

**Aleksandras Stulginskis University**

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

INTERNATIONAL SCIENTIFIC CONFERENCE

**AgroEco2018  
PROGRAMME AND ABSTRACTS**

**AKADEMIJA, 2018**

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*The conference is organised to address issues highlighted in Lithuanian Research Council's National Research Programme 'Sustainability of Agro-, Forest and Water Ecosystems' (2015–2021) and to celebrate 100 years of restoration of Lithuania.*

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# PROGRAMME

## 2 October (Tuesday)

Room No. 211 in 4th building, Universiteto str. 8a, Akademija, Kaunas district

17 <sup>00</sup> – 19 <sup>00</sup>	<b>Registration and coffee</b>
18 <sup>00</sup> – 18 <sup>30</sup>	<b>Meeting of international conference scientific and organising committees and keynote speakers</b> Moderators: Prof. Dr. Aušra Blinstrubienė, Prof. Dr. Vaclovas Bogužas
18 <sup>30</sup> – 19 <sup>00</sup>	<b>Research activities and cooperation possibilities at Aleksandras Stulginskis University</b> Moderators: Prof. Dr. Kęstutis Romaneckas, Assoc. Prof. Dr. Zita Kriauciūnienė
19 <sup>00</sup> – 21 <sup>00</sup>	<b>Welcome evening</b> (registration on agroeco@asu.lt is necessary until 1st of October)

## 3 October (Wednesday)

Room No. 505 in Central building, Studentu str. 11, Akademija, Kaunas district

8 <sup>00</sup> – 9 <sup>00</sup>	<b>Registration, poster mounting and coffee</b>
9 <sup>00</sup> – 9 <sup>30</sup>	<b>Opening of the conference</b> Prof. Dr. Antanas Maziliauskas, <i>Rector of Aleksandras Stulginskis University</i> , Prof. Habil. Dr. Zenonas Dabkevičius, <i>Vice-President of Lithuanian Academy of Sciences</i> , Zigmas Medingis, <i>Ministry of Agriculture of the Republic of Lithuania</i> , Prof. Dr. Aušra Blinstrubienė, <i>Dean of Faculty of Agronomy Aleksandras Stulginskis University</i>
9 <sup>30</sup> – 12 <sup>30</sup>	<b>Plenary presentations</b> Chairs of the section: Assoc. Prof. Dr. Rimantas Vaisvalavičius, <i>Aleksandras Stulginskis University, Lithuania</i> ; Prof. Dr. Rainer Horn, <i>Christian-Albrechts-University, Germany</i>
9 <sup>30</sup> – 10 <sup>00</sup>	<b>Advances in soil research – tasks and requirements for a better understanding of a sustainable environment</b> Prof. Dr. Rainer Horn, <i>Christian-Albrechts-University, Germany</i>
10 <sup>00</sup> – 10 <sup>30</sup>	<b>Ecological aspects of agricultural soils</b> Assoc. Prof. Dr. Jūratė Aleinikovienė, <i>Aleksandras Stulginskis University, Lithuania</i>
10 <sup>30</sup> – 11 <sup>00</sup>	<b>Coffee break, photography of participants at central entrance of Central Building</b>
11 <sup>00</sup> – 11 <sup>30</sup>	<b>Impact of soil tillage systems on arbuscular mycorrhizal fungal communities in maize and wheat cropping systems in a chernozem in Germany</b> Prof. Habil. Dr. Ewald Sieverding, <i>University of Stuttgart Hohenheim, Germany</i> , Prof. Habil. Dr. Helmut Baltruschat, Prof. Dr. Annette Deubel, <i>Anhalt University of Applied Sciences, Bernburg, Germany</i> , PhD Student Fritz Oehl, <i>Agroscope, Wädenswil, Switzerland</i>
11 <sup>30</sup> – 12 <sup>00</sup>	<b>Climate change impact to alive organisms</b> Prof. Dr. Saulius Mickevičius, Prof. Dr. Audrius Dėdelė, Prof. Dr. Algimantas Paulauskas, <i>Vytautas Magnus University, Lithuania</i>

12 <sup>00</sup> – 12 <sup>30</sup>	<b>Cambisol and Retisol quality changes under long-term contrasting management in Lithuania</b> Leading Researcher Dr. Virginijus Feiza, Senior Researcher Dr. Dalia Feizienė, Leading Researcher Dr. Danutė Karčauskienė, Senior Researcher Dr. Aleksandras Velykis, Researcher Dr. Antanas Satkus, Researcher Assoc. Prof. Dr. Jonas Volungevičius, PhD Student Mykola Kochiiuru, <i>Lithuanian Research Centre for Agriculture and Forestry, Lithuania</i>
12 <sup>30</sup> – 13 <sup>30</sup>	<b>Lunch, poster presentations</b>
13 <sup>30</sup> – 15 <sup>00</sup>	<b>Oral presentations</b> Chairs of the section: Prof. Dr. Vaclovas Bogužas, <i>Aleksandras Stulginskis University, Lithuania</i> ; Prof. Habil. Dr. Ewald Sieverding, <i>University of Stuttgart Hohenheim, Germany</i>
13 <sup>30</sup> – 13 <sup>45</sup>	<b>Innovations – a cornerstone of bioeconomy development</b> Prof. Dr. Vilija Aleknevičienė, <i>Aleksandras Stulginskis University, Lithuania</i>
13 <sup>45</sup> – 14 <sup>00</sup>	<b>Potentials and limitations of legumes in providing ecosystem services</b> Leading Researcher Dr. Žydrė Kadžiulienė, Junior Researcher PhD Student Monika Toleikienė, Senior Researcher Dr. Lina Šarūnaitė, Leading Researcher Dr. Skaidrė Supronienė, Junior Researcher Dr. Kristyna Razbadauskienė, Senior Researcher Dr. Aušra Arlauskienė, <i>Lithuanian Research Centre for Agriculture and Forestry, Lithuania</i>
14 <sup>00</sup> – 14 <sup>15</sup>	<b>The response of faba bean productivity to soil tillage intensity</b> Prof. Dr. Kęstutis Romaneckas, PhD Student Rasa Kimbirauskienė, Lect. Dr. Aida Adamavičienė, Assoc. Prof. Dr. Aušra Sinkevičienė, Prof. Dr. Vaclovas Bogužas, Prof. Dr. Egidijus Šarauskis, Assoc. Prof. Dr. Vidmantas Butkus, Prof. Dr. Algirdas Jasinskas, Researcher Dr. Sidona Buragienė, <i>Aleksandras Stulginskis University, Lithuania</i>
14 <sup>15</sup> – 14 <sup>30</sup>	<b>The suitability of selected spring cultivars for autumn sowing</b> Researcher Dr. Marta Wzyńska, Assoc. Prof. Dr. Jerzy Grabiński, <i>Institute of Soil Science and Plant Cultivation – State Research Institute, Poland</i> , Researcher Dr. Marzena Mikos-Szymańska, <i>New Chemical Syntheses Institute, Poland</i>
14 <sup>30</sup> – 14 <sup>45</sup>	<b>Potassium as indicator of soil profile formation and change of its physico-chemical properties</b> Assoc. Prof. Dr. Rimantas Vaisvalavičius, <i>Aleksandras Stulginskis University</i> , Researcher Assoc. Prof. Dr. Jonas Volungevičius, <i>Vilnius University</i> , Researcher Dr. Kristina Amalevičiūtė-Volungė, Leading Researcher Dr. Alvyra Šlepėtienė, Leading Researcher Dr. Virginijus Feiza, <i>Lithuanian Research Centre for Agriculture and Forestry</i> , Dr. Virgilija Gregorauskienė, <i>Lithuanian Geological Survey, Lithuania</i>
14 <sup>45</sup> – 15 <sup>00</sup>	<b>Effect of crop rotation structure on perennial weed distribution</b> Leading Researcher Dr. Līvija Zarina, Researcher MSc Dace Pilikšere, <i>Institute of Agricultural Resources and Economics, Latvia</i> , Researcher Dr. Liga Zarina, <i>University of Latvia, Latvia</i>
15 <sup>00</sup> – 15 <sup>30</sup>	<b>Coffee break, poster presentations</b>
15 <sup>30</sup> – 17 <sup>15</sup>	<b>Oral presentations</b>
15 <sup>30</sup> – 15 <sup>45</sup>	<b>The effect of superabsorbent polymer application on yielding of spring wheat</b> Assoc. Prof. Dr. Jerzy Grabiński, Researcher Dr. Marta Wzyńska, Assoc. Prof. Dr. Alicja Sulek, <i>Institute of Soil Science and Plant Cultivation – State Research Institute, Poland</i>

