agrarian landscape in Lithuania. Presented findings obtained through project "The influence of long-term contrasting intensity resources management on genesis of different soils and to other agro-ecosystem components (SIT-9/2015) financed by Research Council of Lithuania.

Key words: agrarian landscape, landed property, landscape components, emissions from agricultural soils.

ALLELOCHEMICALS IN *BRASSICA NAPUS* L. RESIDUES DECOMPOSING IN THE SOIL

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Studies on the allelopathic properties of oilseed rape are not sufficient to explain the impact of oilseed rape and its morphological parts on soil and agricultural crops that are grown after oilseed rape. To find out influence of allelochemical compounds released by oilseed rape on agrocenosis complex investigations should be carried out. Our studies aim to reveal and scientifically reason the allelopathic effect of winter oilseed rape by identification allelochemicals released by oilseed rape residues during decomposition in the soil. We analysed composition of allelochemical compounds of winter oilseed rape (*Brassica napus* L.) residues (threshing remains, stubble and roots) after harvesting and ascertained quantitative and qualitative changes of these compounds in residues after different period of decomposition in the soil (3, 7, 14, 19 and 26 months). Phytochemical analysis revealed that total content of phenolic compounds in all investigated oilseed rape residues significantly decreased after three months of decomposition in the soil. Further, during the process of decomposition content of these compounds in residues increased and the highest was after 19 months of decomposition, except winter oilseed rape threshing remains. The highest content of phenolic compounds in winter oilseed rape residues was after earlier – after 14 months of decomposition in the soil. After 26 months of decomposition in the roots of winter oilseed the content of phenolic compounds was significantly higher to compare with that after harvest. Qualitative and quantitative analysis of glucosinolates revealed that accumulation of these compounds is significantly higher in stubble and roots of winter oilseed rape than that in threshing remains. The aromatic glucosinolates were dominating. The total content of glucosinolates was lower in winter oilseed rape stubble and roots decomposed for three months in the soil than in those residues after harvest, and contrary in threshing remains it was higher. It was estimated that threshing remains the highest content of volatile organic compounds released after three months of decomposition, while stubble and roots – after seven months. Our results suggest that winter oilseed rape residues decomposing in the soil have allelopathic properties and may have influence on agroecosystem for two years.

Key words: allelopathy, phenols, glucosinolates, volatile compounds, winter rape, residues, decomposition

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WEED FLORA AS INFLUENCED BY TILLAGE AND FERTILIZATION

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A major reason to till soil is to reduce the competition of weeds, but with the increasing range of herbicides, reduced tillage become more effective. The area under NT has increased. The results of investigations are various. Tillage practices have more influence than fertilizer source on weed flora.

The aim of this study was to determine the effect of different fertilization systems under three tillage practices on weed population density.

Tillage systems – conventional tillage (CT), reduced tillage (RT) and no-tillage (NT). Fertilization - not fertilized (1), moderate rates (calculated according to soil properties and expected yield of the crop grown) of mineral NPK fertilizers (2) and maximum rates (2 rates + 30 %) of mineral NPK fertilizers were sub-plots.

The weed flora was composed of species which are typical for loamy soils in Lithuania. Major weeds were *Chenopodium album* L., *Galium aparine* L., *Thlaspi arvense* L., *Lamium purpureum* L., *Viola arvensis*, *Veronica arvensis* L., *Tripleurospermum perforatum* (Merat.) M. Lainz.). Minor weeds were *Euphorbia helioscopia* L., *Fallopia convolvulus* (L.) Löve, *Cirsium arvense* (L.) Scop., *Echinochloa crus-galli* (L.) P. Beauv. and *Trifolium pratense* L. Tillage systems differently affected weed density. Total density of weeds was significantly higher after NT and RT systems as compared with CT system. Tillage systems had no significant influence on density of perennial weeds. Rate of fertilizer played crucial role in reducing density of weeds. Density of weeds increased, when rate of fertilizer decreased.

Inversion tillage seems to be superior to non-inversion tillage for weed control. Fertilizer application reduces density of weeds.

Key words: tillage systems, fertilizers rate, weeds

Acknowledgement: the paper presents research findings, obtained through project (SIT-9/2015) financed by Research Council of Lithuania.

EFFECTS OF SUSTAINABLE INTEGRATED PEST MANAGEMENT ON CARROTS YIELD QUALITY

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Relatively large amounts of pesticides are used to control pests in horticulture. Therefore monitoring and forecast systems become very important. By monitoring main pests numbers and considering thresholds it is possible to reduce loss of quality in vegetable yield.

Recent years in horticulture noticed a rapid growth of sustainable cropping systems in Lithuania. In this system the same active ingredients of plant protection products can't be used more than two times per season and harvest interval have to be 1.5 times longer than indicated on the label. For this reason investigation on the efficiency of forecasting models for carrot fly *Psila rosae* was carried out at the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry in 2011-2012. The aim was to compare carrots yield quality, when insecticides was used according forecasting system iMETOS®sm (sustainable) and conventional cropping systems.

For carrot fly control optimization *P. rosae* emergence model based on soil temperature accumulation system. Yellow sticky traps (IVOGR – System) were used to monitor carrot fly imagoes. Application was made with the same insecticides, but not in the same time.

The usage of sustainable plant protection system not only the alternative to traditional plant protection, but also lets to control pests more effectively and forecasting model helps to select optimal application time for pest occurrence. Compare the number of damaged carrots in conventional and sustainable cropping systems there were not found any statistical differences. The protection system from carrots flies showed that spraying by *P. rosae* forecasting model was more accurate and more efficient (70.27-84.95%) than conventional (54.05 – 60.18) because the number of damaged carrots decrease.

P. rosae forecasting model was adapted to local conditions as well as implemented in horticultural sector in order to ensure optimal use of plant protection products and can be used in sustainable cropping system, because the number of damaged carrots decrease.

Key words: carrot fly, *Psila rosae*, protection system, sticky traps.

IMPACT OF NON-CHEMICAL WEED CONTROL SYSTEMS ON WEEDINESS OF ORGANICALLY GROWN SUGAR BEET CROP

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The investigations were carried out in 2015 at Aleksandras Stulginskis University Experimental Station. The aim - to evaluate the non-chemical weed control systems on the sugar beet crop weediness in organic farming conditions. Were investigated sustainable non-chemical weed control systems:

1. Inter-row loosening (control treatment);
2. Inter-row cutting and mulching with weeds;
3. Inter-row cutting and mulching with the Persian clover;
4. Inter-row cutting and mulching with white mustard;
5. Inter-row cutting and mulching with spring barley;
6. Inter-row steaming.

Crop weediness was assessed prior to each stage of weed control and at the end of the vegetation. There was found weed species composition, density and dry biomass. It is also estimated under crop plants dry biomass. The measurements were executed at each subtract time.

In 2015, in dry weather situation, the sugar beets weakly competed with weeds, so the alternative weed control systems were ineffective. In the plots of control treatment weed density and biomass were generally lower than in other plots. In control plots during the vegetation of sugar beet, weeds accumulated 121.70 g m⁻² of dry biomass, while in other plots - up to 2-3 times more. Less dry biomass of weeds was accumulated in interrows occupied with spring barley - up to 179.17 g m⁻² because barley accumulated the highest biomass - 338.96 g m⁻².

Key words: sugar beet, non-chemical weed control systems, weed.

CUMULATIVE AFTER-EFFECT OF LONG-TERM CONTRASTING SOIL MANAGEMENT ON SOIL PHYSICAL QUALITY

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In the face of changing climate, understanding of soil quality remains important because of the processes complexity, and the evaluation of after-effects of soil management practices on soil bearing potential to ensure sustainable crop production needs multiplex revision.

The investigations were carried out at the Institute of Agriculture, LRCAF, on Endocalcari-Epihyogleyic Cambisol in 2015. Two 2-factorial field experiments were established in 1999 according to the same trial design on a loam and on a sandy loam textured soil. Cumulative effects of tillage (CT - conventional, RT - reduced tillage, NT - no-tillage) and straw management (retuned or removed) were studied.

On loam, on both straw backgrounds, the content of WSA-water stable aggregates (>0,25 mm) in 0-20 cm layer, in RT and NT amounted to 56-60% and was significantly higher than in CT, where this index reached 48%. On sandy loam the highest content of WSA was in NT (53%), while in CT and RT it amounted to 44-47%. NT caused an increase in content of WSA mostly >1 mm in diameter.

On loam, RT and NT increased WR-water retention in 0-10 cm layer only, compared to CT. However, in 10-20 cm layer the WR was higher in CT because of a higher soil macro-porosity, whereas meso-porosity and micro-porosity was similar in CT, RT and NT. Macro-porosity and soil WR within 0-10 and 10-20 cm soil layers was significantly higher in CT than in RT and NT. However, meso-porosity and micro-porosity was similar in all tillage systems.

Straw returning increased total soil porosity and WR in both loam and sandy loam primarily in 0-10 cm layer, however the influence of straw on WR in 10-20 cm layer was negligible.

Key words: soil tillage, straw management, pore-size distribution, water retention, water stable aggregates.

Acknowledgement: the study presents data of project SIT-9/2015 financed by Research Council of Lithuania.

AGROECOSYSTEMS PRODUCTIVITY IN RELATION TO LONG-TERM SOIL MANAGEMENT AND SOIL CHEMICAL QUALITY

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The aim of investigations was to increase crop productivity and simultaneously sustain and exploit soil quality remains relevant to the processes trends under changing climate.

Two 3-factorial field experiments were established in 1999 on a very fertile loam and on a moderately fertile sandy loam. Effects of tillage (CT-conventional, RT-reduced, NT- no-tillage), fertilisation (1-unfertilised, 2-moderate NPK rates according to soil properties and targeted yield, 3-higher rates for 30% higher targeted yield than in (2)), straw management (retuned or removed) were studied. On loam P fertilizers were not used due high soil P content.

At the 17th experimental year, on loam the highest P, K and C contents within 0-10 cm layer were in RT and NT. In the 10-20 cm layer, soil fertility was similar in all tillage systems. On sandy loam, K within 0-10 cm layer did not differ, within 10-20 cm it was significantly higher in CT than in RT and NT. Soil P and C within 0-10 cm increased in order of priority CT→RT→NT, within 10-20 cm decreased in the same sequence. Straw returning mitigated soil deterioration primarily within 0-10 cm layer.

On loam, crop yields in NT were 2-36% lower in eight years of 17, in four years did not differ; in five years were 10% higher than in CT. On sandy loam, yields in NT were 3-32% lower in twelve years; in three years did not differ, only in two years were 10% higher than in CT. On sandy loam yield loss in NT was significantly higher because of CT refusal.

On loam, moderate fertilisation increased yields on average by 44%, on sandy loam by 84%, compared to unfertilised crops. On loam, the higher fertilisation under CT and RT increased yield by 7-8%, on sandy loam by 8-9%, under NT by 13% and 16%, respectively, compared to moderate fertilisation.

Key words: tillage, fertilisation, straw, stratification, yields.

Acknowledgement: the study presents data of project SIT-9/2015 financed by Research Council of Lithuania.

BIODIVERSITY AND ECOSYSTEM SERVICES IN AGROECOSYSTEMS

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Historically, agricultural systems have been managed, above all, for the production of food and fibre; however, agricultural landscapes can provide a wide range of goods and services to society. 'Ecosystem services' are those functions of ecosystems including agro ecosystems – that are useful to humans or support human well-being. The ecosystem services concept is remarkably longstanding. Approximately 400 forests provided important services to Attica and forest loss resulted in drying springs and soil erosion.

In the past two decades, work at the interface of ecology and economics to characterize, value, and manage ecosystem services has supported a paradigm shift in how society thinks about ecosystems and human relationships to them. As both major providers and major beneficiaries of ecosystem services, agricultural landscapes and the people within them are at the centre of this shift. Growing calls for agriculture landscapes to be managed as 'multi-functional' systems create new mandates, as well as opportunities, to maintain and enhance ecosystem services as part of productive agro ecosystems.

Work on multifunctional ecosystems draws on the Millennium Ecosystem Assessment (2005) and other recent evaluations of ecosystem services (e.g., The Economics of Ecosystems and Biodiversity and The Common International Classification of Ecosystem Services). The Millennium Ecosystem Assessment provides a globally recognized classification that emphasizes relationships between ecosystem services and human well-being and describes four types of services (The authors draw on the classification of ecosystems services used in Millennium

Ecosystem Assessment throughout the article (MEA, 2005), recognizing that more recent classifications have minimized or eliminated supporting services in favour of specific, operational descriptions designed for environmental accounting.

Key words: biodiversity, agroecosystems, classification.

WHETHER YIELD INCREASE IS ALWAYS GUARANTEED BY BEANS' SEED TREATMENT WITH RHIZOBIUM BACTERIA?

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Field beans (*Vicia faba* var. *minor*) is important crop for consideration of greening demands according EU CAP. Inoculation of beans' seed with *Rhizobium* bacteria is mostly recognized as tool for yield increase. It is known that *Rhizobium* bacteria are host-plant specific and strains are with different N-fixing efficacy.

The aim of this research was to evaluate the effect of seed treatment with *Rhizobium leguminosarum* strain 407 on yield of eight cultivars.

Two factor (A – seed treatment: A1 – without inoculation; A2 – seed inoculation with strain 407; B1 – B8: eight beans' cultivars: Laura; Boxer; Isabell; Fuego; Fanfare; Taifun; Vertigo; Albus) field trial was carried out in 2015. Soil at the site was well-cultivated Endocalcaric Abruptic Luvisol, silt loam. *Rhizobium leguminosarum* strain 407 was isolated at the same research farm in 1972 and presently obtained from collection.

Average bean yield was 6.10 t ha⁻¹. Inoculation with strain 407 decreased yield significantly (-0.45 t ha⁻¹; $p < 0.001$) which is in contradiction with many research results. It can be explained with possible presence of effective wild *Rhizobium* strains in the soil; emergence of beans took more than month due to cool spring; possibly nodulation with cultivated strain was hampered, but these aspects have to be investigated further. Significant ($p < 0.05$) cultivar effect was noted on weight of 100 nodules at budding, seed yield, number of seeds per pod, crude protein content and volume weight. Significant ($p < 0.05$) inoculation effect was noted only on seed yield and 1000 seed weight, but both were decreased.

Inoculation with *Rhizobium* does not always guarantee positive effect on bean yield and it's forming elements. Effect depends on environmental conditions.

Key words: field beans, *Rhizobium leguminosarum*, inoculation, yield, yield forming elements, nodulation.

FARMERS ATTITUDES TOWARDS SUSTAINABLE AGRICULTURE PRACTICES IN LUBLIN AND MAZOVIAN PROVINCE

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This study was conducted to determine the socio-economic characteristics of farmers, attitudes of farmers towards sustainable agriculture practices in Lublin and Mazovian province.

Data for the study were collected through by interview using a questionnaire method from a randomly selected sample of 152 farmers. The first part of research included the independent variables, while the second part included scale to measure. The attitude of the farmers, towards sustainable agriculture practices to be assessed by summing up the reaction of positive, negative and neutral. To achieve this, a five point Likert scale, while the scoring was reversed for unfavorable statements. The total of 20 questions were asked for the attitude analysis, the maximum and minimum scores were 100 and 20, respective.