15 <sup>45</sup> – 16 <sup>00</sup>	<b>Impact of farming system on barley nutrient use efficiency</b> PhD Student Keyvan Esmaeilzadeh-Salestani, Researcher Dr. Maarika Alaru, Researcher Dr. Vyacheslav Eremeev, Assoc. Prof. Dr. Jaan Kuht, Senior Researcher Dr. Evelin Loit, <i>Estonian University of Life Sciences, Estonia</i>
16 <sup>00</sup> – 16 <sup>15</sup>	<b>Impact of climate change on winter wheat phenology</b> PhD Student Martynas Klepeckas, Assoc. Prof. Dr. Gintarė Sujetovienė, Assoc. Prof. Dr. Arvydas Kanapickas, Prof. Habil. Dr. Romualdas Juknys, <i>Vytautas Magnus University, Lithuania</i>
16 <sup>15</sup> – 16 <sup>30</sup>	<b>Leaching of soil organic carbon and nutrients in organic farming</b> Leading Researcher Dr. Kęstutis Armolaitis, <i>Lithuanian Research Centre for Agriculture and Forestry</i> , Assoc. Prof. Dr. Jūratė Aleinikovienė, <i>Aleksandras Stulginskis University</i> , Junior Researcher PhD Student Aušra Gudauskienė, Researcher Dr. Vilma Žėkaitė, Senior Researcher Dr. Rūta Česnulevičienė, <i>Lithuanian Research Centre for Agriculture and Forestry, Lithuania</i>
16 <sup>30</sup> – 16 <sup>45</sup>	<b>Stability of soil aggregates after freezing–thawing processes in Retisol and their relationship with organic carbon</b> PhD Student Mykola Kochiiaru, Leading Researcher Dr. Virginijus Feiza, Leading Researcher Dr. Alvyra Šlepetienė, Senior Researcher Dr. Aleksandras Velykis, Researcher Assoc. Prof. Dr. Jonas Volungevičius, <i>Lithuanian Research Centre for Agriculture and Forestry, Lithuania</i>
16 <sup>45</sup> – 17 <sup>00</sup>	<b>Analysis of phosphorus compound concentration changes in a subsurface flow constructed wetland in Latvia</b> Lector PhD student, lector Linda Grinberga, Alise Trifane, <i>Latvia University of Life Sciences and Technologies, Latvia</i>
17 <sup>00</sup> – 17 <sup>15</sup>	<b>Legume Manure Decomposition in Organically Managed Soils</b> Junior Researcher PhD Student Monika Toleikienė, Senior Researcher Dr. Aušra Arlauskienė, Leading Researcher Dr. Žydrė Kadžiulienė, <i>Lithuanian Research Centre for Agriculture and Forestry, Lithuania</i>
17 <sup>15</sup> – 17 <sup>30</sup>	<b>Concluding remarks and discussions</b> Moderators Prof. Dr. Vaclovas Bogužas, Prof. Dr. Aušra Blinstrubienė <i>Aleksandras Stulginskis University, Lithuania</i> ; Prof. Habil. Dr. Ewald Sieverding, <i>University of Stuttgart Hohenheim, Germany</i> ; Prof. Dr. Rainer Horn, <i>Christian-Albrechts-University, Germany</i>
18 <sup>00</sup> – 22 <sup>00</sup>	<b>Conference dinner with cultural program</b>

#### 4–5 October (Thursday–Friday)

#### Post conference AgroEco2018 Scientific Field Expedition

7 <sup>00</sup>	Meeting point central entrance of Central building, Studentu str. 11, Akademija, Kaunas district <b>Soil cover peculiarities in the lowlands of the Northern Lithuania</b> Moderators Assoc. Prof. Dr. Rimantas Vaisvalavičius, Lect. Dr. Romutė Mikučionienė, <i>Aleksandras Stulginskis University, Lithuania</i>
More information: <a href="http://ldd.asu.lt/en/index_en.html">http://ldd.asu.lt/en/index_en.html</a>	

## Poster presentations

No.	Authors	Institution, country	Title of presentation
1.	Lect. Dr. Aida Adamavičienė, Prof. Dr. Kęstutis Romaneckas, Researcher Dr. Sidona Buragienė, PhD Student Edita Eimutyė	Aleksandras Stulginskis University, Lithuania	Influence of living mulches on productivity indicators of maize
2.	Prof. Habil. Dr. Jan Adamiak, Prof. Habil. Dr. Ewa Adamiak, Habil. Dr. Arkadiusz Stepień	University of Warmia and Mazury in Olsztyn, Poland	Response of spring barley to long-term monoculture in diversified conditions of chemical protection
3.	Assoc. Prof. Dr. Inga Adamonytė, Assoc. Prof. Dr. Vilda Grybauskienė, Lect. Gitana Vyčienė	Aleksandras Stulginskis University, Lithuania	Comparison of the effect of perlite and vermiculite on the moisture retention
4.	Jovita Balandaitė, Lect. Dr. Aida Adamavičienė, PhD Student Edita Eimutyė, Prof. Dr. Kęstutis Romaneckas, Assoc. Prof. Dr. Dejan Prvulović	Aleksandras Stulginskis University, Lithuania; University of Novi Sad, Serbia	Influence of non – chemical weed control methods on sugar beet productivity and quality parameters
5.	Habil. Dr. Stanisław Bielski, Prof. Dr. Kęstutis Romaneckas, Prof. Habil. Dr. Jan Falkowski	University of Warmia and Mazury in Olsztyn, Poland; Aleksandras Stulginskis University, Lithuania	Effect of the nitrogen and boron fertilisation on yield of winter triticale production
6.	Msc Aivis Bikernieks, PhD Student Simona Larsson, Vivita Viksnina, Assoc. Prof. Dr. Olegs Kukainis	Latvia University of Life Sciences and Technologies, “Razosanas Tehnologijas” Ltd., Latvian Institute of Humic Substances, Latvia	The role of humic substances in agricultural sustainability
7.	PhD Student Indrė Čechovičienė, Prof. Dr. Honorata Daniľchenko, Assoc. Prof. Dr. Živilė Tarasevičienė, Leading Researcher Dr. Skaidrė Supronienė, Assoc. Prof. Dr. Aurelija Paulauskienė, Rugilė Sabaliauskaitė, Toma Savickaitė	Aleksandras Stulginskis University, Lithuania	The effects of moistening water on the quality of the sprouted cereal seeds for food
8.	Lect. Dr. Austra Dikšaitytė, Leading Researcher Dr. Akvilė Viršilė, PhD Student Gintarė Juozapaitienė, Assoc. Prof. Dr. Irena Januškaitienė	Lithuanian Research Centre for Agriculture and Forestry, Vytautas Magnus University, Lithuania	Impact of heat and drought on summer rape under adequate and deprived soil nitrogen and elevated atmospheric CO <sub>2</sub> conditions