The majority of the farmers (77.6%) were between 30-56 years, 14.7% with primary education and most of the farmers (about 61.4%) were married. Averages of farming experience, family size and farm size were: 14 years, 5 persons, 14.6 ha, respectively. The findings indicated revealed that majority (68%) of the respondents showed neutral attitudes towards sustainable agriculture practices.

The neutral attitude is evidenced in their responses towards sustainable agriculture practices may be due to the lack of extension activities in this region in the subject of sustainable agriculture practices. There was a significant relationship between attitudes of farmers towards sustainable agriculture practice.

Key words: sustainable agriculture, farmers, towards.

ACCUMULATION OF PHENOLIC COMPOUNDS IN THE ALTERNATIVE PLANT RAW MATERIALS FOR FOOD

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Jerusalem artichoke, ware potatoes tubers and mulberry leaves contains biologically active materials phenolic compounds. In that case above mentioned plant's raw material has a positive perspective for processing production of fodder, dietary and increased nutritional value foods or high quality pharmaceutical raw material.

For this reason, investigations were carried out at the Institute of Agriculture and Food Sciences of Aleksandras Stulginskis University, Lithuania, in 2011-2015. The aim was to investigate the total phenolic compounds content (TPCC) in the tubers of Jerusalem artichoke (*Helianthus tuberosus* L.) cvs. 'Sauliai', 'Rubik', 'Albik', in the tubers of ware potatoes (*Solanum tuberosus* L.) cvs. 'Red Emmali', 'Blue Congo', 'Vitelotte' and in white mulberry (*Morus alba* L.) leaves of cvs 'Plodovaja 3' and 'Smuglianka'.

The total phenolic compounds content (TPCC) mg GAE $1g^{-1}$ in the dry matter was established by the Folin-Ciocalteu colorimetric method (Gao et al., 2000).

The TPCC in the tubers of tested potato cultivars varied from 2.49 to 3.50 mg GAE $1g^{-1}$ DM. The TPCC in the tubers of cv. 'Vitelotte' was significantly by 23.24% higher than that in the tubers of cv. 'Blue Congo', and as much as 36.72% higher than that in the tubers of cv. 'Red Emmalie'. TPCC in the studied mulberry leaves species varied between 13.48 to 26.88 mg GAE $1g^{-1}$ DM. Significant higher amount of phenolic compounds found in the mulberry leaves of cv 'Smuglianka'. The highest concentrations of phenolic compounds in Jerusalem artichoke tubers were estimated in cv 'Rubik' 16.69 mg GAE $1g^{-1}$, as well in 'Albik' the content of TPCC was 18% and in 'Sauliai' - 41% lower than that in the tubers of cv. 'Rubik'.

Accumulation of phenolic compounds in the alternative plant raw materials for food depends on the cultivars' genetic properties. Summarizing the conclusions for the creation of new functional products could be recommended ware potatoes 'Vitelotte' cv. tubers, white mulberry 'Smuglianka' cv. leaves as well Jerusalem artichoke cv. 'Rubik' tubers because contains the highest biologically active materials phenolic compounds.

Key words: Jerusalem artichoke, phenolic compounds, mulberry leaves, tubers, ware potatoes.

CONTENT OF SELECTED POTENTIALLY TOXIC TRACE ELEMENTS IN WHEAT GRAINS AS INFLUENCED BY PHOSPHORUS BIOFERTILIZERS FROM RENEWABLE RAW MATERIALS

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Fertilizers containing phosphorus recovered from municipal and animal wastes could pose an alternative to the use of non-renewable phosphate resources. Preparations based on ash from incinerated sewage sludge can increase the concentrations of heavy metals and other toxic elements in plant tissues. However, advanced methods of fertilizer production from renewable sources reduce the content of heavy metals in products to safe levels.

The Department of Advanced Material Technologies at the Wrocław University of Technology developed suspension biofertilizers containing: (1) ash from incineration of treated sewage sludge, and (2) animal (poultry) bones, and both of them enriched with *Bacillus megaterium* cultures. The effectiveness of those biofertilizers was analysed in a field experiment involving spring wheat (northeast Poland, 2014). The aim of this study, which is a part of a larger research project, was to evaluate the influence of the developed phosphate biofertilizers on the content of As, Cd, Co, Cr, Ni, and Pb in wheat grains.

The functional properties of two new biofertilizers were compared to conventional fertilizers (superphosphate, phosphorite), ash-water solution (without microorganisms) and a control treatment without P fertilization. The content of selected elements was determined by ICP-OES.

New phosphate biofertilizers containing ash and bones similarly to superphosphate and, phosphorite did not influence the content of As, Cd, Co, Cr, Ni, and Pb in spring wheat grains. The concentrations of above elements were in the range of values recognized as natural and did not exceed the prescribed limits.

Ash and bones-based biofertilizers did not increase the concentrations of As, Cd, Co, Cr, Ni, and Pb in spring wheat grains.

Key words: sewage sludge ash, animal bones, phosphorus-solubilizing microorganisms, spring wheat, heavy metals.

AFTER-EFFECT OF LONG-TERM TILLAGE AND N APPLICATION ON WINTER WHEAT PHYSIOLOGICAL PERFORMANCE

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There is still lack of knowledge about the physiological traits of winter wheat affected by long-term tillage, straw and nitrogen management. The aim of this study was to evaluate the after-effect of long-term tillage and nitrogen application in combination with or without crop residues on winter wheat physiological traits. The investigation was carried out at the LRCAF, Institute of Agriculture, in a long-term field trial established in 1999. Tillage treatments - no-tillage (NT), reduced tillage (RT) and conventional tillage (CT) – were main plots; fertilization – without fertilizers (1), moderate rates (2) according to soil properties and expected 6.5 t ha⁻¹ yield, and higher rates of NPK (3) according to soil properties and expected 8.5 t ha⁻¹ yield were as sub-plots. Two residue management methods (straw returned or removed) were included as backgrounds. Chlorophyll index (SPAD) and maximum quantum efficiency of PSII (Fv/Fm) – were measured during the growing season.

We found that residue returning increased SPAD values of winter wheat, however significant influence of straw on SPAD was only in the several tested cases. Tillage impact on SPAD was significant in most of measurements. The maximum of SPAD was in RT treatment, and differences were significant, compared with CT. Application of fertilizers caused a significantly higher SPAD compared to unfertilized wheat. Straw management influence on the maximum quantum efficiency of PSII (Fv/Fm) was negative and significant only in 40% of the tested cases. Fertilization significantly increased Fv/Fm. The influence of soil tillage system on Fv/Fm was insignificant.

Key words: *Triticum aestivum* L., fertilization, SPAD, Fv/Fm.

Acknowledgement: the study presents research findings, obtained through project „The influence of long-term contrasting intensity resources management on genesis of different soils and to other agro-ecosystems components (SIT-9/2015) financed by Research Council of Lithuania.

LONG-TERM CHANGES IN DURATION OF VEGETATION SEASON OF WINTER WHEAT UNDER CLIMATE WARMING IN NORTH LITHUANIA

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The rebirth of phenology is a specific feature of the last decades and recently phenological observations usually are treated as a source of the most sensitive data of plant response to climate change. The objective of this study is to examine climate warming related the long term (1961–2015) changes in duration of both – initial (pre-winter) and main (post-winter) winter wheat vegetation seasons, and to present projections of future phenological changes. The data of long-term agricultural investigations (1961-2015) which include phenological observations and were performed in Joniškėlis Experimental Station of the Lithuanian Research Centre for Agriculture and Forestry were used for this study. The latest generation of climate change scenarios which are based on the Representative Concentration Pathways (RCPs) approach is used to project annual and monthly temperature for the near (2011–2040), middle (2041–2070) and far (2071–2100) future. This study covers two (optimistic and pessimistic) scenarios for future concentrations of greenhouse gases and future climate conditions simulated by five Global Circulation Models (GCM). Phenological projection is based on thermal accumulation approach, “leave one out” is applied for the cross validation of phenological model.

Appreciable changes in duration of both parts of winter wheat vegetation seasons are defined over investigated 55 years period. An essential delay of emergence phase (13.5 days) and a very slight delay in the beginning of winter dormancy (0.5 day) resulted in the shortening of pre-winter vegetation period by almost two weeks. More essential advancement of green-up after winter dormancy (12 days) than maturity phase (7 days) led to extension of main (post-winter) vegetation season by five days. More essential advancement of maturity than green-up phase and consequently shortening of post-winter vegetation period is foreseen for both analyzed (RCP 2.6 and RCP 8.5) climate change scenarios. According to pessimistic RCP 8.5 scenario advancement of winter wheat maturity phase by almost 30 days and shortening of post-winter vegetation season by 15 days is foreseen for far (2071–2100) projection. Correction of agricultural practice and modification of winter wheat cultivars should be considered as necessary options in order to adopt ongoing climate changes. An essential decrease (33 days) in duration of winter dormancy is projected according to the same scenario, however, taking into account that in higher latitudes climate warming lead to prolonged chilling period and earlier fulfillment of chilling

requirements, projected decrease in the duration of winter dormancy period do not pose threat of plant vernalization shortage in the investigated geographical region.

Key words: winter wheat, vegetation season, dormancy, thermal time, climate change scenarios, phenological projection.

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BELOW-GROUND CARBON SEQUESTRATION UNDER CLIMATE CHANGE

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Global changes such as elevated atmospheric CO₂ and temperature are altering the input rates of carbon to plant and soil.

In order to study carbon sequestration in below-ground of different crop species, closed growth chamber experiment was performed with winter wheat and summer rape in a controlled environment at ambient [21 °C 400 ppm⁻¹] and elevated [25 °C 800 ppm⁻¹] temperature and CO₂ conditions. Measurements of carbon sequestration were carried out after 28-days duration of treatment. Carbon content was measured with Shimadzu TOC solid sample module SSM-5000A.

The results showed that after 4 weeks of treatment under elevated temperature and CO₂ conditions winter wheat have sequestered bigger amount of carbon (38.8% C) in roots than summer rape (36.8% C). Roots of wheat under conditions of [25 °C 800 ppm⁻¹] have sequestered significantly bigger (6.0%, $p < 0.05$) amount of carbon, as compared to conditions of [21 °C 400 ppm⁻¹]. Contrary, roots of rape under conditions of [25 °C 800 ppm⁻¹] have sequestered less carbon (-1.9%), as compared to [21 °C 400 ppm⁻¹], however the difference was not statistically significant ($p > 0.05$). Similarly there was a very small change in rape soil carbon under elevated climate condition (0.6%, $p > 0.05$), by contrast amount of carbon in wheat soil increased to 22% ($p > 0.05$) under conditions of [25 °C 800 ppm⁻¹] after 4 weeks of treatment. Also it was estimated, that while increasing carbon in wheat roots, soil carbon also increased ($r = 0.9$, $p < 0.05$).

Our results suggest that under future elevated temperature and CO₂ conditions winter wheat will sequester more carbon in below-ground. However elevated temperature and CO₂ conditions did not significantly affect amount of carbon in rape roots and soil.

Key words: below-ground carbon, closed chamber method, summer rape, winter wheat.

Acknowledgement: this research was funded by a grant (No. SIT-8/2015) from the Research Council of Lithuania.

CHANGES IN BIODIVERSITY OF SHORT AND LONG- TERM USE OF GRASS-LEGUME GRAZING SWARDS

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Climate change and various management practise modernization can be expected to affect grassland productivity, fodder quality and production risks. Legumes in intensively or less intensively managed grasslands are key option to fulfil ecosystem services. Swards of legume and grass species in grasslands are logical solution for improving provisioning ecosystem service. Although a greater variability of legume and grass mixtures production also could be presumable. Therefore the assessment of climate change and grassland functionality interactions is important for useful solutions for ecosystem sustainability and efficiency of farming.

Legume and grasses were sown in mixtures and measurements made over 12 years of grazing periods under grazing on gleyic loamy Cambisol near Dotnuva, Lithuania (55°24'N, 23°50'E). The soil pH varied from 6.5 to 7.0, humus content was 2.5-3.2 %, available P 50-80 mg kg⁻¹ and K 100-150 mg kg⁻¹ of soil. In field experiment were sown mixtures: white clover and perennial ryegrass; white clover, perennial ryegrass and smooth-stalked meadow grass; lucerne, perennial ryegrass and smooth-stalked meadow grass; white clover, lucerne and perennial ryegrass; perennial ryegrass without nitrogen fertilization; perennial ryegrass fertilized with 240 kg N ha⁻¹ yr⁻¹; white clover and *Festulolium* hybrid. All swards received 26 kg P ha⁻¹ and 50 kg K ha⁻¹ at the beginning of spring. The perennial ryegrass received 60 kg N ha⁻¹ in spring and after the first, second and third grazing. The grazing period lasted from the beginning of May until middle of October with four-five grazing at 25-40 day intervals. Proportion of legumes within grazing period had positive effect on providing more even distribution yield over seasons. If we accept that grass-legume swards with ca. 30-50 % of legume are an optimal system, it is that alfalfa fulfill this option in more grazing seasons. Favouring presence of white clover in grazing swards was observed in short-time use of swards and in long-term of use proportion of legumes depends on climatic conditions. Dry matter yield of swards with white clover showed greater variation within seasons than swards with lucerne. Changes of legume proportion and yield over several grazing seasons result declining more slowly in swards with lucerne.

Key words: biodiversity, grazing swards, legumes, sward yield.

Acknowledgement: the study presents a part of the long-term LRCAF program 'Bio-potential and Quality of Plants for Multifunctional Use'.

SORPTIVE PROPERTIES OF AGRICULTURALLY USED ORGANIC SOILS

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Peat soils used to be drained to obtain fertile agricultural land. After drainage, peat soils undergo the moorsh-forming process which causes changes in chemical composition of these soils.

For this reason the study of drained peat soils that were intensively used in agriculture for 150-160 years was undertaken. Basic soil properties and sorptive capacity were examined in soil samples taken in 1980 and 30 years later.

Soil samples were taken from surface and subsurface horizons. Loss-on-ignition (LOI) was determined after dry ashing of soil samples during 6 hours at a temperature of 550 °C. Soil reaction was determined potentiometrically in water and potassium chloride. The base exchangeable cations (Ca^{2+} , Mg^{2+} , K^{+} , Na^{+}) were extracted by a 1.0 M ammonium acetate and determined using AAS method. Exchangeable hydrogen (H^{+}) was determined in barium chloride and triethanolamine buffer solution (BaCl_2 -TEA). Cation exchange capacity (CEC) and base saturation (BS) were calculated based on exchangeable cation content.

In all studied soil formations, the prevailing exchangeable cation was Ca. Studied formations contained quite high amounts of H^{+} , especially in the soil samples taken in 1980. Cation exchange capacity and H^{+} decreased over the 30-year period. Lower cation exchange capacity (CEC) was found in surface formations as compared to underlying layers.

Sorptive properties of studied soils changed after drainage and long-term use and these changes were negative.

Key words: base saturation, calcium cation, cation exchange capacity.

ECOLOGICAL VALUE OF FODDER BEANS IN INCREASING OF SOIL FERTILITY

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Beans are a cheap source of vegetable protein for the food and fodder purposes and one of important the environmental links on which the balance of organic substance in the soil depends. Use of fodder beans in crop rotations can have huge ecological value as it allows improving considerably physical and chemical properties of the soil, to increase its fertility, having reduced at the same time consumption of nitrogen fertilizers. At the same time, complex researches on studying of ways of crops, norm of seeding and backgrounds of food of high-yield and high-protein crop in conditions to the Republic of Tatarstan were not carried out. It has formed the basis for carrying out researches on an assessment of methods of cultivation on productivity and quality of grain of fodder beans and her activity of a symbiotic nitrogen fixation, as has defined relevance of research. Formation of high productivity of grain ($2,34 \text{ t ha}^{-1}$) of field beans is noted against application of designated doses of mineral fertilizers on $2,5 \text{ t ha}^{-1}$ at a wide-row seeding method with seeding rate of 0,6 million pieces per hectare, increase in seeding rate from 0,4 million of fertile seeds to 0,8 million pieces per hectare, increased the content in grain of a crude protein, led to decrease in content of crude cellulose, fat and ashes. Mineral fertilizers increased the content of crude protein and sugars in grain. Big number (39,6 and 42,3 pieces per plant) of nodules on one plant is received, at wide-row seeding methods with seeding rate of 0,6 million pieces per hectare on both nutrient statuses. Bigger accumulation of mass of nodules per 1 hectare of crops ($227\text{--}238 \text{ kg ha}^{-1}$) were in a phase of formation of fruits against application of NPK on $2,5 \text{ t ha}^{-1}$, at wide-row seeding methods (45 and 60 cm) with seeding rate of 0,6-0,7 million pieces per hectare.

Key words: fodder beans, nitrogen fixation, nodule bacteria, yielding capacity.

VARIATION IN SOIL CARBON, NITROGEN, AND SULPHUR CONTENTS IN LONG-TERM FERTILISATION EXPERIMENT IN CZARNY POTOK

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In spring of the 48th year of long-term fertilisation experiment, soil samples were collected from the mountain meadow. The experiment included 8 fertilising objects with full NPK fertilisation and with control fertilisation. Since 1985, the experiment has been conducted in two series: unlimed and limed. Botanical composition and plant yield were formed under experimental conditions and they greatly affected the soil properties. Soil properties are important from the point of view of sustainable agriculture and conservative livestock rearing. Changes in acidification were primarily caused by fertilisation with nitrogen, and liming every 10 years significantly balanced this negative effect. Mineralisation of organic matter by liming increased the total nitrogen content and, consequently, significantly narrower C:N ratio was observed. The C:N and C:S ratios cannot be valid indicators of pratotechnic treatments. It is due to the high dynamics of sulphur, nitrogen and carbon cycles caused not only by liming, but also diversity in plant yield.

Key words: macroelement ratios, meadow sward yield, acidification.

LAND USE STRATEGY FOR SUSTAINING SOIL RESOURCES AND SOCIETY: A CASE OF GRAIN PRODUCTION IN KAZAKHSTAN, CENTRAL ASIA

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In order to avoid or mitigate the risk of land and soil degradation, must be established an appropriate land and soil management strategy, which is practically sound and scientifically verified. Summer fallowing has been commonly practiced in wheat-based farming systems. However, it has often been reported that this practice had accelerated organic matter decomposition. We studied whether summer fallowing is beneficial to sustainable grain production from the viewpoints of soil moisture and organic matter dynamics and soil quality change.

The experiment was conducted in northern Kazakhstan, where soils are Haplustolls with mean annual temperature of 1.6 °C and total annual precipitation of 324 mm, with the treatments of a variety of the frequencies in summer fallowing and other water-harvesting management techniques, i.e. snow collection and subsoil cutting. Soil moisture, temperature and CO₂ emission were regularly monitored and plant biomass was recorded. To evaluate the soil quality change, potential mineralizable C (PMC) and N (PMN), and mineralized N (min-N) and light (SG<1.8 g cm⁻³) fraction organic matter (LF-C and LF-N) were analyzed besides routine physico-chemical characterization of soils. Summer fallowing and snow collection practices accumulated additional ca. 100 mm moisture (0-90 cm soil) when practiced individually. When together, the benefit of 100 mm moisture from snow collection was, however, cancelled by summer fallowing due to surface runoff and evaporation in spring because of subsoil freezing. Soil organic matter (SOM) dynamics in a cropping season exhibited that the output was 2.5-3.0 Mg C ha⁻¹ and the input ranged from 0 (fallowing) to 2.5 (cropping wheat), being the budget of -2.9 and -0.2 Mg C ha⁻¹ under fallowing and cropping, respectively. SOM content was estimated to decrease in a conventional rotation cycle (with summer fallowing) for 5 years by 2.9 Mg C ha⁻¹. SOM degradation was detected with the soil characteristics affecting microbial activity, i.e. PMC and LF-C. Soil N fertility increases through conversion of PMN into min-N, which is, however, subject to surface runoff and/or leaching at the snow thawing period in spring before taken up by crops. An extensive and uniform application of summer fallowing is not always beneficial, and thus, an alternative soil and land management technology must be developed with taking account of snow-collection-based water harvest management and its site-specific application in accordance with soils and topographical conditions.

Key words: soil organic matter, soil moisture, rotation system, summer fallowing, mechanized grain farming.

EFFECT OF LONG-TERM CULTIVATION OF LOESS SLOPE ON SOME SOIL PROPERTIES DIVERSITY

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Agricultural terraces are among the most widespread in the world landforms created by man for the needs of soil cultivation on mountain and hill steeply sloping. Terraces create condition for farming and are the dominant elements of rural landscapes in some regions of the World (Southeast Asia, the Andes and the Mediterranean). Geomorphological transformations and cultivation of crops combined with terracing of slopes affect pedogenic changes and the properties of the soil. The degree of conversion of the primary soil cover is varies greatly depending on individual processes, their duration and the sensitivity of the environment. Great examples of the agricultural terrace could be observed on the area of Proszowice Plateau. Spatial profile and diversity of soil particle distribution was investigated within terraces in loess landscape near the Podgaje village (Małopolska district), in the southern part of Plateau. This slope consists of 10 terraces used for agriculture, separated by a high boundary strips. Field studies relied on accurate morphometric measurements of agricultural terraces. Soil sampling was carried out within each terrace and soil was taken in order to study the particle size composition and assessment of its spatial variability. Totally, 80 soil samples were collected. Grain size distribution of each soil sample was determined using the Cassagrande method, modified by Prószyński. Granulometric group names were determined according to the Polish standard BN-78 / 9180-11, and the classification of Polish Soil Science Society. Soils of the well-developed terraces have similar soil texture. In all collected samples dominated dust particles clearly. Soil material was classified as clayey silt (pyi) mainly, and in individual cases silt loam (pyg). Most variable was the content of the smallest particles in soil – clay fraction. The content of clay gradually decreases along the terraces, the lowest values were recorded on the field margins. Each section of the slope – terrace - between the boundary strips creates a partially closed units of soil erosion and accumulation. This configuration results in displacement of silt fraction within the individual terraces and hampering of gravity movement of these fraction downslope from the higher position.

Key words: cultivation, slope, soil properties.

GENOTYPIC AND ENVIRONMENTAL VARIANCE OF MACROELEMENTS IN TUBERS OF COLOURED POTATO VARIETIES

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Coloured-flesh potatoes, rich in nutrients, in particular minerals, are getting more and more popular on the European market. Therefore, the aim of this paper was to determine the influence of genotypic and environmental variance on phosphorus, potassium, calcium and magnesium content in tubers of coloured-flesh potatoes. The results of the study based on a field experiment conducted between 2013-2015 in Central Eastern Poland (49.8333°N; 21.8500°E) on earth based on flysch deposits (mechanical composition: silt loam with slightly acidic pH). It involved a randomised block design and 3 repetitions. The study included 4 potato varieties (Vitelotte, Blue Congo, Red Emmalie, Purple Majesty). Fertilisation remained constant (80 kg N, 35 kg P, 100 kg K and 25 t ha⁻¹ of manure). Potatoes were cultivated according to good agricultural practice. After harvest, tubers were analysed for content of potassium, calcium and magnesium (Atomic Absorption Spectrometry) as well as phosphorus (colorimetry). Statistical evaluation of the results involved an analysis of variance and descriptive statistics. Mineral content in tubers of coloured potato varieties depended on both environmental and genetic factors. One of the most significant environmental factor turned out to be minerals phytoavailability in the earth. The variety containing the most minerals was Purple Majesty, and the least – Vitelotte. Among the macroelements under study, the least fluctuation in potato tubers was demonstrated by magnesium, and the most – by phosphorus. Minerals content in potato tubers under study may be increased by combining genotypes with a naturally higher content of minerals in tubers with the right fertilisation methods in order to achieve the minerals most crucial in diets.

Key words: coloured potato varieties, macroelements, environmental variance, genotypic variance, varieties

QUALITY PARAMETERS OF PUMPKIN SEED OIL FROM DIFFERENT CULTIVARS GROWN IN LITHUANIA

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Pumpkin seed oil is rich in nutrients and can be considered a superfood as it rich in essential vitamins, protein, minerals, antioxidants and good fats. This oil is becoming now more popular because oil quality and great resource of beneficial ingredient appropriate for various illness prevention, especially for cancer, heart and prostate diseases.

The objective of this research was to evaluate quality parameters of pumpkin seeds oil from *Cucurbita pepo* L. 'Miranda', 'Golosemiannaja', 'Herakles' cultivars grown in Lithuania.

Pumpkin seeds oil were analysed by standards methods for peroxide value, acid value, fatty acids, total phenolic contents and antioxidant activity measured by the DPPH method.

The four dominant fatty acids found in pumpkin seed oil - palmitic, stearic, oleic and linoleic. The oil contains an appreciable amount of unsaturated fatty acids (about 83%) and found to be rich source of linoleic acid (66 %). Pumpkin seeds oil recognized as a good source of phenolic compounds. The highest amount of total phenolic was found in seeds of cv. 'Golosemianaja' and 'Miranda'. The highest antioxidant activity was displayed from pumpkin seeds of cv. 'Miranda' and little less – in 'Golosemianaja'. Antioxidant activity increased proportionally to the total phenolic content and a linear relationship between DPPH-radical scavenging activity and total phenolics was established.

The important indicators for oil quality assessment are the acid value and number of peroxide. They have been compared with maximum allowed amount, which were indicated in Codex Standard for Vegetable Oils. The best quality oil was prepared form 'Golosemianaja' seeds.

The best antioxidant properties have been established in pumpkin seed oil of Miranda cultivar. But the best oil quality according to acid value and number of peroxide indicators was in oil prepared form 'Golosemianaja' seeds.

Key words: pumpkin seeds oil, antioxidant activity, quality.

THE EFFECT OF FARMING SYSTEM ON SOIL MICROBIAL HYDROLYTICAL ACTIVITY

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The biological characteristics of the soil, such as microbial activity parameters, are much more sensitive to changes than physical or chemical parameters, therefore it is believed to be a reliable indicator of changes in soil quality. Many studies have shown a negative impact of nitrogen-based fertilisers on soil biological parameters. Winter cover crops, as a type of organic waste, have nitrogen-binding features, which have effect on the succeeding crops.

The aim of the study was to investigate the influence of conventional and organic farming on the soil hydrolytic activity (FDA).

The field experiment was situated at the experimental station of the Estonian University of Life Sciences in Eerika, Tartu, Estonia. In a five-field crop rotation, barley undersown with red clover, red clover, winter wheat, peas and potato were grown in succession. There were two conventional farming systems without winter cover crops and three organic farming systems. Conventional systems were treated with herbicides and fungicides.

There have been a tendency of increase in the hydrolytic activity in 2013, but in 2014-2015 yearly differences were not found ($p < 0.05$). Higher microbial activity was found in organically amended soils. The average results during 2012-2015 show, that the highest hydrolytic activity was in Org II system ($p < 0.05$), where green manures with combination of composted manure were used. Conv I systems 2012-2015 average FDA is the lowest because of the use of herbicides and the lack of any incorporated organic manure. In Conv II system herbicides were also used, but the FDA showed an increasing tendency through the years.

Adding organic manure to field contribute largely in improving soil quality by increasing the microbial activity. The results show a tendency of increase of the hydrolytic activity in all systems.

Key words: microbial activity, organic and conventional farming, soil quality, organic manure.

WEED SPECIES OCCURRENCE IN CEREAL SOWINGS IN KURZEME REGION

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According to the Framework Directive 2009/128/EC on the sustainable use of Pesticides farmers have to follow integrated pest management principles obligatory since 1st of January 2014. For successful integrated weed management data from monitoring of weed population are relevant. Objective. The aim of the weed monitoring is to survey the constant six fields in the farms with different area and to fix weed species and interview the owners about growing technology. Weed surveys were carried out in 14 farms located in the Kurzeme of Latvia in 2013-2015. Methods. Weed surveys were performed from the end of June until the beginning of July, when most of the weeds were well-developed. The surveys were carried out according to the quantitative occurrence method developed by Rasiņš and Tauriņa (1982). The occurrence of each weed species within a 0.02 m² frame was recorded at 100 points in each field. Plant density per m² was calculated from the occurrence data using correlation table based on the negative binomial distribution. Results. Cereals were main crop grown in surveyed fields (68%-81% of all the fields visited). The average weed density in the cereals fields was 102 pcs m⁻² identifying 20 various weed species. In cereals field average 72% annual broad-leaved species, average 12% perennial grass weed species were found. *Elymus repens* (L.) Gould (15.3 pcs m⁻²), *Viola arvensis* Murray (14.2 pcs m⁻²), *Fallopia convolvulus* (L.) Å. Löve (5.9 pcs m⁻²), *Veronica* spp. (4.9 pcs m⁻²), *Polygonum arenastrum* Boreau (3.6 pcs m⁻²) were dominant weed species in surveyed cereal fields. Conclusion. The total number of weed fields surveyed in all three monitoring years was the highest in the smaller farms with occupied area of 100 hectares. The lowest number of weed found in farms with 500-1000 ha managed area. This confirms the earlier hypothesis that larger farms use more efficient weed control techniques.

Key words: weed survey, dominant weed species, cereals

THE CHANGES OF WEED ECOLOGICAL GROUPS IN THE WINTER RYE MONOCROP

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Weed species can be associated with a particular range of conditions, for example pH, site moisture and soil fertility, and on this basis can be given values denoting the position along environmental gradients at which each, on average, reaches peak abundance.

The objective of this investigations was to determine the changes of weed ecological groups in the long-term cultivated winter rye (*Secale cereale* L.) monocrop without / whit fertilization and without / whit spraying with herbicides.

The field experiment was established since 1967 and investigations were carried out in 2003 and 2015 at the Experimental Station of Aleksandras Stulginskis University. Soil – *Calc(ar)i-Endohypogleyic Luvisol*. The treatments of the experiment: 1) without fertilization and spraying with herbicides, 2) with fertilization (N₉₂P₄₅K₇₅) and spraying with herbicides (in autumn – Legacy Pro, 2.0 l ha⁻¹; in spring – Mustang 0.6 l ha⁻¹). The weed classification into ecological groups was done according to Ellenberg et al. (1992).