9.	Leading Researcher Dr. Virginijus Feiza, Senior Researcher Dr. Dalia Feizienė, Senior Researcher Dr. Irena Deveikytė, Researcher Dr. Vytautas Seibutis, Researcher Assoc. Prof. Dr. Jonas Volungevičius, Senior Researcher Dr. Daiva Janušauskaitė	Lithuanian Research Centre for Agriculture and Forestry, Lithuania	The influence of contrasting tillage on soil porosity, water storage capacity and carbon dioxide emission
10.	Senior Researcher Dr. Dalia Feizienė, Leading Researcher Dr. Virginijus Feiza, Junior Researcher Dr. Agnė Veršulienė, PhD Student Mykola Kochiiieru, Senior Researcher Dr. Irena Deveikytė, Researcher Dr. Vytautas Seibutis, Researcher Assoc. Prof. Dr. Jonas Volungevičius, Senior Researcher Dr. Daiva Janušauskaitė	Lithuanian Research Centre for Agriculture and Forestry, Lithuania	Consequence of long-term contrasting soil management: soil properties and wheat roots distribution
11.	Senior Researcher Dr. Daiva Janušauskaitė, Senior Researcher Dr. Dalia Feizienė, Leading Researcher Dr. Virginijus Feiza	Lithuanian Research Centre for Agriculture and Forestry, Lithuania	The influence of soil tillage and fertilization on wheat physiological traits
12.	MSc Oskars Java	Vidzeme University of Applied Sciences, Latvia	Bog restoration for greenhouse gas emissions sequestration and climate change mitigation
13.	Assoc. Prof. Dr. Darija Jodaugienė, Lect. Dr. Rita Čepulienė	Aleksandras Stulginskis University, Lithuania	Influence of biological preparations on soil nitrogen and phosphorus content in the spring wheat crop
14.	PhD Student Vaiva Jurevičienė, Assoc. Prof. Dr. Renata Dagiliūtė	Vytautas Magnus University, Lithuania	Impact of changes in LULUCF accounting rules on the achievement of climate change mitigation goals
15.	Jānis Kaņeps, Assoc. Prof. Dr. Gunita Bimšteine, Prof. Dr. Biruta Bankina, Assist. Ingrīda Neusa-Luca, Assist. Ance Roga, Dr. Dāvids Fridmanis	Latvia University of Life Sciences and Technologies, Latvian Biomedical Research and Study Centre, Latvia	Fungal communities in infected wheat stem bases
16.	PhD Student Silvija Kosteckienė, Prof. Habil. Dr. Rimantas Velička, Assoc. Prof. Dr. Lina Marija Butkevičienė, Assoc. Prof. Dr. Zita Kriaučiūnienė, Lect. Dr. Robertas Kosteckas	Aleksandras Stulginskis University, Lithuania	The effect of sowing time on <i>Alternaria brassicae</i> and <i>Phyllotreta</i> spp. spreading in spring oilseed rape crop

17.	Assoc. Prof. Dr. Zita Kriaučiūnienė, Prof. Dr. Aušra Marcinkevičienė, Prof. Habil. Dr. Rimantas Velička, Dr. Rita Mockevičienė, Lect. Dr. Robertas Kosteckas, Assoc. Prof. Dr. Lina Marija Butkevičienė, Dr. Sigitas Čekanauskas, PhD Student Silvija Kosteckienė	Aleksandras Stulginskis University, Lithuania	Application of bio-preparations in organic spring rapeseed crop and the humus content effect on soil properties
18.	PhD Student Osvaldas Kučinskas, Prof. Dr. Vitas Marozas, Lect. Dr. Jurgita Sasnauskienė, Assoc. Prof. Dr. Nijolė Maršalkienė, Prof. Dr. Laima Česonienė, Assoc. Prof. Dr. Lina Straigyte	Aleksandras Stulginskis University, Lithuania	The impact on soil CO <sub>2</sub> emissions by tree plantations composition, structure and climatic factors
19.	Prof. Dr. Aušra Marcinkevičienė, Prof. Habil. Dr. Rimantas Velička, Assoc. Prof. Dr. Zita Kriaučiūnienė, PhD Student Marina Keidan, Assoc. Prof. Dr. Rita Pupalienė, Assoc. Prof. Dr. Lina Marija Butkevičienė, Lect. Dr. Robertas Kosteckas	Aleksandras Stulginskis University, Lithuania	The impact of non-chemical weed control on soil biological properties in the winter rapeseed agroecosis
20.	Prof. Habil. Dr. Marek Marks, PhD Student Marek Reich, Habil. Dr. Stanisław Bielski	University of Warmia and Mazury in Olsztyn, Poland	Yield and quality of malting barley grain depending on nitrogen fertilisation and applied fungicides
21.	PhD Student Brigita Medveckienė, Assoc. Prof. Dr. Jurgita Kulaitienė, Assoc. Prof. Dr. Judita Černiauskienė	Aleksandras Stulginskis University, Lithuania	Nutrition value of rosehips
22.	PhD Student Andra Miķelsone, Dr. Dace Grauda	University of Latvia, Latvia	Determination of flax rust L2 and L9 resistance alleles in Latvian origin flax ( <i>Linum usitatissimum</i> ) genotypes
23.	Assoc. Prof. Dr. Romutė Mikučionienė	University of Applied Sciences, Lithuania	Testing the criteria of soil resources under national and international soil classification
24.	Assoc. Prof. Dr. Aurelija Paulauskienė, Assoc. Prof. Dr. Živilė Tarasevičienė, PhD Student Dalė Televičiūtė, PhD Student Aloyzas Velička	Aleksandras Stulginskis University, Lithuania	Quality of naturally fermented cucumbers
25.	PhD Student Remigijus Peleckis, Prof. Dr. Natalija Burbulis, Prof. Dr. Aušra Blinstrubienė	Aleksandras Stulginskis University, Lithuania	Improvement of cold tolerance of winter oilseed rape by exogenous amino acids



26.	Dr. Liga Proskina, Prof. Dr. Irina Pilvere, Dr. Sallija Cerina	Latvia University of Life Sciences and Technologies, Institute of Agricultural Resources and Economics, Latvia	Legumes as feed: economic consideration
27.	PhD Student Vita Smalstienė, Assoc. Prof. Dr. Irena Pranckietienė, Assoc. Prof. Dr. Rūta Dromantienė, Prof. Habil. Dr. Gvidas Šidlauskas	Aleksandras Stulginskis University, Lithuania	The influence of different nitrogen forms and application time on winter wheat
28.	PhD Student Inga Stafecka, Dr. Dace Grauda, Veneranda Stramkale	Institute of Agricultural Resources and Economics, Research Centre of Priekuli, Daugavpils University, University of Latvia, Latvia	The evaluation of disease resistance of flax genetic resources
29.	Dr. Vaida Steponavičienė, Prof. Dr. Vaclovas Bogužas, Assoc. Prof. Dr. Aušra Sinkevičienė, PhD Student Lina Skinulienė, MSc Alfredas Sinkevičius	Aleksandras Stulginskis University, Lithuania	Long-term impact of reduced intensity tillage systems, straw and green manure combinations on soil properties
30.	Habil. Dr. Alicja Sułek, Habil. Dr. Grażyna Cacak-Pietrzak	Institute of Soil Science and Plant Cultivation - State Research Institute, Warsaw University of Life Science, Poland	The influence of production technology on yield and quality parameters of hard spring wheat ( <i>Triticum durum</i> )
31.	Assoc. Prof. Dr. Živilė Tarasevičienė, Simona Eidukynaitė, Vidmantė Rimkutė, Miglė Navašinskaitė, Assoc. Prof. Dr. Aurimas Krasauskas, Prof. Dr. Elvyra Jarienė, Assoc. Prof. Dr. Aurelija Paulauskienė	Aleksandras Stulginskis University, Lithuania	Impact of edible coatings on chemical content, microbiological contamination and physical properties of blueberries
32.	Assoc. Prof. Dr. Rimantas Vaisvalavičius, Assoc. Prof. Dr. Irena Pranckietienė, Assoc. Prof. Dr. Jūratė Aleinikovienė, Assoc. Prof. Dr. Rūta Dromantienė	Aleksandras Stulginskis University, Lithuania	Fish processing by- products utilization for soil amendment purposes