In 2003 in winter rye monocrop without fertilization and spraying with herbicides dominated *Apera spica-venti*, *Viola arvensis*, *Arenaria serpyllifolia*, *Equisetum arvense*, in 2015 – *Tripleurospermum perforatum*, *Equisetum arvense*, *Cirsium arvense*, *Mentha arvensis*. In 2003 weed species distributed into 6 ecological groups according to soil pH, into 7 groups according to nitrogen demand and into 5 groups according to soil moisture, in 2015 – into 4 groups according to soil pH, into 6 groups according to nitrogen and into 5 groups according to soil moisture. In 2003 and 2015 years the highest abundance of weed belonged to indifferent to soil pH, nitrogen and moisture weed species (growing at wide pH, nitrogen and moisture range). In 2003 the higher abundance was determined of moderately alkaline, dry and moderately moist, moist soil weed species in 2015 – moderately nitrogen rich and nitrogen rich, moist soil weed species. In 2003 in winter rye monocrop with fertilization and spraying with herbicides the most abundant weed species were *Apera spica-venti*, *Viola arvensis*, *Galium aparine*, in 2015 – *Mentha arvensis*. In 2003 weed species distributed into 5 ecological groups according to soil pH, nitrogen demand and soil moisture, in 2015 – into 2 groups according to soil pH, into 3 groups according to nitrogen and into 4 groups according to soil moisture. In 2003 the highest abundance was obtained of moderately alkaline, indifferent to nitrogen, moderately moist and moist soil weed species, in 2015 – indifferent to soil pH, nitrogen and moisture, moist soil weed species.

In the long-term cultivated winter rye monocrop whit fertilization and spraying with herbicides decreased the diversity of weed ecological groups. In winter rye monocrop without / whit fertilization and without / whit spraying whit herbicides the highest abundance of weed belonged to indifferent to soil pH, nitrogen and moisture, moist soil weed species. In long-term cultivated winter rye monocrop without fertilization and spraying with herbicides the higher abundance was determined of moderately nitrogen rich and nitrogen rich weed species.

Keywords: winter rye, monocrop, fertilization, spraying with herbicides, weed ecological groups.

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THE IMPACT OF BIO-ACTIVATORS AND NON-CHEMICAL WEED CONTROL SYSTEMS ON WINTER OILSEED RAPE PRODUCTIVITY AND SOIL PROPERTIES

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Organic farming is spreading because of the concerns about environment protection, health issues, and search for ways of novel social problem-solving methods. The cultivation of organic oilseed rape in farms boosted the requirement for the healthy, pesticide residues free food.

The objective of these investigations was to determine the impact of bio-activators and non-chemical weed control systems on winter oilseed rape (*Brassica napus* L.) seeds yield and soil biological properties in the organic farming.

The field experiment was conducted in 2014 and 2015 at the Experimental Station of Aleksandras Stulginskis University. Soil – *Calc(ar)i-Endohypogleyic Luvisol*. Treatments of the experiment: factor A: weed control systems: 1) thermal (water steam), 2) mechanical (inter-row loosening), 3) smothering (self-regulation); factor B: bio-activators: 1) no application, 2) with application.

It was established that significantly highest yield of the winter oilseed rape seeds was obtained in plots where mechanical weed control method was used, it was from 11.7 to 56.8 % higher compared with plots where thermal weed control method and smothering was used. The use of bio-activators, as compared to their non-use, significantly increased the yield of oilseed rape seeds in the plots where thermal (43.4 %) and mechanical (25.1 %) weed control was used. The yield of oilseed rape seeds depended on the crop density ($r = 0.86$, $P < 0.05$). The use of bio-activators and different non-chemical weed control systems had no significant influence on the soil enzyme urease activity. The use of bio-activators and application of the mechanical weed control system significantly, by 7.8 % inhibited the activity of enzyme saccharase in the soil, compared with smothering. The use of bio-activators in the plots where smothering system was used, as compared to their non-use, significantly (14.6 %) stimulated the activity of enzyme saccharase. Different non-chemical weed control systems had no significant influence on the number and biomass of earthworms. The use of bio-activators in the plots where smothering was used, as compared to their no application, significantly, by 67.3 % increased the biomass of earthworms. The biomass of earthworms depended on the soil saccharase activity ($r = 0.85$, $P < 0.05$).

The significantly highest yield (2.3 t ha^{-1}) of the winter oilseed rape seeds was estimated in plots where mechanical weed control and bio-activators were used. The highest activity of soil enzyme saccharase and highest biomass of earthworms was determined in plots where smothering system with bio-activators were used.

Keywords: winter oilseed rape, weed control systems, bio-activators, organic farming, productivity.

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INFLUENCE OF GENOTYPE ANT METEOROLOGICAL CONDITIONS ON SEED PRODUCTIVITY OF FLAT PEA (*LATHYRUS SYLVESTRIS*)

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Flat pea (*Lathyrus sylvestris* L.) is a member of the family *Fabaceae*, native to Europe, parts of Africa and Asia. Flat pea is adapted to a wide range of soils and tolerant of numerous environmental factors that restrict the growth of many other plant species. Flat pea is a long-lived erosion control plant that can grow on severely disturbed soil under acid conditions and begin a soil improvement process as well used as living mulch. Flat pea possesses numerous characteristics that make it a potentially valuable agricultural species.

Influence of genotype ant meteorological conditions on seed productivity of 12 flat pea genotypes of different geographical origins grown under equal field and agrotechnic conditions were investigated in 2011–2015 m. Phenological observations of vegetation stages were performed. The morphological evaluation of plants included stem height, number of inflorescences, flowers and pods per stem, number of ovules and seeds per pod and plant. Diseases activity and severity was estimated with the Horsfall scale. The research data shows, that the meteorological conditions had a decisive influence on flat pea height of stem, number of inflorescences, seed productivity as well as the spread of fungal diseases, especially downy mildew caused by *Peronospora viciae*. Height of stem correlated positively with pod ($r = 0.68$) and seed number ($r = 0.63$) per stem. Number of ovules per pod was the most stabile characteristic ($V = 4.2\%$), while most variable were numbers of pods and mature seeds per stem ($V = 55.9$ and 56.3% , respectively). Resistance to downy mildew of the genotypes correlated directly with the number of pods per stem, number ovules per pod and especially number of seeds per stem ($r = 0.65$; 0.62 and 0.69 , respectively). The reduction of numbers of flowers and pods per stem may be partly affected by leaf loss due to downy mildew.

Key words: flat pea (*Lathyrus sylvestris*), productivity, seed, resistance, downy mildew (*Peronospora viciae*).

FLORAL COMPOSITION AND EFFECT OF DIFFERENT CATCH CROPS ON CROP WEEDINESS IN ALTERNATIVE FARMING SYSTEMS

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Alternative farming systems are used to cultivate high quality food products and retain the viability and fertility of soil. Field experiments of different agricultural systems were conducted at Joniškėlis Experimental Station of the Lithuanian Research Centre for Agriculture and Forestry in 2006–2014. The soil of the experimental site was *Endocalcari-Endohypogleyic Cambisol (CMg-n-w-can)*. The research objective was to investigate the capacity of plants cultivated as catch crops to smother weeds in organic and sustainable farming systems. The floristic composition and smothering capacity of the catch crops cultivated for green manure were carried out by cultivating them during the post-harvest period of winter wheat. The competitiveness, or smothering capacity, of agricultural plants is the main mechanism of indirect weed control, allowing the reduction of direct methods; however, it does not ensure productivity. The direct damage done by weeds depends on the ratio between soil surface coverage of agricultural plants and weeds. This experiment established that catch crops have a strong positive smothering capacity on weeds and germinated voluntary plants. It also demonstrated that narrow-leaved lupine in combination with oil radish, cultivated in the organic agrosystem, was less effective at smothering weeds compared with white mustard cultivated as a sole crop or in combination with buckwheat. In a rotation without catch crop cultivation in soil with low and moderate humus content, the number of weeds was two to three times higher, and the mass was four to five times higher compared with the agricultural systems with catch crops. A correlation-regression analysis established that the catch crops had a higher effect on the biomass of weeds and voluntary plants in soil with low humus content. The highest influences on voluntary plant and weed mass in soils with both humus contents were obtained using white mustard and a mixture of white mustard and buckwheat as catch crops.

Key words: catch crops, floristic composition, voluntary plants, weeds, smothering capacity.

AGROECOSYSTEMS CONTRIBUTION TO SEASONAL CARBON EXCHANGE IN TEMPERATE CLIMATE OF CENTRAL LITHUANIA

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The increasing anthropogenic CO₂ emissions into atmosphere force the choice of grown crops aimed at mitigate climate change. Carbon exchange in ecosystems or net ecosystem production (NEP) is defined as the difference between gross primary production and total ecosystem respiration, and represents the total amount of organic carbon in an ecosystem available for storage in biomass. These gains and losses is a fundamental property of ecosystems that are is becoming an important challenge for the agro sector.

For this reason, investigations of seasonal carbon exchange were carried out in 2013–2016 at the Training Farm of Aleksandras Stulginskis University, Lithuania. The aim was to investigate and compare carbon exchange rate of different crops, viz. maize, grassland, winter wheat, spring rapeseed and barley of conventional farming.

This study comprised carbon exchange rate, specifically, emitted and absorbed CO₂ fluxes ($\mu\text{mol m}^{-2}\text{s}^{-1}$) applying closed chamber method. The biomass measurement (g m^{-2}) and leaf area index (LAI, $\text{m}^2 \text{m}^{-2}$) calculation at different plant growth stages were used to evaluate carbon exchange in different agro ecosystems.

The differences in photosynthetically assimilated CO₂ rates were significantly impacted by leaf area index ($p=0.04$) during plant vegetation period. The significant ($p=1.02$ and 0.50) strong correlation ($r=0.6-0.7$) exist between soil respiration (Rs) and LAI. Soil respiration composed only 21% of agroecosystem carbon exchange. Plant respiration (Ra) ranged between 0.034 and $3.613 \mu\text{mol m}^{-2}\text{s}^{-1}$ during vegetation period composing negligible ratio (mean 16%) of carbon exchange. Generally, respiration emissions were obviously recovered by crops gross primary production (GPP). Therefore the ecosystems were acting as atmospheric CO₂ sink. Rapeseed accumulated the lowest mean GPP $11.46 \mu\text{mol m}^{-2}\text{s}^{-1}$. The highest mean GPP was determined for grassland ($15.36 \mu\text{mol m}^{-2}\text{s}^{-1}$) and maize ($14.38 \mu\text{mol m}^{-2}\text{s}^{-1}$) due to the biggest LAI and bio-characteristics.

Consequently, grassland ($12.73 \mu\text{mol m}^{-2}\text{s}^{-1}$) and maize ($11.67 \mu\text{mol m}^{-2}\text{s}^{-1}$) agroecosystems sank the highest C from the biosphere, and thus might be considered the most sustainable item between the investigated crops.

Key words: CO₂ fluxes, bio-parameters, crops.

C₄ WEED *ECHINOCHLOA CRUS-GALLI* INTERFERENCE WITH PEA INCREASES UNDER ELEVATED CO₂ AND TEMPERATURE

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C₄ weed *Echinochloa crus-galli* is one of the most troublesome weed in the world. The investigations of its competitive ability with crops can provide decisions for this weed management under changing climate.

The aim of this study was to investigate the C₄ weed barnyard grass (*Echinochloa crus-galli* L.) interference with pea (*Pisum sativum* L.) under future elevated temperature and CO₂ conditions. For this reason, the pot experiments were carried out in closed controlled environment plant growth chambers located at Department of Environmental science of Vytautas Magnus University, Lithuania. The growth of pea was evaluated with and without the presence of barnyard grass at ambient [21 °C 400 ppm⁻¹] and elevated [25 °C 800 ppm⁻¹] temperature and CO₂. Measurements of roots and shoots dry mass and length were carried out at 14-day after the treatment.

The growth of barnyard grass was increased significantly ($p < 0.05$) by raising temperature and the CO₂ concentration and in both mono- and multi culture with pea. It was observed that elevated [25 °C 800 ppm⁻¹] temperature and CO₂ conditions have resulted in higher both shoots and roots dry mass production and enhanced length of barnyard grass in comparison with ambient [21 °C 400 ppm⁻¹] conditions. In contrast, growth of pea under condition of [25 °C 800 ppm⁻¹] was stimulated only in monoculture. Barnyard grass growth enhancement in mixture with pea in response to higher temperature and CO₂ enrichment was 1.6 times greater in shoots and 3.2 ($p < 0.05$) times greater in roots than in monoculture. While, pea results demonstrated that when grown in mixture with C₄ weed barnyard grass under condition of [25 °C 800 ppm⁻¹] the shoots and roots dry mass were significantly reduced by 11.5% and 26.4% ($p < 0.05$) respectively.

The results suggest that barnyard grass, the C₄ weed, competitiveness may be enhanced in future warmer climate and in multiculture with legumes.

Key words: Climate change, competition, barnyard grass, pea

Acknowledgement: the study was implemented within a scope of the project „Integrated impact of climate change and environmental changes to the productivity, biodiversity and sustainability of agro-ecosystems“ (SIT-8/2015). Funding for this project was provided by Research Council of Lithuania within the National Research Programme „Sustainability of agro-, forest and water ecosystems“.

THE EFFECT OF NON-CHEMICAL WEED CONTROL ON SOIL BIOLOGICAL PROPERTIES IN THE SPRING OILSEED RAPE CROP

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Soil enzymes activity and abundance of earthworms are the important indicators of soil quality in the organic farming system. The objective of these investigations was to establish the effect of non-chemical weed control on plant root development, soil enzymes activity and abundance of earthworms in the organically grown spring oilseed rape (*Brassica napus* L.) crop cultivated in a soil with a regular and thickened humus layers. The field experiments were conducted in 2013–2015 at the Experimental Station of Aleksandras Stulginskis University. Soil – *Calc(ar)ic Endohypogleyic Luvisol*. Treatments of the experiment: weed control systems: 1) thermal (water steam), 2) mechanical (inter-row loosening), 3) smothering (self-regulation). Thermal and mechanical weed control were applied in oilseed rape crop cultivated at a wide row spacing of 48 cm, smothering – at an inter-row spacing of 12 cm. Spring oilseed rape was cultivated in a soil with a regular (23–25 cm) and thickened (45–50 cm) humus layers. It was determined that the highest biomass of spring oilseed rape roots (on average 1.68 t ha⁻¹) was formed in a soil with a regular humus layer where mechanical weed control was applied. The biomass of oilseed rape roots depended on the crop density ($r = 0.82-0.96$, $P < 0.05$). In a soil with a regular humus layer different non-chemical weed control systems had a low influence on soil enzymes activity. In a soil with a thickened humus layer the significantly strongest activity of soil enzymes saccharase and urease, to compare with other treatments used, in 2013 and 2014 was obtained in plots where thermal weed control was applied, and in dry 2015 year – where smothering was used. In a thickened humus layer, as compared to regular one, the activity of urease was significantly (1.5–1.6 times) higher in 2013; and in 2015 – in plots where thermal weed control was applied, also in plots where smothering was used (2.8 times). The activity of saccharase significantly 1.8 times increased in 2015 in smothering plots. Soil enzymes activity depended on the soil agrochemical properties. In a soil with a thickened humus layer the highest number and biomass of earthworms was established in 2013 in plots where thermal weed control was applied, in 2014 and 2015 – where smothering was used. In a thickened humus layer, as compared to regular one, the number and biomass of earthworms significantly 1.5 and 1.6 times increased in 2014 in plots where mechanical weed control was applied, in 2015 – in plots where smothering was used, accordingly 2.6 and 3.1 times. The abundance of the earthworms depended on the soil enzymes activity and soil agrochemical properties. The biomass of spring oilseed rape roots significantly increased with increasing crop density. Significantly strongest activity of soil enzymes saccharase and urease and the highest abundance of earthworms was determined in a soil with a thickened humus layer in plots where

thermal weed control and smothering was applied. The positive effect of thickened humus layer on soil biological properties, as compared to regular, was higher in the dry years. Soil enzymes activity and abundance of earthworms depended on meteorological conditions and soil agrochemical properties.

Key words: spring oilseed rape, weed control systems, soil enzymes, earthworms, roots, organic farming.

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FREE AND INDISPENSABLE AMINO ACIDS IN THE FOREST SPEPPE ZONE OF THE VOLGA REGION AND EFFECTIVENESS OF CHELATE MICROFERTILIZERS

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The middle Volga region is the largest farming area in Russia. Optimization of nitrogen in agrocoenosis is closely connected with its nitrogen content and quantity and quality nitrogen forms which easily can be obtained by plants. Amino acids play an important role in nitrogenous metabolism of soil and plants.

Our aim was to identify nitrogen components' contents in the soils of Tatarstan Republic that is why we have researched Shkond and Karolyova acid hydrolysates (1964) and content and structure of indispensable amino acids and in alcohol extract it has been researched free amino acids. Withdrawn from the soil amino acids have been found out with automatic amino acid explorer.

Amino acid content of researched soils is lack of variety. In all types of soil there are dicarboxylic acids as asparagines acid, glutamine acid; neutrals are glycine, alanine, serine, threonine, valine, leucine, isoleucine; cyclical as phenylalanine, tyrosine, proline and diaminocarboxylic acids as lysine, arginine, histidin the latest two are only in traces. In total 15 free amino acids have been determined and identified, only in average gray ash soil there are 14 amino acids where there is no proline. We proved high effectiveness of chelate micro fertilizers in the spring wheat experimental fields. Glycine has been applied as a chelate fertilizer. Experimental design was to research effectiveness of applying different chelate copper and zinc to the soil with spring wheat. Copper and zinc chelates have been got with the help of solution of adequate amount of inorganic salts with glycine with the ratio of 1:3. Copper and zinc chelates in liquate fertilizer complexes with the level 2 kg ha⁻¹ gave practically equal statistically valid crop addition yield 3.7 and 3.6 hundreds of kg per hectare. There are some substantial differences in separate amino acid groups. In all types of soil neutral amino acids are more (64-73%), there are less dicarboxylic acids (11-29%) and cyclical acids are (5-11%), and very little is diamine carboxylic acids (1-7%). Effectiveness of application of these acids has been proved in the experimental spring wheat fields. Chelate copper, zinc micro fertilizers with amino acids as glycine using in the content of liquate fertilizer complexes gives the addition yield of crop as 3,5-4 dt ha⁻¹.

Key words: nitrogen, amino acids, physiologically active substances, humus, soil, plants.

NEAR-INFRARED SPECTROSCOPY AS A TOOL TO APPREHEND SOIL FERTILITY

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Climate change potential effects on soil fertility and the ability of crops to acquire and utilize soil nutrients is poorly understood but essential for the future of global agriculture. Soil fertility estimation is complex and require many expensive and time consuming analyses. Visible and near-infrared spectroscopy (VIS-NIRS) allows simultaneous analyses of several chemical and physical soil constituents. It is cheap, easy to use and do not require environmentally harmful chemicals. Precision agriculture can support the needs to match nutrient availability to plant needs so that nutrients will not be a limiting factor for plant development.

For this reason we assessed the capability of VIS-NIRS as a rapid and non-destructive analytical method to predict a range of soil fertility parameters.

I) crop rotation A- (potato, winter wheat, spring barley and corn silage), and B- with (potato, winter wheat + mustard, spring barley and a mixture of clover with grasses).

II) five levels of increasing doses of wet manure, 0, 20, 40, 60 and 80 t·ha⁻¹.

III) application of four levels of mineral nitrogen fertilizers at rates suitable for species N requirements: N0- no nitrogen, N1- 170 kg N ha⁻¹ in crop rotation A and 275 kg N ha⁻¹ in crop rotation B, N2- 340 kg N ha⁻¹ in crop rotation A and 550 kg N ha⁻¹ in crop rotation B and N3- 510 N ha⁻¹ in crop rotation A and 825 kg N ha⁻¹ in crop rotation B per rotation.

Soil organic carbon (SOC), total nitrogen content (N), P₂O₅, K₂O were analysed.

Spectral analysis was performed using Veris® VIS-NIR spectrophotometer (350-2220 nm) using Veris software V1.83.

The best models are usually for N and SOC content because of the direct response in the NIR band. Other macronutrients are well predicted with e.g. $0.6 < r^2 < 0.9$ (predicted vs. measured) and RMSE of around 1 to 3% for P and K and generally less than 0.1% for N.

Key words: VIS-NIRS, crop rotation, macro nutrients.

INFLUENCE OF COMPACTING AND LAND CULTIVATION SYSTEMS ON SOIL COMPACTNESS AND YIELDS OF CROPS IN THE ROTATION SYSTEM

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The aim of the work was to evaluate of the influence of compacting and different cultivation methods on soil compactness and yields of crops cultivated in the rotation system sequence - winter rapeseed, winter wheat and spring barley.

The experimental factors were: I-level of pre-sowing soil compacting (control lot without compacting, a lot with soil compacting after harvest of the fore crop, II-different methods of field preparation before sowing of the crops cultivated. The sequence and choice of fore crops preceding the sowing of experimental crops. Winter oilseed rape: after harvest U1 (skimming 10 cm+harrowing), U2 (chisel+diskcultivator+harrowing+ cultivating), U3 (skimming 10 cm+harrowing), U4 (without tillage); before harvest U-1 (sowing ploughing 20 cm), U2 (sowing ploughing 20 cm), U3 (without tillage), U4 (single ploughing 30 cm). Winter wheat: after harvest U1 (skimming 10 cm+harrowing), U2 (rotary cultivator), U3 (diskcultivator+harrowing+cultivating), U4 (chisel); before harvest U1 (sowing ploughing 20 cm), U2 (sowing ploughing 25 cm), U3 (sowing ploughing 20 cm), U4 (single ploughing 30cm).

Spring barley: after harvest U1 (skimming 10 cm+harrowing), U2 (skimming 10 cm+harrowing + cultivating), U3(cultivator), U4 (without tillage); before harvest U1(winter ploughing 30 cm), U2 (winter ploughing 25 cm), U3 (winter ploughing 30 cm), U4 (single ploughing 30 cm).

During the stage germination of the winter rapeseed, at the depth to 20 cm (lots without compacting) after U-2 cultivation, the resistance of the soil. During the wheat stem elongation stage on the lots without and with compacting, the highest soil compactness was found at the depth of 20-30 cm after U-3 cultivation. Following the spring barley harvest, in the lots without compacting, significantly higher soil resistance was found after applying full tillage cultivation (depth 10-20 cm).

Key words: soil packing, soil tillage, crop yield, soil compaction.

ANTHROPOGENIC TRANSFORMATION OF SOILS IN YOUNG GLACIAL LANDSCAPE IN NORTH-EASTERN POLAND

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The land relief of young glacial region of northern Poland was shaped during the Vistula glaciation. The development of agriculture caused changes in land use and intensification of anthropogenic denudation processes.

The aim of the research was to examine the origin and directions of the evolution of alluvial and deluvial soils in young glacial landscape.

The research was carried out by catena method in the landscape of ice-dammed lakes origin, in morainic landscape, in Łyna river and Vistula deltas.

The obtained results of radiocarbon dating of fossil peat soils revealed that the accumulation of deluvial deposits in the zone of ice-dammed lakes origin began in Subboreal period. The age of 60-cm-deep deposit was dated at 3410 ± 35 years BP. Average rate of accumulation of deluvial deposits was very slow and amounted to 0.18 mm per year. In morainic zone, the beginning of deluvial accumulation was dated from Subatlantic period, 1085 ± 30 years BP, to Subboreal period, 4325 ± 30 years BP. The thickness of deluvial deposits ranged between 65 and 107 cm. The average rate of deluvial accumulation was faster than in the zone of ice-dammed lakes origin and ranged between 0.27-1.00 mm. In Łyna river valley the deposition of alluvial - sediments on fossil peat soils began approximately 5720 ± 40 years BP. These sediments are now 100 cm thick. In delta landscape, alluvial sediments on peats began accumulating much later. In Vistula delta, the deposition began 2850 ± 35 years BP. The thickness of alluvial layers in delta landscape ranged between 80 and 86 cm.

The rate of accumulation of denudation deposits depend on deposits texture, slope gradient and local conditions. The scale and time shift of the beginning of accumulation of deluvial deposits are related to the selected overtaking of land for agricultural purposes.

Key words: deluvial and alluvial soils, ice-dammed lakes, morainic landscape, delta river.

EFFECT OF STORAGE CONDITIONS ON THE CHEMICAL COMPOSITION OF *ACTINIDIA KOLOMIKTA* FRUITS

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Actinidia kolomikta fruits are evaluated as a healthy fruits because of high content of ascorbic acid and their antioxidant activity. But the fresh fruit can be stored for only two weeks in the refrigerator. Storage time are prolonging on creating optimal conditions.

Investigations were carried out at the Aleksandras Stulginskis University, Lithuania, in 2015. Object of the research was fruits of *Actinidia kolomikta* (Maxim. & Rupr.) Maxim.) cultivars 'Lankė', 'Landė', 'Laiba', 'Paukštės Šakarva'. The aim of the research was to analyse the changes in basic chemical parameters of *Actinidia kolomikta* fruits during ripening in the controlled atmosphere chambers.

Fruits were stored in controlled atmosphere chambers for 6 weeks in the same temperature (0 °C) and humidity (90 %), but in different air composition (No. 1. – 21 % O₂, 78 % N₂; No. 2. – 0,5 % O₂, 98,5 % N₂, 1 % CO₂; No. 3 – 1,5 % O₂, 95,5 % N₂, 3 % CO₂; No. 4. – 2 % O₂, 93 % N₂, 5 % CO₂, 0,03 ppm C₂H₄).

Dry matter content was determined by drying the samples to constant mass at 105 °C; soluble solids content – by refractometric method; ascorbic acid – by titration with 2,6-dichloroindophenol sodium salt; chlorophylls and carotenoids – by two-ray UV spectrophotometer.

The largest amounts of ascorbic acid and pigments were identified in *Actinidia kolomikta* fruits just after harvest whereas the levels of dry matter and soluble solids increased during storage. Ascorbic acid content decreased during storage, the biggest amount remained in 'Landė' fruits. After 6 weeks 'Paukštės Šakarva' fruits, stored in 3rd chamber, were the most ripe.

Key words: *Actinidia kolomikta*, ascorbic acid, controlled atmosphere chambers.

RESPONSE OF CROPS YIELD TO LONG-TERM REDUCED SOIL TILLAGE AND DIRECT SOWING

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Many short-term field experiments worldwide are done to investigate reduced soil tillage but only limited number long-term ones. The effect of short-term and long-term reduced tillage and direct sowing on crops can be different.

The aim of our investigation was to study response of several crops yield within 15 years period to application of long-term reduced soil tillage and direct sowing.

Field experiment was set up at Experimental Station of Aleksandras Stulginskis University (at that time Lithuanian Agricultural Academy) in 1988 and modified in 2001. Soil of the experimental site – *Endohypogleyic-Eutric Planosol – Ple-gln-w*. Soil texture – medium loam on sandy loam over the moraine clay. The effect of following five treatments was investigated: conventional ploughing at 23-25 cm depth (CP), shallow ploughing at 12-14 cm depth (SP), deep chiselling at 23-25 cm depth (DC), shallow chiselling at 12-14 cm depth (SC), direct sowing (DS). Crop rotation in the experiment: 1) spring rape, 2) spring wheat (2001-2003) and winter wheat (from 2004), 3) sugar beet (2001-2007) and maize (from 2008), 4) spring barley.

During fifteen year period (2001-2015) cumulative spring rape seed yield was higher when reduced tillage and direct sowing were applied as compared with that where soil was conventionally ploughed. This yield increase was not significant – in average up to 0.10 t ha⁻¹ per year. Reduced tillage had no negative influence on cumulative spring and winter wheat yield until 2010. During 15 year period cumulative wheat grain yield in plots with reduced tillage was less by 2.11-2.89 t ha⁻¹ than that in conventionally ploughed plots. Significant winter wheat grain yield decrease took place in 2013 where deep chiselling was applied and in 2014 where shallow ploughing was used. Response of wheat grain yield to application of direct drilling was positive. Direct sowing had no negative effect on sugar beet yield only during period 2001-2003. Cumulative sugar beet yield from 2001 to 2007 was less by 18.6 t ha⁻¹. Shallow ploughing, deep and shallow chiselling had no significant influence on sugar beet cumulative yield as compared with conventional ploughing. Maize was sensitive to application of direct drilling. Cumulative maize grain yield during period 2008-2015 was less where reduced soil tillage and direct sowing were used than that where plots were conventionally ploughed. Significant maize yield reduction by application of all reduced tillage and direct sowing treatments took place in 2012. Cumulative spring barley grain yield during 15 year period in plots with reduced tillage application was similar to that where conventional ploughing was used. In opposite, direct sowing reduced cumulative barley grain yield starting from year 2005. Here cumulative yield reduction within period 2001-2015 was 3.42 t ha⁻¹.

Key words: spring rape, winter wheat, sugar beet, maize, spring barley and yield.

PRODUCTIVITY OF AROMATIC VARIETIES OF HOP IN BELARUS AND DEPENDENCE OF ITS QUALITY ON BITTER ACIDS CONTENT

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As hop cones contain numerous compounds which refer to bitter acids, polyphenols, and essential oil giving foaminess, biological stability, unique flavor and bouquet to beer, hop cones are used in brewing widely. Bitter acids are useful and common components of hop which are not found in the same form in other herbs. Till present the technology of hop cultivation have been learned, worked out and introduced in the conditions of the Republic of Belarus. However, qualitative research of hop is not studied at all. Currently at commercial farm units that produce hop and beer production facilities only one qualitative index of hop is determined that is alpha acid contamination. It is impossible to produce beer of a good quality when it is only known the content of alpha-acid in hop cones. It proves that while rationing of various selection cultivars with equal alpha-acid mass fraction the different amount of useful for brewing components of hop are applied.

Quality impartial assessment of hop and hop products using in brewing requires applying of a great number of modern and safe methods of measurement. Therefore the aim of the research is to learn quality indicators of hop cones and hop products and to determine its influence on brewing value by high performance liquid chromatography method.

Field studies were carried out in 2014–2015 LCC 'Belhmelagro' of Malorita district of Brest Region. Laboratory researches were taken at Grodno State Agrarian University in scientific laboratory with the use the American liquid chromatograph Agilent 1200. The research of varietal features were carried out with the following aromatic hop varieties: 1. National (Ukraine); 2. Northern Brewer (England); 3. Spalter Select (Germany); 4. Perle (Germany); 5. Thettninger (Germany). Laboratory analysis was carried out by the high-performance liquid chromatography method that was used in the countries of European Union according to European Brewery Convention (EBC).