33.	PhD Student Aloyzas Velička, Assoc. Prof. Dr. Živilė Tarasevičienė, Prof. Dr. Honorata Danilčenko, Assoc. Prof. Dr. Algirdas Radzevičius, Renata Masionytė, Raimonda Metlovaitė, Assoc. Prof. Dr. Aurelija Paulauskienė, Ernesta Genevičiūtė	Aleksandras Stulginskis University, Lithuania	The influence of irrigation on the chemical composition and colour parameters of <i>Mentha spicata</i> 'Moroccan' mints
34.	Senior Researcher Dr. Aleksandras Velykis, Researcher Dr. Antanas Satkus	Lithuanian Research Centre for Agriculture and Forestry, Lithuania	Reduced tillage, lime matter and cover crop effects on cleyey soil physical state
35.	Researcher Lidija Vojevoda, Assoc. Prof. Dr. Vilhelmīne Šteinberga, Lect. Laila Dubova	Institute of Agricultural Resources and Economics, Stende Research Centre, Latvia University of Life Sciences and Technologies, Latvia	Effects of the extracts of organic products on the soil microorganisms in the biological potato plantation

## ABSTRACTS

### IMPACT OF SOIL TILLAGE SYSTEMS ON ARBUSCULAR MYCORRHIZAL FUNGAL COMMUNITIES IN MAIZE AND WHEAT CROPPING SYSTEMS IN A CHERNOZEM IN GERMANY

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Arbuscular mycorrhizal fungi (AMF) are considered to be important soil microbial components for nutrient uptake and productivity of mycotrophic agronomic crops. Little information is available about the diversity of AMF in Chernozems that are considered to be soil types with highest natural soil fertility. We aimed at studying the impact of soil tillage systems and fertilization intensities on AMF fungal communities in a long-term field trial experiment that was established in a Chernozem of the Magdeburger Börde, Central Germany, in 1992. Besides the rotations of crops (winter wheat, winter barley, winter oil seed rape, winter wheat, maize) there were two tillage systems (conservation tillage by cultivator & ploughing) and two or three fertilization intensities. Soil samples were taken at harvest of maize that grew after winter wheat, and from wheat that grew after rape, in 2015. Oil seed rape is a so-call non-mycorrhizal crop, while the other crops are known to multiply AMF. Spores of AMF were extracted from soils and characterised as well as identified by spore morphology. Unexpectedly high spore densities (up to 41 spores g<sup>-1</sup> soil) and species richness (19-33 species) of AMF were found in these soils. Numbers were higher in conservation tillage than in ploughed plots and generally decreasing with increasing fertilization input. In wheat, the diversity of AMF was not significantly different to maize, despite that wheat grew after a non-mycorrhizal crop. As expected, some AMF species, so-called generalists, were found in higher concentrations in all cropping and cultivation systems, while others were only found in higher concentrations in conservation tillage or under reduced fertilizer inputs; one was preferably found in ploughed plots. In conclusion, higher AMF species richness and diversity might be responsible for the stabilisation of yields in Chernozems under reduced tillage.

**Keywords:** diversity, *Glomeromycotina*, reduced tillage, ploughing, long-term.

# INNOVATIONS – A CORNERSTONE OF BIOECONOMY DEVELOPMENT

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Shifting from fossil-based to a bio-based economy requires scientific research and innovations. Innovations will foster bioeconomy development.

For this reason, the author presents the conceptual model for bioeconomy development and innovation interaction consisting of the drivers of bioeconomy development, types of innovations and the tasks necessary for the achievement of the goals of bioeconomy development.

The main research methods used for preparation of the conceptual model were scientific abstraction, analysis and synthesis, content analysis, and modelling.

Rising population, depletion of natural resources, increased environmental pressure, and climate change are the main global drivers of bioeconomy development. They imply a strong need for innovation, which in the context of a transitional bioeconomy must be radical, open, systematic and sustainable. Only through such types of innovations it will be possible to solve the tasks (in the conceptual model indefinite) and to achieve the goals of bioeconomy development. This does not mean that bioeconomy could not be developed through incremental, rationalisation or disruptive innovations. This means that they are not important for the transition period. The main tasks, such as replacement of fossil materials by biomass, replacement of one type of biomass with another one, searching for the new forms of biomass, increasing of food security and improvement of food quality, decreasing of food waste, development of circular economy, changing consumers' behaviour, creating value chains and markets, etc., presuppose the necessity to build horizontal, cross-sectoral economic structure.

In general, the radical and open innovations are necessary for the transition process. Horizontal, cross-sectoral economic structure needs to be built and this leads to pressure, confusion and barriers that hamper the innovation process.

**Keywords:** bioeconomy development, innovations, typology of innovations, conceptual model.

## POTENTIALS AND LIMITATIONS OF LEGUMES IN PROVIDING ECOSYSTEM SERVICES

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Including legumes into conventional or organic cropping systems can lead to a range of environmental effects and sustainability of the agro-ecosystems. Considering this, the questions related to the benefits of red clover, peas and other less common legumes for the northern pedo-climatic conditions, such as soybeans nowadays are very important. Legumes, plant-based manures and organic fertilizers are tools for supporting nutrient cycling in low-input systems.

In order to take advantage of the multifunctional properties of legumes, the number of recent experiments was aimed for assessment of the potential of legumes productivity and their ecological services in cropping systems.

Few field studies were conducted on a loamy Endocalcari-Ephygogleyic Cambisol in Dotnuva and on clay loam Endocalcaric Endogleyic Cambisol in Joniškėlis.

The highest effect to subsequent spring crops productivity was obtained by the use of biomass of incorporated red clover and manure pellets or by using manure pellets twice in the crop rotation. The functional diversity of microbial communities was greater in soil fertilised with organic plant-based manures. Soybean grain yield and quality was affected by management factors (sowing time, inoculation and rows spacing), however, row spacing affected them inversely.

The legumes potential value is greatly dependent on legume species. The productivity and the quality of subsequent crops can be improved by the use of legumes in combination with other management factors, however, to maintain soil fertility with legume nitrogen is not easy. Organic plant-based manures increased microbial functional diversity. The use of different management practices influences soybean yields and affect the quality.

**Keywords:** ecosystem services, legumes, plant-based manures, subsequent crops.

## THE RESPONSE OF FABA BEAN PRODUCTIVITY TO SOIL TILLAGE INTENSITY

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Reduction of soil tillage intensity leads to changes in soil properties and in this way influences crop biometry and productivity. In Lithuania, according to the EU Greening regulation, the areas of faba bean crop expanded several times during the last three years; however, there was no scientific background on some technological parameters, including tillage. For this reason, a long-term (since 1988) stationary field experiment was carried out at the Experimental Station of the Aleksandras Stulginskis University, Lithuania. Five tillage operations were investigated: deep (22–25 cm) ploughing, shallow (12–15 cm) ploughing, chiselling (25–30 cm), disking (10–12 cm) and no-till. Faba bean crop was cultivated since 2016. The aim of these investigations was to establish the response of faba bean productivity parameters to long-term reduced tillage.

Results of investigations showed that long-term different tillage intensity mainly had no significant effect on the faba bean productivity parameters.

**Keywords:** faba bean, productivity, tillage intensity.

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# THE SUITABILITY OF SELECTED SPRING CULTIVARS FOR AUTUMN SOWING

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Both breeders and farmers are looking for ways to increase the yield of spring wheat. There are genotypes of spring wheat which can also be sown in autumn.

Field trials were conducted during three vegetation seasons 2008/2009, 2009/2010, and 2010/2011 at the Experimental Centre for Variety Testing in Bezek, Czesławice and Cicibór Duży, the Lubelskie voivodeship, Poland (three different localities).

The basis for the research were two-factor field experiments. The first-order factor (A) was the sowing time (three levels) and the second (B) was a spring wheat cultivar (five levels).

Wheat cultivars responded with yield increase in the autumn sowing date conditions comparing to spring sowing date conditions. ‘Tybalt’ and ‘Monsun’ were the highest yielding cultivars in these dates. Yield components of wheat varied in years of experiments. The number of plants and ears per the surface unit and tiller production depended significantly on both experiment factors (wheat cultivar, sowing date) and conditions of experimental sites. Experimental factors influenced the technological value of wheat grain. The most variable quality parameter, under the influence of experimental factors, was the quantity and quality of wet gluten content.