There are edaphoclimatic conditions of the Republic of Belarus which are productive for growth and development of aromatic varieties of hop of ukrainian, English and German selection. It was found out that according to the yield on sod-podzol sabulous soils of the Republic of Belarus the following varieties of aromatic hop were determined: National (8.6 ce ha⁻¹), Northern Brewer (7.3 ce ha⁻¹) and Perle (5.4 ce ha⁻¹). These varieties contained the maksim of alpha-acid – 8.6%, 7.3% and 5.4% respectively. The content of beta-acids was the following: National (6.2%), Perle (3.3%) and Northern Brewer (3.0%). The National (0.72), Perle (0.61) and Northern Brewer (0.41) demonstrated the highest coefficient of β/α - acids relation.

Hop and beer respectively of a good quality can be produced by increasing the content of beta-acids (as it has soft bitter taste). And our further research will be directed on determine the dependence how agro methods influence on alpha and beta contamination.

There are National, Perle and Northern Brewer among cultivated aromatic varieties of hop according to yield of hop cones and quality features.

Key words: hop, variety, productivity, alpha and beta acids.

GRAIN YIELD AND YIELD QUALITY DEPENDING ON SOIL TILLAGE

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Implementation of reduced soil tillage systems (without ploughing) allows to save resources and time, additionally proportion of wheat increases in the sowing structure under conditions of Latvia, but consequences of this system are unclear.

The objective of this investigation is to evaluate the influence of reduced soil tillage on the yield and yield quality of wheat.

Long-term multifactorial field trial was established in autumn 2008 at the Study and Research farm “Peterlauki” of the Latvia University of Agriculture. In this study data were arranged as two factor investigation: A – soil tillage (A1 – traditional soil tillage using mould board ploughing; A2 – reduced soil tillage with disc harrowing); B – crop rotation (B1 – continuous wheat; B2 – crop rotation). Data obtained in 2012 – 2015 are presented in this paper.

Crop rotation significantly affected yield of winter wheat ($p=0.002$), but influence of soil tillage was not essential, the average yield in fields with ploughing was 6.56 t ha^{-1} , but without ploughing – 6.25 t ha^{-1} . However, importance of soil tillage was observed in continuous wheat sowings, the average yield was 5.91 t ha^{-1} in ploughed fields, and only 4.48 t ha^{-1} in fields without ploughing. Quality of yield was not influenced by soil tillage and crop rotation, it depended only on the meteorological situation of the respective year.

Soil tillage method was not the factor that limited the level of wheat yield and yield quality, on the condition that crop rotation, even minimal rotation, was maintained.

Key words: wheat, soil tillage, crop rotation yield, quality of yield.

Acknowledgements: research was founded by projects: “Influence of minimal soil tillage on its fertility maintenance, development and distribution of pests as well as crops’ yield and quality in resowings” and State Research Programme’ project No. 1 “Sustainable use of soil resources and abatement of fertilisation risks”.

IMPACT OF LONG-TERM CULTIVATION OF MAIZE ON PHYSICOCHEMICAL SOIL PROPERTIES

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Nowadays in Poland as well as in other parts of the world, only limited number of field experiments regarding the effect of continuous cultivation of plant are conducted. The obtained results demonstrate the changes after many years from the establishment of the experiment.

The main aim of the investigations was evaluation of effects of long-term cultivation of maize on physicochemical properties of medium-textured soil. The effect of monocultural maize cultivation on the soil properties was compared with a 6-field crop rotation.

Presented results were obtained from a field experiment established in 1967 at the Agricultural-Experimental Station in Bałcyny (53°40'N, 19°50'E). The experiment is located on Haplic Luvisol developed from light silty loam. Investigations were focused on soils from plots covered by a 6-field crop rotation: sugar beet – maize – spring barley – peas – winter rye – winter wheat as well as from maize monoculture (38-43 years old). Soil samples were taken from maize fields and the following determinations were performed according to standard methods: organic C content, pH, cation exchange capacity, content of P, K, Mg, B, Mn, Cu and Zn.

After six years of maize cultivation in crop rotation, small changes in soil properties were stated concerning organic carbon content, pH and contents of examined macro- and micronutrients. However in case of maize monoculture no significant changes were found concerning pH and content of P and K, but decrease of organic carbon content by 0.08% and increase content of Mg.

Maize cultivation in a crop rotation does not cause significant changes in soil properties. Maize cultivation in a monoculture causes decrease of organic carbon content, increase of exchangeable acidity and decrease of available Mn and Zn.

Key words: crop rotation, monoculture, maize, organic carbon, soil properties.

PARTICLE SIZE DISTRIBUTION OF SPLASHED MATERIAL ON DIFFERENT DISTANCES FOR SOIL SAMPLES DERIVED FROM ENDOGLEYIC UMBRISOL (ARENIC)

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Soil which is an important part of many land ecosystems degrades under the influence of various factors on it. One of these factors may be water. Water erosion in its initial phase begins with a splash, when by the water-drop impact from the soil surface begins to detach soil material. The detached material is transferred over various distances.

For many years, the phenomenon of splash has been described only by the mass of detached particles, therefore, when the mass was too low to be weighted the phenomenon remained unmeasurable especially at low precipitation. Use of the measurement by laser diffraction method allows the analysis of samples having a low weight.

Measurements consisted of collecting soil material detached from the soil surface and transferred to a specified distance after being hit by water-drops. For material collected on a suitable trays with the different diameter the particle size distribution was measured using a laser diffraction method.

Measurements were conducted on *Endogleyic Umbrisol (Arenic)* which initial texture was: 85% sand, 14% silt and 1% clay. The sand content in splashed material changed from 79% (at a distance of 4.5 cm from the point of impact drops) to 91% (at a distance of 36.5 cm from the point of impact drops). Changing the size distribution of the sample caused a change in its classification from loamy sand to sand.

In general, particle size distribution of splashed material was various for different splash distances.

Key words: particle size distribution, soil splash, soil erosion, laser diffraction method

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EVALUATION OF SOIL QUALITY AND DEGRADATION IN THE AGROECOSYSTEMS ACCORDING INTEGRATED INDEX OF CHEMICAL, BIOCHEMICAL AND BIOLOGICAL FEATURES

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Overall evaluation of the soil quality and degradation towards sustainability is quite complicated and still not solved problem because of the complexity of ecosystems and the soil itself as a complex ecosystem. Various methods of calculations of the integrated soil quality index will be overlooked and data of soil quality and degradation index in some Lithuanian agroecosystems will be presented.

Investigations were carried out in the Luvisols at the conventional, organic, and extensive agroecosystems under different crop rotation. Soil agrochemical, biochemical and microbiological properties were determined in order to investigate relationships and to develop the integrated index of the soil quality and degradation.

Standardized chemical, physico-chemical and microbiological methods were used to determine soil quality indexes. Statistical methods such as correlation and regression were used for the data analysis.

Soil agrochemical, biochemical and microbiological properties varied greatly in the soils. For the highly correlated indexes such as organic matter, C/N ratio, mineral nitrogen, pH, electrical conductivity, enzymes activity and *Rhysobium Galegae* regression analysis was performed and integrated index was developed.

In general, soil quality index in the conventional and organic farming systems was higher and degradation lower than in the extensive agroecosystem while process of the renaturalization was observed in the last. *Fabaceae* crops increased soil quality while *Poaceae* decreased. Under the proper crop rotation system soil quality remained constant.

Key words: soil quality, degradation index, sustainability, agroecosystems, renaturalization.

SEEDBED QUALITY AND SPRING CROP EMERGENCE UNDER CLAY LOAM SOIL REDUCED TILLAGE CONDITIONS

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Spring crops emerge poorly in clayey soils during dry springs, because the prepared seedbed is coarse and dries out rapidly. Effects of reduced clayey soil tillage systems on seedbed quality and emergence of spring crops have not been sufficiently investigated in Lithuania.

For this reason, investigations were carried out at the Joniškėlis Experimental Station of Lithuanian Research Centre for Agriculture and Forestry, Lithuania, in the experiment, established in 2006. The aim was to investigate the long-term effect of reduced tillage as well as its combinations with supplementary practices for soil improving on seedbed structure, water content, germination rate and growth of spring oilseed rape and field pea.

The experiment examined the effects of deep and shallow ploughing, shallow ploughless tillage, combinations of ploughless tillage with incorporation of lime sludge and cover crop for green manure and application of the cover crop for mulch without autumn tillage.

Application of cover crop for mulch without tillage in autumn causes deterioration of seedbed structure (decrease of 2-5 mm most appropriate aggregates and increase of >5 mm aggregates, predetermining cloddiness). Incorporation of lime sludge by ploughless tillage increased water content in seedbed layer after sowing and crop emergence in droughty years. Under these conditions reduced tillage, except in combination with lime sludge, had negative influence on spring crop emergence. Spring oilseed rape germination rate was influenced by water content in the seedbed, proportion of 2-5 mm aggregates in seedbed structure, field pea germination rate - by the amount of rainfall after sowing.

In years with droughty post-sowing periods, spring oilseed rape and field pea demonstrated the best emergence after the ploughless tillage had been applied together with incorporation of lime sludge.

Key words: cover crop, field pea, lime sludge, ploughless tillage, spring oilseed rape.

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THE INFLUENCE OF FOLIAR FERTILIZATION WITH MACRO- AND MICRO ELEMENTS ON THE CONTENT OF MAGNESIUM AND CALCIUM IN POTATO TUBERS

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The study attempted to assess the impact of fertilizers macro- and micronutrient content of magnesium and calcium in several varieties of potato. The study was based on 3-year field experiment conducted in Uhnin (province Lublin) on podzolic soil, slightly acidic. The experiment was assumed randomized block design, where the factors of the first order were 3 technologies foliar fertilization and control treatment, without foliar fertilization, and the second-order factors were potato varieties all groups of earliness (Lord, Vineta, Satina, Jelly). In the experiment was applied of permanent dose of nitrogen-phosphorus-potassium, in the amount of 80 kg N, 29 kg P and 96 kg K ha⁻¹. Tillage was carried out in accordance with good agricultural practice. Chemical pesticide to combat: weeds, Colorado potato beetle and potato blight, as well as the dose, timing of application and the choice of products were in accordance with the principles of Good Agricultural Practice and recommendations IOR-PIB. After harvest was preparation of samples from each combination of field experience to chemical analysis (30 tubers of medium size, undamaged). The calcium content was determined by flame spectrophotometry. Magnesium content determined by atomic absorption spectrometry. The genetic characteristics of the tested cultivars were determined by a greater extent than the content of macronutrients by foliar fertilization. The most prosperous in magnesium and calcium was Jelly cultivar, which means greater its suitability for consumption and food processing. Obtaining a high nutritional value of potato tubers it can be achieved using rational fertilization, in particular foliar application. When using a constant level of phosphorus-potassium fertilization highest content of magnesium and calcium in tubers were found in objects other cultivation technology with fertilization with the first spraying against potato late blight + additional fertilization.

Key words: potato, fertilization, Mg, Ca.

EFFECT OF CROP ROTATION ON WEED INFESTATION AND CROP YIELD IN DIFFERENT TILLAGE SYSTEMS

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Crop rotation and minimal soil disturbance characterize conservation agriculture. By rotating the crops in combination with reduced tillage weed population and crop production are affected.

The objectives of this study were to investigate the effect of different crop rotations in combination with conventional and reduced tillage systems on weed population and crop production.

The experiment consisted of two tillage treatments: CT - conventional tillage and RT - reduced tillage, and two short crop rotations: spring oilseed rape → spring barley → winter wheat, winter wheat → winter oilseed rape and also winter wheat grown as monoculture.

Annual dicotyledonous weeds predominated (96.2-99.4%). In all 6 years the most abundant species were *Chenopodium album* L., *Sinapis arvensis* L., *Galium aparine* L., *Viola arvensis* L., *Tripleurospermum perforatum* (Merat) M. Lainz and *Fallopia convolvulus* (L.) Löve.

CT significantly decreased the abundance of weeds as compared with RT. In the stubble-cultivated soils, the density of *C. album*, *S. arvensis*, *G. aparine* and *T. perforatum* was higher than in the ploughed soils. The density of weeds in winter wheat was 1.2-fold lower when grown in a rotation compared to monoculture. Spring barley demonstrated the best suppressing ability compared to all other crops under investigation. Spring and winter oilseed rape exhibited weak weed suppression ability: the number of weeds was 3.1-fold higher compared to that of spring barley.

Yield of winter wheat was significantly higher in crop rotation as compared with monoculture. Only winter wheat yield was significantly higher in CT than in RT.

Key words: tillage systems, crop rotation, weed, crop yield.

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THE FAT YIELD AND FATTY ACID PROFILE OF WINTER RAPESEED GROWN IN MONOCULTURE AND IN CROP ROTATION UNDER DIFFERENT AGRICULTURAL PRODUCTION SYSTEMS

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New rapeseed cultivars offering high and reliable yield, as well as improved agronomic techniques increase the profitability of agricultural production and enable specialization towards faster crop rotation and even growing crops in monoculture. The aim of this study was to evaluate the fat yield and fatty acid profile in three winter rapeseed cultivars grown in five-year monoculture and after a 4-year break in the crop rotation system with three levels of agricultural inputs.

The fatty acid composition was evaluated by the standard gas chromatography method. Winter rapeseed was grown in a strict field experiment in a five-year monoculture and crop rotation. Three cultivars (Californium, Castille, Nelson) were compared, and three levels of production technology with different fertilization rates of nitrogen and sulphur and pest control applied.

Most SFA (saturated fatty acids) was found in cultivar Californium in both monoculture and crop rotation with a low level of technology. Rapeseed varieties Nelson of rotation at an average level of technology characterized by the highest share of MUFA (monounsaturated fatty acids). The intensity of technology increased MUFA content in rapeseed Castille and Nelson from the crop rotation and the monoculture compared to the low level of technology. Varieties population (Californium and Castille) oilseed rape crop rotation with low technology showed the highest amount of PUFA (polyunsaturated fatty acids). The ratio of MUFA and PUFA to SWA underwent narrowed for a cultivar of Californium and Castille in the crop rotations with a low level of technology, and for a cv. of Nelson with a high level of technology. In contrast, the ratio of linoleic acid to linolenic underwent extension for rape cv. Californium and Nelson in monoculture and cultivars Californium and Castille in crop rotation at a low level of technology.

Key words: winter rapeseed, cultivar, production systems.

HEMP (*CANNABIS SATIVA L.*) NEW USES FOR LITHUANIA: CHALLENGES AND FUTURE TENDENCIES

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As we know, in the worldwide hemp industry, the key to an economically and environmentally brighter future is hemp sustainability leading the way for environmentally sustainable world. Hemp sustainability is the ability for hemp to sustain and support, while improving environment. The hemp industry is helpful to environment as it improves natural resources, thereby supporting long-term ecological balance in Lithuania. Lithuania legalized hemp cultivation in 2014 and the demand for hemp and their products is still developing in Lithuania.

Objective of this research was deep analysis of real situation of the hemp cultivation in the Lithuania, estimation of hemp using possibilities for safety and healthy food and feed, for using as building materials, textile and to provide future tendencies. The analytical and constructive methods were used, statistical and logical analyses were used, attention is paid to hemp uses innovation analysis in different countries of EU, Israel and USA.

Hemp has been grown in our country long time ago for food and fiber. It was mainly used in in the food and feed industry, textile industry. Hemp cultivation technology will be described by researchers from Lithuanian Research Centre for Agriculture and Forestry (LRCAF), who found in trials, that all varieties of five different countries are suitable for the cultivation in Lithuania. Cannabis is valuable proceedings in crop rotation and suitable to growing in ecological farms. Hemp doesn't emaciate soil, so farmers need less fertilizers after succeeding crops. Cannabis needs well-manured land. Usually hectare of cannabis needs 100-125 kg of nitrogen, 40-60 kg of phosphate fertilizer, and 65-90 kg of potassium. Large quantity of biomass can be obtained in a short period of growth of the cannabis plant. Substantially big part of this biomass remains in the field after harvesting, and so comes back into the soil in the form of organic fertilizers, thus enriching the soil. Hemp is a highly effective weed suppressant.

The seeds for the market are not intended for sowing and their products, raw or soaked hems, and their stalks must have an accredited laboratory certificate attesting that the THC content in hemp from which these products were received, do not exceed 0.2 per cent. The importers must obtain the status of approved importer in order to bring the seeds of hemp grown for fibre to Lithuania. The hemp stalks, pellets from the chaff, dust, due to higher biomass than of many other plants and good incandescent properties are supposed to be used as fuel. Currently, the supply and demand of hemp production is still developing in Lithuania. The introduction of existing products (hempseed oil, hemp salt, clothes from hemp, etc.) and the process of the search for the markets, new product manufacturing, processing perspectives, expanding areas for crops are going on. The main research is done at Lithuanian Institute of Agriculture,

Institute of Animal Sciences of Lithuanian University of Health Sciences, Kaunas Technology University and A. Stulginskis University.

Hemp is useful plant, suitable for both food, feed and cosmetics. Hemp is environmentally friendly building material, suitable for the construction of houses. Building blocks from cannabis have A1 non-combustibility class, they are produced not only using cannabis boon, but chopped fibers also. These blocks can be called 100 percent organic, because only lime and other natural supplements are used as a binding agent. Cannabis has no non-recyclable parts, it is fully recyclable. Hemp fiber is very strong compared with other natural fibers (cotton, flax, and nettle), so it has long been widely used in ropes, net, and sail production, also in agrotextile and geotextile. Hemp boon is useful for thermal insulation composite production due to their small-pored porous structure. High-quality building blocks, ideal for eco-friendly passive houses are produced by blending hemp boon with clay or lime. They have good heat resistance in winter time and cool in summer, resistant to mold, moisture-proof, and highly breathable. Cannabis has a lot of cellulose, and is therefore used in papermaking. Cannabis paper is of a high-quality and durable for long term storage for forms, cash, and cigarettes production). The experience in hemp growing and processing is rather poor. Hemp cultivation and processing in Lithuania is very relevant in growing processing sections, such as: textile, paper, and others. There is a possibility of hemp appliance in production of textile, furniture, and building construction products taking into account its eco-friendliness, harmony and increasing production in Lithuania. The effective manufacturing, including cultivation and processing, is required for the successful development of the sector.

Key words: sustainability, hemp, food, feed, fiber, textile.

ECO-INNOVATION AND WATER RESOURCE EFFICIENCY: TOWARDS A KNOWLEDGE DRIVEN AGRICULTURE

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Efficient water management and irrigation practices at farm level can help improve agricultural profitability and competitiveness in an era of increasingly limited and threatened water supplies due to unsustainable exploitation and climate change. However, despite the continued generation of knowledge throughout Europe, research results are often insufficiently exploited and taken up in agricultural practice, while on the other hand innovative ideas and effective methods of water management at farm level from practice are not captured and spread. Aim of this work is to highlight the importance and need of transferring scientific innovations and local expertise to operational level across borders, and identify a roadmap towards a knowledge driven agriculture in EU.

As a result of research efforts and local knowledge and experience, there is a plethora of technologies and management options through which EU agriculture could improve water management, ranging from options targeting increased water use efficiency to options targeting increased water supply. ‘Technologies’ include practical applications and tools that are ready-to-use or have a successful demonstration status, including technologies that make water use more efficient, reduce water losses, monitor water use and those that target water supply. ‘Management options’ are considered as types of water, land and crop management that contribute to the effective use of water resources in farming systems, and could potentially replace prevailing management. Each one of these options has certain co-benefits for other environmental priorities or the farm’s economic objectives and certain trade-offs. The selection of the appropriate strategy is rather challenging and must consider prioritization between these various benefits and objectives and be tailored to local conditions. Towards this direction the European Innovation Partnership for Agriculture (Focus Group on water and agriculture) revealed that efficient knowledge transfer can be achieved through the establishment of active cooperation networks among practitioners, consultants and scientists, appropriate decision support mechanisms for practitioners in an easy and understandable way, and the effective use of Information and Communication Technology.

Key words: irrigation, water management, innovation, knowledge transfer.

THE STATUS, DYNAMICS AND MODELLING OF ORGANIC CARBON STOCK IN ESTONIAN ARABLE SOILS

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Soil organic carbon is an essential factor in soil functioning and crop production. The content of soil organic carbon is affected by crop cover, cultivation practices, soil texture and climate. Since soils have the capacity to store and bind atmospheric carbon dioxide (CO₂), the content and stocks of organic carbon in soils is under elevated interest. The aim of this study was to evaluate the dynamics and stocks of organic carbon in Estonian arable soils and model future scenarios using Hénin-Dupuis equation and model ICBM. The study is based on Estonian National Soil Monitoring Database (1983-2015) from which nine monitoring areas were chosen for further investigation. The study revealed that since the beginning of soil monitoring the stocks of organic carbon in Estonian arable soils have increased. Cultivation practices and crop cover affect the content of organic carbon. Continuous growing of cereals did not reduce organic carbon stocks if sufficient carbon inputs from residual plant material and other organic amendments (e.g manure, compost) were returned. The positive effect of short-time grasslands to carbon stocks and sequestration depended on the ratio of grasslands and cereals/oilseed rape grown in crop rotations. The extent of influences related to cultivating practices and crop cover was appointed by the soils mineral particle size distribution. Based on our study in the climatic conditions of Estonia, the increased temperature during the monitoring period has no negative impact on organic carbon stocks. Both the equation Hénin-Dupuis and simulation model ICBM performed better on monitoring areas where the soil texture was loamy sand or sandy loam. On areas where the texture was sand or loam, models tended to overestimate the contents of organic carbon stock. Model ICBM simulated more accurate results on areas, where crop rotations were based on cereals.

Key words: SOC, land management, legacy soil data, Hénin-Dupuis equation, model ICBM.

AROMA PROFILE AND COLOUR OF FRESH AND PROCESSED DIFFERENT SPECIES MINTS

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Plants of mint genus (lat. *Mentha*) belongs to the *Labiatae* family. It is one of the most important aromatic plant in the world. Mint species differ not only by chemical content, usage but also by appearance and volatile compounds. Postharvest mints are extremely sensitive to ethylene-induced senescence there for processing method and conditions are the main factors of mint products quality.

The research was carried out at the Aleksandras Stulginskis University, Lithuania, in 2014-2015. The influence of freeze drying on different mints species aroma profile and color was determined. The three species of mints 'Swiss' (*Mentha spicata* var. 'Swiss'), 'Apple' (*Mentha suaveolens* Ehrh.) and 'Chocolate' (*Mentha x piperita* var. 'Citrata') were freeze dried. Color of fresh and freeze dried mints was detected by spectrophotometer ColorFlex (Hunter Associates Laboratory Inc., USA) assessing coordinates L*, a*, b*. The chroma (C*) and hue angle (h°) were also calculated. Volatile compounds in mints were analyzed using the Heracles II electronic nose (Alpha M.O.S., Toulouse, France) based on ultrafast gas chromatography. During processing it was observed degradation of photosynthetic pigments (a* value becomes lower by 2.07 NBS units in 'Chocolate') and plants of all mints species become lighter. Processing lead to incensement of yellowness: after processing the lightest and the most yellow mints was 'Swiss' variety and the darkest - 'Chocolate'. It was determined 25 volatile compounds in mints which composition depended on variety as well as on processing.

Key words: appearance, freeze dried, *Mentha*, volatile compounds.

QUALITY OF SPROUTED CEREAL SEEDS FOR FOOD

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Sprouting of seeds is one of the processing methods to increase the nutritive value and the health qualities of foods in a natural way. Based on research it was determined that biologically active substances in sprouted seeds stimulate the human body's regenerative processes, removes the toxins from it, free radicals, and the body can easily absorb them.

Aim of the work - determine the impact of irrigation water on quantity of bioactive substances in different kinds of seeds sprouted for food.

The research of spring wheat (*Hordeum vulgare* L. nutans), winter wheat (*Triticum aestivum* L.), naked oats (*Avena sativa* L. mutica), triticale (*Triticum x Secale*) and rye (*Secale cereale* L.) sprouted seeds, irrigated by different water solutions, biochemical composition was carried in 2015-2016 year at the Aleksandras Stulginskis University, Faculty of Agronomy, Agriculture and Food Science Institute's Plant materials quality laboratories.

Using standard methods were evaluated the amounts of dry matter, crude ash, crude fat, crude protein, crude fiber, carotenoids and vitamin C. Data were subjected using two-ways analysis of variance (ANOVA) and the Fisher's LSD test to trial mean at the confidence level $P \leq 0.05$.

The results showed that the chemical composition changed dependent on irrigation water. It was found that in all investigated sprouted seeds the biggest amount of dry matter (52.37 %) and crude fat (3.67 %) was in triticale, crude ash (3.98 %) in naked oats, crude protein (30.83 %) in spring wheat, crude fiber (8.23 %) in winter wheat. Crude fiber content decreased in all of investigating variances. Was established that dry matter and vitamin C had a very strong correlation. $r = 0.95^*$. A strong positive correlation was between green ash ($r = 0.84^*$), crude fiber ($r = 0.77^*$) and carotenoids ($r = 0.85^*$) when filtered water was used for seeds irrigation.

Compared with the control the filtered water had the greatest influence of crude ash content increasing in rye (3.33 %), triticale (3.62 %); crude fat in spring wheat (3.59 %); vitamin C content in winter wheat (0.97 mg100g⁻¹); carotenoids in naked oats (0.19 mg100g⁻¹), crude proteins in summer and winter wheat (3.55 and 3.27 %). Filtered water with 4% ethyl alcohol influenced the most increasing of the dry matter amount in rye and triticale (50.47 and 52.37 %); crude protein in winter wheat (28.37 %) and naked oats (23.99 %); crude ash in spring and winter wheat (3.55 and 3.27 %), naked oats (3.98 %); crude fat amount of naked oats (2.04 %).

Key words: sprouted seeds for food, filtered water, chemical composition.

DIVERSITY OF WEED COMMUNITIES OF WINTER WHEAT GROWN IN CONVENTIONAL AND ORGANIC SYSTEMS

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In organic farming no synthetic herbicides are used and in a common opinion of European organic farmers weed pressure is the biggest problem in organic system.

The aim of the study was to evaluate the effect of organic and conventional growing method on the weed communities.

In 2007-2010 organic winter wheat growing was conducted on a farm in northern Poland. The comparison was made with the conventional farm in Łasin run in a very intensive way. On the organic farm winter wheat was grown after potato. Weeds were controlled by harrowing (two times in spring). Weed infestation (number of weed species and their biomass) were measured in two growing stages of wheat – towards the end of the tillering stage (BBCH 25-27), and in the flowering stage (BBCH 63-65).

In the tillering stage in the conventional wheat plantation the number of weeds was 180-times lower than on organic one. On the organic farm 33 weed species were detected while on the conventional one in 2007 – 0, in 2008 – 3 and in 2009 – 1.

In the flowering stage on the organic farm 32 weed species were detected while on the conventional one in 2007–2008 no single weed was found, and in 2009 just 1. The total number of weeds was 70.7 per square meter in the organic, and 0.03 in the conventional plantation.

The weed community biomass on organic farm was in the range of 64.1 g per square meter in 2007 to 359.87 g in 2009 (the latter was unacceptable), having a negative impact on wheat yielding in 2009. On the conventional plantation the weed biomass in 2007-2008 was 0 g, and in 2009 – 1.37 g per square meter.

The weed communities in the organic plantations were characterized by higher number of weed species. It was accompanied by a 109-times higher weed biomass in the organic plantations.

Key words: winter wheat, weed communities, organic farming, conventional farming.

CONSEQUENCES AND PREVENTION OF POTASSIUM DEFICIENCY ON ORGANIC FARMS – CASE STUDIES FROM POLAND

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Potassium is an element sharing ca. 50% by weight of all minerals constituting crop biomass. Therefore unfertilized soils are mined from K in relatively short time span, leading to K deficiency. This in turn means unbalanced nutrient content in soils, lower yields (sometimes extremely low) and lower yield quality. And an organic farm should be sustainable.

In Poland few case studies were done to document the history of K deficiency development, its consequences, ways of improvement and its effectiveness.

On 4 selected organic farms (two on sandy and two on silty loam soils) with a long history of organic management soil samples were taken in the 1990's, then ca. 10 years later and this year. In the same time development of selected crops (red clover and cereals) and their yielding were monitored.

Two main deficiency development scenarios were recognized. One is a very low level of exchangeable potassium in the soil before the beginning of farm conversion to organic system (one may call it "inherited deficiency"). Second is the lack or insufficient K fertilization during organic management (documented by a K balance). A strong crop response to K deficiency is often completely unexpected by farmers. For years a low K status in soil is not visible in crop development and yielding and suddenly farmers are confronted with a very bad crop overwintering (especially red clover), and with K deficiency symptoms on cereals and with lower yielding.

Implementation of appropriate organic/mineral K fertilization is very effective in controlling K deficiency. Regular soil chemical analyses and nutrient balances should be a basis in nutrient management in organic farming.

Key words: organic farming, potassium deficiency, K balance, K fertilization, crop response.

THE LONG-TERM IMPACT OF REDUCED TILLAGE SYSTEMS ON CLAY LOAM SOIL PHYSICAL STATE UNDER SPRING CROP MANAGEMENT CONDITIONS

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Changes of the soil physical state, depending on tillage, are determined by the soil type, soil moisture, tillage depth, climate conditions and implements used. Reduced clayey soil tillage systems for spring crop growing have not been sufficiently investigated in Lithuania.

For this reason, investigations were carried out at the Joniškėlis Experimental Station of Lithuanian Research Centre for Agriculture and Forestry, Lithuania, in the experiment, established in 2006. The aim was to investigate the long-term effect of reduced tillage as well as its combinations with supplementary practices, improving soil under spring crop growing conditions on soil dry bulk density, water content, structure and aggregate stability.

This study examined the impact of deep and shallow ploughing, shallow ploughless tillage, combinations of ploughless tillage with incorporation of lime sludge and cover crop for green manure and application of the cover crop for mulch without autumn tillage.

Application of reduced tillage increased water content at upper (0-15 cm) topsoil layer directly after spring crop sowing. However, due to reduced tillage the water content in all topsoil markedly decreased when droughty periods lasted for a long time. Soil structure in the upper topsoil layer is usually worse when applying the ploughless tillage or cover crop mulch without autumn tillage. Application of cover crop mulch without autumn tillage, ploughless tillage and shallow ploughing causes the increase of dry bulk density in the bottom (15-25 cm) topsoil layer. Incorporation of lime sludge under ploughless tillage conditions helped to avoid soil structure worsening and compaction.