The usability of selected spring wheat cultivars for autumn sowing was found. The studied sowing contributed to the higher yielding of wheat.

**Keywords:** alternative wheat, alternative sowing, yield, quality.

## POTASSIUM AS AN INDICATOR OF SOIL PROFILE FORMATION AND CHANGE OF ITS PHYSICO-CHEMICAL PROPERTIES

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Taking into account the importance of potassium for soil diagnostic purposes, the investigations on the formation peculiarities of the youngest (Northern Lithuania) and the oldest (Eastern Lithuania) loamy soils were carried out in 2016–2017. Having made a soil profile description, the allocation of each investigated soil was done according to the WRB classification system (2014 edition). Soil samples for physico-chemical analysis were collected from the genetic horizons of the soil profiles. Undisturbed core samples for determining bulk density of soil and total porosity were collected using stainless steel rings (100 cm<sup>3</sup> volumes) in four replications. Bulk density and total porosity were calculated from undisturbed soil samples. For chemical analyses, the soil samples were air-dried, crushed and sieved through a 2-mm sieve and homogeneously mixed. The data obtained shows that total potassium content has a direct strong correlation ( $r = 0.83$  in Luvisol and  $r = 0.83-0.98$  in Planosol) with soil clay and silt fractions content, thus, indicating a direct relationship between these soil constituents. However, this relationship remains statistically significant only in subsoil whose formation is not affected by SOC. The distribution of mobile K in studied soil profiles is related to the distribution of soil organic material and its migration throughout the soil profile. The correlation of total and mobile K with SOC can be estimated only by analysing the distribution of potassium in the humic soil horizons. The negative correlation ( $r = -0.97$ ) indicates that the soil is not affected by the agricultural activity. The positive strong correlation ( $r = 0.99$ ) shows a direct or indirect effect of adjacent agricultural areas and potassium sorption in soil organic matter. The correlation between soil bulk density and total porosity it was estimated a little bit lower in the Planosol compared to the Luvisol. It is dependent on its 10 times longer pedogenesis and synergistic interactions effect of different soil forming factors. Thus, it likely that periglacial processes and the migration of organic material into the deeper layers throughout soil profile has had a significant effect in regard of such regularities.

**Keywords:** soil formation, planosol, luvisol, physico-chemical properties.

**Acknowledgement:** the paper presents research findings, obtained through the national 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.



## EFFECT OF CROP ROTATION STRUCTURE ON PERENNIAL WEED DISTRIBUTION

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Many plants that are considered as weeds play an important role in the ecosystem, however, the number of weeds in the fields often fails to balance. Perennial weeds continue to be a major problem for organic farmers causing production losses and economic issues. The influence of crop rotation (CR) on the weed distribution has been studied thoroughly worldwide. In contrast, we still lack results on long-term impact on the composition of weed species generally and the effect on the distribution of concrete taxons. For this reason, the data from long-term experiments of (LTE, 1958–2004) weed monitoring were studied at the Priekuli Research Centre of Institute of Agricultural Resources and Economics (AREI). The aim was to determine the influence of CR structure on distribution of most problematic perennial weeds (PW) in Vidzeme agroecological conditions – thistle, sow-thistle, and couch grass. There were weediness from five different longiness and structure rotations compared. Crops were fertilized using manure 10 t ha<sup>-1</sup> in period of 1958–1980, after – 20 t ha<sup>-1</sup>. No herbicides were used during the experimental period. The results of this study suggest limited potential for PW successful management with crop rotation diversification in rotations where cereals account for more than 34%. With an increase of the number of rotations circles, an increase in the level of weediness was fixed, therefore, it can be assumed that the precise agronomic measures are crucial for the limitation of PW.

**Keywords:** LTE, weediness, perennial weeds, cropping system.

# THE EFFECT OF SUPERABSORBENT POLYMER APPLICATION ON YIELDING OF SPRING WHEAT

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Superabsorbents are hydrophilic polymers that can absorb large amounts of water. The production of these substances in the world is still increasing and a question, whether it is possible to use these substances in the farming to reduce the drought stress, has become justified. In Poland droughts most strongly are touching spring plants and therefore for examinations it was chosen the spring form of the wheat.

The aim of the study was to determine the influence of superabsorbent applied to soil on the yielding of spring wheat.

In the years 2014–2016 field experiments were carried out in two regions of Poland, in the crossed sub-block design and 4 replications. The crosslinked acrylic potassium polymer was evaluated by the following rates: 1) control – without hydrogel; 2) 10; 3) 20 and 4) 30 kg ha<sup>-1</sup>. During the vegetation period dates of the plant development stages were noted. Prior to the harvest, samples of plants were taken in order to determine the elements of yield structure. The results were statistically analysed.

The influence of the superabsorbent (SAP) applied to soil on yielding of the spring wheat was not identical in both research points and depended on variables of weather conditions of the year. The smallest positive effect of the SAP was observed in the year with relatively highest precipitation and their most even distribution. However, the strongest in the year with the great deficiency of fallouts (in particular in experiment carried out in central Poland).

The effect of superabsorbent on spring wheat yield varied throughout the years. A strong positive impact was observed in the year with bigger rainfall deficits.

The use of hydrogel influenced significantly the increase of the weight of 1000 grains and the grain yield per ear.

**Keywords:** superabsorbent, doses, spring wheat, yield.

## IMPACT OF FARMING SYSTEM ON NUTRIENT USE EFFICIENCY

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Barley (*Hordeum vulgare* L.) is one of the most important crops that is cultivated in the world. For analysing significant correlations among barley traits in different farming systems a field experiment with seven different treatments was performed at Estonian University of Life Sciences during 2012–2016. The organic treatment had three subtreatments: M0, MI with cover crops and MII with cover crops and composted cattle manure. Conventional system had four subtreatments: N<sub>0</sub>P<sub>0</sub>K<sub>0</sub>; N<sub>40</sub>P<sub>25</sub>K<sub>95</sub>; N<sub>80</sub>P<sub>25</sub>K<sub>95</sub>, and N<sub>120</sub>P<sub>25</sub>K<sub>95</sub>. Based on results the correlation coefficient of important measured parameters was tabulated and investigated. Among all studied variables, there was a strong correlation (0.831) between treatments and seed yields. Our results showed that seed yields in conventional systems were approximately 60% higher than organic ones. Also, correlation of treatments with total biomass and above-ground biomass were statistically significant and strong, 0.763 and 0.793 respectively. Similarly, seed yield correlation was the highest with total and above-ground biomass, 0.789 and 0.817 respectively. Interestingly, above-ground biomass had a positive and strong correlation with number of productive tillers per m<sup>2</sup>, stem length and total biomass 0.725, 0.730 and 0.947 in a row. These results prove that the treatments can affect seed yields directly with improving vegetative features of barley.

**Keywords:** *Hordeum vulgare*, correlation coefficient, yield, biomass.

# IMPACT OF CLIMATE CHANGE ON WINTER WHEAT PHENOLOGY

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Phenological observations can be a reliable tool for estimating climate change impact on vegetation. Essential impact on the productivity of winter crops is caused by a climate warming through induced shift in the timing of phenological phases, which leads to changes in the duration of the vegetation period. The purpose of this study is to examine climate related changes in the duration of the pre-winter and post-winter wheat vegetation seasons and to present the projection for the future phenological changes. The study is based on the data of long-term phenological observations from the period of 1961–2015. Climate projections from five GCMs were analysed. The latest generation climate change scenarios based on the RCP approach were used to project annual and monthly temperatures for the 2011–2100 period. Over the investigated 55 years, a delay and shortening of the pre-winter vegetation period was noticed along with the advancement and slight extension of the post-winter vegetation period. These changes resulted in the reduction of the whole vegetation period by more than 1 week. According to the pessimistic (RCP 8.5) scenario, timing of projected phenological phases differ essentially from the observed period. 30 days advancement of the winter wheat maturity phase and the shortening of the post-winter vegetation season by 15 days are expected for the 2071–2100 period. The investigated historical period (1960–2015) and all projected periods showed an increasing trend in the available chilling amount; in addition, the projected climate warming showed that plant vernalization shortage should not be a threat in future.