Clay loam soil having poor physical properties by origin require more intensive tillage or application of supplementary practices to maintain proper physical condition for spring crops.

Key words: cover crop mulch, green manure, lime sludge, ploughing, ploughless tillage.

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EXTENT AND CAUSES OF FOOD WASTE IN LITHUANIA

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Wasted food is an importance issue directly linked with social (e.g. food security and quality, health, etc.), environmental (e.g. energy, climate change, water, availability of resources, good environmental governance, etc.), and economic (e.g. increasing agrifood demand and households expenditure, resource allocation and efficiency, food price volatility, increasing waste management costs, consumption, commodity markets etc.) impacts. According to different studies, from one third to half of the world food production is not consumed, leading to negative impacts throughout the food supply chain including agriculture, food processing, retail and wholesale, food service/catering and households.

The aim was to investigate the extent and key causes of food waste in Lithuania.

The investigation have been based on the analysis of food waste statistical data and oh the findings of different studies as well.

There was an estimate of almost half a million tons of food waste in Lithuania in 2012. This is equivalent to 157 kilograms per person per year. These estimates include both edible food and inedible parts associated with food. Sectors contributing the most to food waste are the primary production sector (297.2 kilotons; 99 kg/capita/year) and the processing sector (105.6 kilotons; 35 kg/capita/year). Both sec-tors account for 86% of Lithuania's total food waste. Around 2.7 kilotons of food are annually wasted in the households. This corresponds to less than 1 kg/capita/year and account for 0.6% of total food waste. That said, in the EU-28, household food waste averaged 92 kilograms per person per year in the same year. The last 13 percent of food waste comes from wholesale, retail, food service and catering. However, there is no accurate statistical data on these sectors.

There is a pressing need to prevent and reduce food waste in Lithuanian food chain, especially at household and food catering levels which account for the largest part of lost edible food.

Key words: food waste, food security, household, agriculture, economics.

TRANSFORMATIONS OF TYPICAL SOIL PROFILE AND ORGANIC MATTER IN WESTERN LITHUANIA AGROECOSYSTEMS

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Soil is a multicomponent and multifunctional system, with definable operating limits and a characteristic spatial configuration. Thus, the major challenge within sustainable soil management is to preserve soil multifunctionality for other ecosystem services while optimizing agricultural yields. The aim of the work is to determine the changes of morphological and chemical properties in Western Lithuania agroecosystems Retisols caused by their agrogenic transformation. Several methods used to study above mentioned transformations: a) particle size distribution of the soil particles in the liquid dispersion was determined using the light-scattering technique, b) soil pH was determined in 1M KCl (soil-solution ratio 1:2.5) using potentiometric method, c) soil organic carbon (SOC) content was determined by the Tyurin method modified by Nikitin (1999) with spectrophotometric measure procedure, d) mobile humic substances were extracted using 0.1M NaOH solution and determined according Ponomariova and Plotnikova (1980), e) water extractable organic carbon (WEOC) was determined in water extract (soil-water ratio 1:5) and measured by IR-detection method after UV-catalysed persulphate oxidation. Our study revealed a clear evidence of soil profile morphological and chemical changes to a depth of 40-50 cm, however, the most distinct transformations take place in the upper 30 cm layer of agrogenically changed Retisols. Thus, here it needs to be highlighted: when Ah horizon is deepening (by ploughing) from 10-15 cm up to 25-30 cm thick the El horizon becomes disturbed and partially incorporated/mixed into Ah horizon; the features of Ahp horizon changes Ah horizon and AhEl horizon develops (caused by soil deep loosening) at a later. Afterwards, due to the long-term deep plough practice and soil erosion (where it takes place), El horizon becomes completely destroyed and a sequence of Retisols layers in the upper profile part changes from Ah-E-ElBt to the Ahp-ElBt. Likewise, significant transformation patterns were observed in the total and organic carbon content of the agrogenically transformed Retisols: the values of both total and organic C decreased twice in comparison to corresponding forest soils. The same trend is characteristic for humus content and humic acids composition. However, a systematic application of farmyard manure and liming has a positive effect on organic carbon content in the

Retisol due to the growing number of carboxylic and phenolic groups that contain humic acids.

Key words: Retisols, agroecosystem, soil tillage, organic matter transformation.

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WHEAT YIELD QUANTITY AND QUALITY DEPENDING ON NITROGEN TRANSPORTER GENES

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Wheat is relatively inefficient in N uptake: N use efficiency is ranging from 14% to 59%. Best solution would be the use of wheat genotypes with the higher N efficiency in combination with suitable management.

This research can give some recommendations to increase crop production except increasing nitrogen fertilizer rates using knowledge of relation between nitrogen transporter gene and wheat yield.

This research focuses on the interaction of genetic factors implicated in wheat yield formation with two main plant management practices – conventional and organic. The results will help to explain the underlying mechanism of yield differences in different management systems. It will also enable us to study the mechanism, how plant production management could further improve the quality and quantity of wheat while using less resources and saving environment.

Field trials with winter wheat will be carried out on the experimental fields. Wheat (flour) quality will be determined in laboratory. Wheat samples (roots, leaf and head) will be collected from different fertilizer treatments and stored at -80° C. RNA will be extracted from the samples with the Plant RNA extraction kit. This experiment conduct in 2016 and 2017. After that can be introduce the analysed results.

After this research, it will be possible to determine specific genes involved in wheat yield structural elements and yield quality. The results of this study will help to model nitrogen usage and yield formation. Special focus will be on ammonia transporter genes which are of critical importance in yield formation. Until now, these genes have been studied in potato, but not in wheat plants in field trial. Ammonia transporter genes can be one of the markers to assess wheat plant nutrients supplying.

Key words: winter wheat, nitrogen transport genes.

METHANE CONSUMPTION IN ARABLE SOILS – SELECTED ASPECTS OF FERTILIZATION

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Methane (CH₄) is an important greenhouse gas with global warming potential 28 times greater than that of carbon dioxide (CO₂) (IPCC, 2014). The process of CH₄ oxidation (methanotrophy) in soil causes reduction of its concentration in the atmosphere and prevents emission of this gas from deeper levels. Therefore, it is extremely important to the global C cycle and they play a major role in climate protection. The methanotrophic activity depends on many physical and chemical factors, naturally occurring in nature or as a result of human activity. The soil ecosystem acts as a reservoir or a sink for many kinds of pollutants such as heavy metals. They are the most toxic inorganic pollutants occurring in industrial areas but also accumulated in fertilized soils.

Land use changes the ability of soil to oxidize CH₄. Applied fertilization results in a supply of not only necessary nutrients, but also accumulation of other substances. Nitrogen fertilizers (ammonium (NH₄⁺) and nitrate (NO₃⁻) ions as well as heavy metal ions are one of the studied factors.

Gas chromatography (GC) methods is used to observe dynamics of methane consumption in soil.

Numerous studies have shown a sensitivity of methanotrophy to N in soil, and mainly demonstrated that ammonium ions inhibit CH₄ oxidation. Our results confirm this reaction. But methanotrophy in tested soils was not destroyed by heavy metals.

We concluded that selected studies on the presented factors - N input and heavy metal accumulation - show how the methanotrophic activity can be changed in arable soils. Because of the participation of soil in the prevention of global warming, the mechanisms of CH₄ oxidation in this ecosystem need to be recognized. In the environmental context, cultivated areas become a global issue.

Key words: methane oxidation, soil, fertilizers, climate change, heavy metals.

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THE EFFECT OF LONG-TERM MINERAL FERTILIZATION OF MOUNTAIN MEADOW ON WATER-AIR PROPERTIES OF SOIL

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The effect of long-term mineral fertilization on soil water-air properties such as bulk density, total porosity, air porosity, water field capacity and available water retention of soil were studied.

The studies was carried out on field experiment located in Czarny Potok a southern region of Poland within Carpathian Mountain, (E 20o54'53", N 49o24'35", altitude 720 m a.s.l.) on a natural mountain meadow - *Nardus stricta* L. and *Festuca rubra* L. with a significant share of the dicotyledonous.

In spring of the 37th (in 2005) and 45th (in 2013) year of long-term fertilization experiment of mountain meadow, soil samples were collected. Samples were taken from humic horizon (5-15 cm) of loamy texture Dystric Cambisol. The experiment included 7 fertilizing objects with full NPK fertilization and with control fertilization. Since 1985, the experiment has been conducted in two series: unlimed and limed. Liming was applied every 10 years in 1985, 1995 and 2005.

Soils of all treatments characterized by a low bulk density high total porosity, air porosity and plant available water. Systematic long-term mineral fertilization has not caused significant changes in investigated water-air properties. Even periodical liming applied every 10 years has not influence on these water-air properties. This trend was reported since first time conducted study on physical soil properties on this experiment in 1998. Only small differences in results between samples taken in 2005 and 2013, but not significant, in analysed properties were confirmed. The main reasons of lack impact long-term fertilization on physical properties of humus horizon was no impact on change level of organic matter and grain size distribution - soil texture. These two basic soil properties have effect on soil structure thereby on water retention, plant available water, air porosity and bulk density.

Key words: long-term experiment, soil water retention, mountain meadow.

LONG-TERM EFFECTS OF CROP ROTATIONS INTENSITY ON WEEDINESS ON SODDY PODZOLIC ARABLE SOIL

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Because of economical aspect mainly weed management is the top priority among farmers. Hereto, caring for the environment nowadays preventive weed control methods, including properly planed crop rotations, becoming increasingly important worldwide. There have been numerous studies in this direction, but we lack regular results on long-term effects of crop rotations intensity on weediness.

In this regard analyze of relevant data from long-term crop rotation experiment at Priekuli Scientifical Centre of the Institute of Agricultural Resources and Economics was made. The aim was to clarify effect of crop rotations intensity on weediness on soddy podzolic arable soil.

Weed taxa (both annual and perennial; at species or family level) and weed abundance (plants per m²) were determined in two 3-field and two 6-field crop rotations in plots under different fertilization systems in the time period from 1964 to 2006. No herbicides were used throughout the experiments.

Both number of species and the average amount of weeds changed over time depending on crop rotation intensity. The number of weed species in the period of 40 years decreased. The number of weeds in the fields of crop rotation was dependent on cultivated crops. Fertilization systems have significant impact on weed diversity.

In general, in less intensive rotations weed abundance was lower.

Key words: long-term crop rotations, weed management, biodiversity.

MULCHING EFFECT ON YIELD AND QUALITY OF ASPARAGUS (*ASPARAGUS OFFICINALIS* L.)

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Asparagus (*Asparagus officinalis* L.) is very valuable vegetable, which becomes more and more popular in Lithuania and produces good yield in our climatic conditions. Young asparagus spears give yield in early spring when choice of fresh vegetables is not wide. However, Lithuania still has not researched sufficiently effect of environment and growing conditions on yield and quality of asparagus. Asparagus is not frost resistant, especially in spring when some part of yield is lost sometimes. It is supposed that mulching of plants may advance yield of spears and to preserve productivity.

The research is carried out in order to find out what effect the peat mulch has on the earliness, extent and quality of asparagus yield.

The research of asparagus mulching has been performed in the Nursery of the Faculty of Agronomy of ASU and the chemical composition of spears was determined in the Laboratory of Quality of Plant Raw Materials in 2013-2014. The asparagus of the varieties Gijnlim and Avalim have been researched: without mulch; with autumn 5 cm mulch, and with spring 5 cm mulch. Productivity of spears was calculated and the chemical composition was determined after harvesting.

The research revealed that the largest total and marketable productivity of spears was in treatment where the asparagus had been applied with mulch in spring. Harvesting of asparagus sprouts started on 28 April 2014 and ended on 14 June 2014. The largest quantity of spears (157 pcs per Gijnlim plant and 154 pcs per Avalim plant in average) was produced by the plants of the treatment where mulch was applied in spring. The chemical analysis of the spears revealed that substantially the highest quantities of vitamin C and the lowest quantities of nitrates were detected in the spears of the control treatment (without mulch), respectively: 82.49 mg kg⁻¹ of vitamin C was in Gijnlim and 79.35 mg kg⁻¹ in Avalim spears; 164.9 mg kg⁻¹ of nitrates was in Gijnlim and 146.9 mg kg⁻¹ in Avalim spears. The largest quantities of dry materials were found in sprouts where the mulch was applied on asparagus in autumn: Gijnlim - 7.3 per cent; Avalim - 6.8 per cent. In case of variety Gijnlim, the substantially largest quantity of potassium (1789 mg kg⁻¹) was in spears where mulch was applied in autumn, and in case of Avalim (1806 mg kg⁻¹) it was without mulch.

The research revealed that mulching of asparagus in spring leads to earlier and higher productivity of spears.

Key words: asparagus, mulching, spears productivity, chemical composition.

THE GROWTH PECULIARITIES OF FALSE FLAX (*CAMELINA SATIVA* (L.) CRTZ.) AND ABYSSINIAN MUSTARD (*CRAMBE ABYSSINICA* HOCHST.)

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Oilseed area and thus the potential of Lithuania is about 300 thousand ha, it is important to look for new oil plant raw materials. In such an alternative plant is Abyssinian mustard (*Crambe abyssinica* Hochst.) and Crop-false flax (*Camelina sativa* (L.). These seeds are valuable fat composition. The seeds extracted oil suitable for industrial purposes – bio fuels, bio oil components.

The experiments were carried out at Experiment Station of Aleksandras Stulginskis University in 2010-2014. There were research growth peculiarities of false flax (*Camelina sativa* (L.) Crtz.) varieties Svalof, Boha, Hoga, Polnar-26 and Abyssinian mustard (*Crambe abyssinica* Hochst.) - Kenya, Borovski, Prophet, BGRC 30347. Experiments perform 4 replicates. Seeding depth - 2 cm. Plants fertilized with nano fertilizer (100 ml 10 l⁻¹), control – without nano fertilizer. Tillage and crop surveillance tests are carried out according to the usual technology, preceding crop - black fallow. *Camelina* harvested 08 14-16 d., *Crambe* - 08 22-25 d. Set for plant growth, yield structure elements of the harvest: plant height, number of pods plant, seed pod, 1000 seeds weight g - obtained from the presser foot, grubbed up from 10 plants of each plot. Calculated handled crop research methodologies.

Used disease and pest monitoring methodology (EPPO) recommended by harmful organisms in the accounting methods used in the evaluation of plant protection measures efficiency.

The best genotypes for reciprocal crossing between *Camelina* varieties are Svalof, Polnar and *Crambe* - Borovski, Kenya, if estimate by forwardness and productivity. In *Camelina* (Svalof, Boha, Hoga, Polnar-26) were spread flea beetles (*Phyllotreta* spp.); cabbage root fly (*Hylemyia brassicae* Bche.) and dark leaf and pod spot (*Alternaria brassicae* (Berk.) Sacc.).

In *Crambe* (Kenya, Borovski, Prophet, BGRC30347) were spread flea beetles (*Phyllotreta* spp.); oilseed rape blossom beetle (*Meligethes aeneus* F.) and dark leaf and pod spot (*Alternaria brassicae* (Berk.) Sacc.).

In general, it found objective assessment of the growing characteristics in Lithuanian conditions.

Key words: false flax, Abyssinian mustard, varieties, productivity, pests.

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