**Keywords:** winter wheat, vegetation period, climate change scenarios, phenological projection.

# LEACHING OF SOIL ORGANIC CARBON AND NUTRIENTS IN ORGANIC FARMING

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Organic farming (OF) could decrease the leaching of nutrients and protect the content of soil organic carbon (SOC). However, a lack of the OF data comparison with the data obtained in the adjacent forests has been observed.

The aim of this study was to compare the leaching of SOC and plant nutrients in Luvisols in OF and Scots pine stands (ecological control).

This study was carried out at the end of a long-term (2006–2017) ecological crop rotation (ECR) in the plots of the OF at the Perloja Experimental Station of LAMMC and adjacent Scots pine stands.

It was found that the SOC content did not essentially differ in the examined OF and forest sites. However, in ECR, in comparison with Scots pine stands, the ploughed Ap horizon was significantly less acidic and contained more plant nutrients. According to the amount and chemical composition of soil water collected at the depth of 40 cm in zero-tension lysimeters, it was calculated that the leaching of nitrate + nitrite nitrogen ( $\text{NO}_3\text{-N} + \text{NO}_2\text{-N}$ ), potassium ( $\text{K}^+$ ) and calcium ( $\text{Ca}^{2+}$ ) cations was more intensive in the cropping plots of the OF. Thus, the leaching of dissolved organic carbon (DOC) in Scots pine stands was from 30–40% to 2-3-fold higher than in the OF.

In comparison with forests, long-term OF has increased the leaching of nutrients. Due to the mineralisation of the forest floor, the DOC leaching is more intensive in forest stands.

**Keywords:** Luvisols, organic farming, Scots pine stand, leaching, nutrients and organic carbon.

# STABILITY OF SOIL AGGREGATES AFTER FREEZING-THAWING PROCESSES IN RETISOL AND THEIR RELATIONSHIP WITH ORGANIC CARBON

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The aim of this study was to evaluate the stability of aggregates after 3 cycles of freezing-thawing and their relationship with organic carbon (Corg) of different land use methods (grassland, reduced tillage (RT) and conventional tillage (CT)), different water contents (air-dried, field capacity and near saturated) and different soil depths (0–10 and 10–25 cm) in Retisol on hilly landscape in Western Lithuania.

Land use method and water content had an effect on the water stability of aggregates (WSA) in different depths. The greatest WSA values averaged across the depth amounted from 80.6 to 95.6% in the grassland and 52.4–86.9% under RT application, while the lowest values – 23.1–42.2% were observed under CT. The contents of Corg amounted to 1.66% in the depth of 0–10 cm and to 1.42% in the depth of 10–25 cm under RT. The content of Corg amounting to 1.33% at the 0–10 cm depth and to 1.11% at the depth of 10–25 cm was recorded in the grassland, while under CT the content of Corg amounted to 0.81% at the 0–10 cm depth and to 0.97% at the 10–25 cm depth. The relationship between WSA and the content of Corg in different depths and land use can be described by linear regression models for water contents samples at freezing-thawing: air-dried ( $y = 58.65x + 1.87$ ,  $R^2 = 0.55$ ), field capacity ( $y = 70.07x - 18.81$ ,  $R^2 = 0.58$ ) and near saturated ( $y = 46.01x + 7.04$ ,  $R^2 = 0.22$ ).

Our results show that the moisture content of aggregate samples significantly influenced their stability on freezing. The air-dried samples (WSA values averaged across the land use and depth – 73.2%) were less affected by freezing-thawing than those at field capacity (WSA – 66.3%) or near saturated (WSA – 62.9%). This indicates that aggregates in soils with moisture content near saturation on freezing will be easily dispersed after the thawing. In addition, soil organic matter content should be increased to improve soil aggregation.

**Keywords:** water content, air-dried, field capacity, near saturated.

# ANALYSIS OF PHOSPHORUS COMPOUND CONCENTRATION CHANGES IN A SUBSURFACE FLOW CONSTRUCTED WETLAND IN LATVIA

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Phosphorus is considered as a depleting and finite resource that has an essential role in food producing and in achieving sustainable environment goals. As worldwide the access to fossil phosphorus is uneven and may become more critical in time, it is important to consider all the options of retaining and possibly recycling phosphorus. An assessment of factors affecting phosphorus retention processes in a horizontal subsurface flow constructed wetland was carried out. The initial purpose of the constructed wetland was to perform as a treatment system of contaminated surface runoff and storm water in the catchment area of a farmyard in Zalenieki County, Jelgava Region, Latvia. The aim of the scientific research was to examine the retention efficiency of phosphorus of the investigated constructed wetland and carry out an analysis of the factors affecting the retention. The catchment area of the constructed wetland is 0,8 hectares, and the surface area is approximately 2% of the catchment area. The base data was collected using a grab sample technique during the period of 32 months (June 19, 2014 – April 12, 2018) and includes concentrations of orthophosphate phosphorus ( $\text{PO}_4\text{P}$ ) and total phosphorus (TP) obtained from the inlet and outlet of the constructed wetland. Phosphorus compound concentrations are mostly influenced by discharge and internal load. Retention capacity of phosphorus in a subsurface horizontal flow constructed wetland is significantly affected by the physical processes that are dependent on the residence time as well as the construction and dimension of the constructed wetland. This research showed a steady decrease of orthophosphate- phosphorous and total phosphorous by 85% throughout the study period, whereas treatment efficiency of phosphorous compounds was less affected by seasonal changes.

**Keywords:** constructed wetland, subsurface flow, phosphorous compounds.

## LEGUME MANURE DECOMPOSITION IN ORGANICALLY MANAGED SOILS

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Due to atmospheric nitrogen fixation, legume crops are cultivated to enhance cycling of N and other nutrients and their availability to other crops in the rotation. In order to use a larger amount of biological nitrogen the aboveground mass of *Fabaceae* family plants is used as green manure.

This study researches differently prepared green legume manure used as fertilizer in an organic farm. Four green manure preparation techniques were used: direct ploughing of aboveground red clover (*Trifolium pratense* L.) mass (RC), ensiling of legume biomass (FerRC), ensiling of legume and cereal biomass (FerP+W), also composting of legume and cereal biomass (ComRC+S). For the comparison granulated cattle manure (GCM) was used, too.

All of them had different (C/N) ratios of compounds, degradation time, mineralisation rate. Larger amount of N was accumulated in RC, ComRC+S and GCM. These fertilizers contained larger amount of P and K, too. Organic fertilizers from the lowest mineralization intensity C:N to the highest were as follows: FerP+W < FerRC < GCM < ComRC+S < RC.

Field experiment was carried at the Lithuanian Centre for Agriculture and Forestry, in two locations of Lithuania: Dotnuva and Joniškėlis. Legume manure was applied in autumn or spring and degradation intensity was monitored for two vegetation periods in 2016 and 2017 using litter-bag method.

During the non-vegetative period (October-April), green red clover mass was decomposed by 43.2% in heavy loam and 65.6% in light loam soils. After 3 months of vegetation the highest intensity of degradation was reached in FerRC and FerP+W manures, respectively 61.4 and 55.6% in light loam, also 26.1 and 17.7% in heavier loam. GCM manure was degraded by 21.3% in light loam soil and 10.3% in heavy loam soil.

The results of the study showed that in the soil of lime loam soil organic leguminous fertilizers decompose faster than in the heavier loam.

**Keywords:** green manure, mineralisation, nitrogen, loam soil, red clover.



## INFLUENCE OF LIVING MULCHES ON PRODUCTIVITY INDICATORS OF MAIZE

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Enhancement of the competitive ability of agricultural crops is one of the principal tools to increase the productivity of crops. Natural means have become of special relevance in recent years, when increasingly more attention is being paid to food safety, reduction of environmental pollution and organic agriculture.

A one-factor stationary field experiment was conducted during the period of 2009–2011 at the Experimental Station of Lithuanian University of Agriculture (since 2011 – Aleksandras Stulginskis University). The soil of the experimental field was Calc(ar)i-Epithypogleyic Luvisol with a texture of silty light loam on heavy loam.

The aim of investigations was to test the impact of living mulch on maize productivity parameters. Different living mulches were inter-seeded in maize crop. Treatments of the experiment: 1. Without a living mulch (control – reference treatment); 2. Spring rape (*Brassica napus* L.); 3. White mustard (*Sinapis alba* L.); 4. Spring barley (*Hordeum vulgare* L.); 5. Italian ryegrass (*Lolium multiflorum* Lam.); 6. Black medic (*Medicago lupulina* L.); 7. Persian clover (*Trifolium resupinatum* L.); 8. Red clover (*Trifolium pratense* L.).

In most cases, living mulches tended to reduce maize grain productivity. In the third year of the experiment, the impact of the living mulches on maize grain productivity became insignificant. When the mass of living mulches was incorporated for a longer time, their negative effect tended to decrease. Italian ryegrass, black medic and Persian clover were living mulches that reduced maize grain productivity considerably.

**Keywords:** maize, living mulches, productivity.

## RESPONSE OF SPRING BARLEY TO LONG-TERM MONOCULTURE IN DIVERSIFIED CONDITIONS OF CHEMICAL PROTECTION

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The response of spring barley to 38-47-year monoculture carried out in 10-year studies (2005–2014) on albic suvisol soil at the Production and Experimental Station in Bałcyny near Ostróda town in different conditions of chemical protection has been presented. The following chemical protections of a barley canopy: O – without protection; H – protection from weeds and HF – protection from weeds and diseases have been considered. The cultivation of spring barley in 6-field crop rotation: sugar beet – maize – spring barley – pea – winter rape – winter wheat was as a comparative object. In a crop rotation the average yield of spring barley grain amounted to 6.88 t ha<sup>-1</sup>. The cultivation in 38-47-year monoculture has decreased its yielding on average by 20.4%. The biggest decrease of its productivity took place on the object without protection – 27.5%. The application of herbicides has limited the decrease to 17.5% while combined application of herbicides and fungicides – up to 16.5%. Smaller decrease is the result of plant protection products of higher efficacy in monoculture than in the crop rotation. Herbicides on that field have increased spring barley yield on average by 17.9%, the combined application of fungicides and herbicides – by 24.8% while in the case of the crop rotation – by 3.6 and 8.3% respectively. Worse yielding of spring barley in a monoculture is conditioned by thinning out the density of ears per 1 m<sup>2</sup>, and the decrease of grains mass from an ear and the mass of 1.000 grains.

**Keywords:** spring barley, crop rotation, monoculture, herbicides, fungicides, yields.

## COMPARISON OF THE EFFECT OF PERLITE AND VERMICULITE ON THE MOISTURE RETENTION

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Due to unfavourable weather, Lithuanian farmers suffered losses in 2000-2014, which amounted to an average of about 5% of total crop production. According to the HadCM3-A1B climate change scenario, considerable decrease in soil moisture in May-August is foreseen in Lithuania in the future. Compared with 1971-2000, soil moisture for as soon as 2001-2030 is projected to decline 15-18%. The greatest changes are expected in western, as well as north-eastern Lithuania (nationwide at 15.9%). The use of additives to the cultivation of agricultural products, particularly germination and rooting periods, can ensure the required moisture content of the soil. The use of additives is more economical growing relatively more expensive raw materials, so in most cases it is related to vegetable and berry crops.

The study was carried out in two stages: the first stage was carried out under laboratory conditions, the second at the Water Resource Engineering Institute's water balance research site (field conditions). Accrued soil moisture change was recorded every 24 hours by weight. Laboratory test conditions were also carried out by means of environmental chambers monitored 24 hours a day set at 17 °C, 19 °C, and 20 °C. During the field experiment evapotranspiration was established with the help of weighed evaporators every 5 days. Evaporation rate was determined via the water balance method.

Experimenting with mixing substrate in different proportions with vermiculite it was found that, at 20 °C, the retention of absorbed moisture content is dependent on the amount of vermiculite in the mixture (the retention of moisture reserve effect is +9 days). Perlite was the most effective at 20 °C with 50:50 ratio of substrate and perlite, all soil moisture reserves evaporated after 36 days. The tendency that a higher number of moisture-retaining additives leading to higher yields does not determined, vice versa – to grow larger onion heads it is enough and a small (1 cm) thick of additives. The results showed that at low temperatures all the biological additives considered help to keep the moisture available to the plants longer in the soil for approximately the same number of days.

**Keywords:** evaporation, soil moisture, biological additives, substrate.

# INFLUENCE OF NON – CHEMICAL WEED CONTROL METHODS ON SUGAR BEET PRODUCTIVITY AND QUALITY PARAMETERS

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Weed control in organic farming conditions is complicated and requires extra expenses. There are many different non-chemical weed control methods but some of them are not effective enough. For this reason, a long-term stationary field experiment was carried out at the Experimental Station of Aleksandras Stulginskis University (ASU) in 2017–2018. The following sustainable weed control systems were tested: 1) inter-row loosening (control treatment); 2) inter-row cutting and mulching with weeds; 3) inter-row cutting and mulching with Persian clover; 4) inter-row cutting and mulching with white mustards; 5) inter-row cutting and mulching with spring barley.

The fertility of sugar beets was determined by weighing clean roots. Their roots ramification was determined by counting all the branched beets in the sample. Amounts of Na, K,  $\alpha$ -amino N and sugar content were determined in the laboratory of Kėdainiai sugar factory (the stock company “Nordic Sugar Lietuva”). To determine the photosynthetic parameters, the sugar beet leaves were scanned by the Delta T Scan scanner, taking 3 leaves from each experimental plot. Sugar beet processing parameters, namely, sugar content in molasses, sugar output and white sugar yield were calculated according to standard formulas.

The alternatives of weed control often reduced the yields of sugar beet substantially; however, when mulching with white mustard, the decrease in fertility was not essential. In most cases, non-chemical weed control measures had insignificant effect on the parameters of sugar beet quality: the content of Na, K and  $\alpha$ -amino N.

The most significant sugar output (16.34% and 16.26%) was found in sugar beet roots, which were grown applying inter-row mulch of spring barley and weed ( $P < 0.05$ ). Comparing non-chemical weed control systems, the highest amount of white (crystalline) sugar (4.96 t ha<sup>-1</sup>) was derived from the sugar beet that was grown using white mustard mulch.

**Keywords:** sugar beet, weed control methods, productivity, quality.

## EFFECT OF THE NITROGEN AND BORON FERTILISATION ON YIELD OF WINTER TRITICALE PRODUCTION

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The area sown with triticale in Poland constitutes about 34% of the area of this species in the world. European agriculture has also appreciated this species. In the last decade, the area sown with triticale increased by 30%. This undoubtedly confirms the growing position of this species (FAOSTAT 2018).

The studies of winter triticale of the 'Twingo' variety were carried out, the aim of which was to know the production effects – expressed by the grain yield and its structure – under the influence of a varied level of nitrogen and boron fertilization.

The 2-factor experiment was established using the random-split (plot) method in 4 replications. The first-order factor was nitrogen fertilization (kg ha<sup>-1</sup>): A – 30, B – 60, C – 90 (60 + 30), D – 120 (90 + 30), E – 150 (90 + 60). The second order factor was boron fertilization: a – 0 kg ha<sup>-1</sup>, b – 1.2 kg ha<sup>-1</sup>, c – 1.8 kg ha<sup>-1</sup>, d – 2.4 kg ha<sup>-1</sup>.

Our statistical analysis of the results demonstrated a significant effect of the year of the experiments on the volume of yields of winter triticale. The difference in grain yields between the best and the worst year was 8.3%. In our trials, a significant increase in grain yields (by 0.76 t ha<sup>-1</sup>) was observed after an application of just 60 kg N ha<sup>-1</sup>. Raising the nitrogen fertilisation level to 90 kg ha<sup>-1</sup> caused significantly higher grain yields. The highest yield was harvested from plots fertilised with 150 kg N ha<sup>-1</sup>, but the difference was not significant versus the 90 kg ha<sup>-1</sup> dose.

Boron applications statistically increased the yield compared with plots without boron fertilisation. The average values during 2013–2015 period indicate that 1000 grain weight, grain weight in ear and grain number in ear were higher on plots with boron fertilisation.

**Keywords:** triticosecale, grain yield, yield components, nitrogen and boron fertilisation.

## THE ROLE OF HUMIC SUBSTANCES IN AGRICULTURAL SUSTAINABILITY

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The issue of food availability for an increasing number of people is becoming more important today. The agricultural sector is dominated by two scientific paradigms on how to ensure the availability of food – conventional agriculture with genetic modification and organic farming, which involves limiting food waste. However, there is also a third way – to increase productivity and to promote the sustainable development of the environment by using alternative methods. These methods dispute the view that organic farming cannot feed the number of people that is growing.

The basis for all the approaches is soil. The foundation of the soil health is soil biodiversity, which consists of all the biological components of the soil including plant roots, earthworms, bacteria, fungi, actinomycetes, algae, protozoa, nematodes, mites, springtails, and small insects. The three major criteria for assessing soil health—the physical, chemical, and biological properties that are all sensitive to the management practices and climatic changes that affect soil health. Among them there are activities that degrade soil health because of the excessive use of mineral fertilizers as opposed to the use of organic fertilizers, promoting the soil organic matter and soil health. Despite its obvious importance, the nature of soil organic matter, and of humic substances, which are complex compounds produced from decomposition of plant and animal remains and secondary synthesis processes, in particular, is not well understood. At the present time, the study of humic substances is truly an interdisciplinary effort.

The influence of humates on nutrient availability in crops is well documented. It is envisaged that N, P and K – availability can be improved by humic substances in the following ways:

- (i) increasing cation exchange capacity of soils
- (ii) increasing the uptake of N, P and K
- (iii) reducing N, P and K losses, which are caused by leaching and thus
- (iv) decreasing the need of fertilizer application.

**Keywords:** biodiversity, soil, organic farming, organic fertilizers, humic substances.

# THE EFFECTS OF MOISTENING WATER ON THE QUALITY OF THE SPROUTED CEREAL SEEDS FOR FOOD

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Seed germination is a simple, inexpensive and environmentally friendly method for producing plant-derived foods with functional properties for human's nutrition. One of the most important factors influencing quality of germinated seeds is water used for seeds soaking and moistening during the germination. Therefore, during the germination of wheat cv. 'Skagen', oat cv. 'Jaugila' and rye cv. 'Matador' for watering was used water with different chemical composition and properties. The research was carried out at Aleksandras Stulginskis University the Faculty of Agronomy in the Institute of Agricultural and Food Science in 2017 – 2018.

The research aim was to determine the influence of water with different properties used in germination process on the quality of germinated seeds.

Standard methods were used to determine the amount of dry matter, ash content, fats, proteins, fibres, carotenoids, chlorophyll *a* and *b*, colour parameters and microbiological contamination of the four days at 21 °C temperature germinated seeds. Seeds were moistened with drinking, filtered and nano-water. Statistical analyses were performed using two-way analysis of variance.

It has been determined that, among the assessed germinated cereal seeds, the greatest amount of the dry matter (33.29%), proteins (9.67%) and chlorophyll *a* (0.28 mg 100g<sup>-1</sup>) was found in germinated wheat seeds, the highest amount of fibre (16.77%), ashes (3.19%) and fats (2.66%) were recorded in germinated oat seeds, and the greatest amount carotenoids (0.15 mg 100g<sup>-1</sup>) and chlorophyll *b* (0.39 mg 100g<sup>-1</sup>) was revealed in germinated rye seeds. Filtered water has affected the germinated cereal seeds positively, the highest amount of carotenoids (0.15 mg 100g<sup>-1</sup>), fats (2.66%), ash (3.19%), fibre (16.77%), proteins (9.67%), dry matter (33.29%) and chlorophyll *a* (0.28 mg 100g<sup>-1</sup>) was determined in seeds moistened with filtered water. The most susceptible to pathogenic contamination were the germinated oat seeds. These seeds were contaminated with *Mucor* spp., *Fusarium* spp., *Penicillium* and *Arthrrium* spp., the wheat seeds with *Mucor* spp., *Penicillium* and *Arthrrium* spp. and the rye was contaminated only with *Mucor* spp., *Penicillium* spp. However, the amounts of these micromycetes were the largest, compared with other cereal seeds. The nano-water used for moistening mostly decreased the development of *Mucor* spp., *Penicillium* and *Arthrrium* spp. micromycetes in all researched germinated cereal seeds.

**Keywords:** germinated cereal seeds, filtered water, nano-water, chemical composition, microbiological contamination.

# IMPACT OF HEAT AND DROUGHT ON SUMMER RAPE UNDER ADEQUATE AND DEPRIVED SOIL NITROGEN AND ELEVATED ATMOSPHERIC CO<sub>2</sub> CONDITIONS

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Considering global warming, the frequency and severity of heat and drought stresses for plants will increase undoubtedly. The 7-day long heat wave (HW, 21/14 vs. 33/26 °C, day/night) and drought (no water irrigation during the HW period) treatments under adequate or deprived (160 and 60 kg ha<sup>-1</sup>, accordingly) soil nitrogen and elevated CO<sub>2</sub> (800 vs. 400 μmol mol<sup>-1</sup>) conditions were investigated in this study on an agronomically important crop summer rape (*Brassica napus* L.). A 7-day long recovery period under ambient temperature and CO<sub>2</sub> conditions was also applied. The above-ground growth of well-watered rape seedlings, grown under adequate soil N conditions, was positively affected by HW and additionally reinforced by elevated CO<sub>2</sub>. However, simultaneously applied HW and drought significantly reduced both the above and below-ground growth. Elevated CO<sub>2</sub> mitigated the negative impact of drought to a large extent under HW conditions but it was not enough to fully negate it and had only a little effect on the recovery after the cease of additional CO<sub>2</sub>. Irrespective of the CO<sub>2</sub> level in the atmosphere, the shoot and root dry weight of both well-watered and drought-stressed seedlings, grown under soil deprived of N, did not differ between the HW-treated and control ones. However, after the recovery, root dry weight of drought-stressed seedlings, grown under HW conditions, was significantly lower. The present study highlights the predominant role of drought stress under HW conditions and suggests that the mitigating effect of elevated CO<sub>2</sub> may only be useful if soil nitrogen is adequate.

**Keywords:** summer rape, heat, drought, nitrogen, elevated CO<sub>2</sub>, recovery.

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# THE INFLUENCE OF CONTRASTING TILLAGE ON SOIL POROSITY, WATER STORAGE CAPACITY AND CARBON DIOXIDE EMISSION

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Soil-water relationship is of great interest from agricultural point of view under climate changing conditions during the periods without rains.

Different intensity of soil tillage methods (deep mouldboard ploughing, deep ploughless loosening with a bent or straight legs cultivator and direct drilling) were investigated in a farm field in Kupiškis district in 2010–2011.

Undisturbed core samples were collected from 5–10, 15–20 and 25–30 cm soil depths for water release characteristics, total porosity (TP) and pore-size distribution determination. A closed chamber method was used to quantify soil surface net carbon dioxide exchange rate (NCER). A portable infrared CO<sub>2</sub> analyser (IRGA) attached to a data logger was implemented.

The goal of this research was to evaluate the influence of contrasting tillage on soil porosity changes, water storage capacity and carbon dioxide emission in luvisol.

The highest mean TP in the 5–30 cm soil layer was in the treatments with deep ploughless loosening application. Soil ploughing caused 6%, direct drilling 25% lower TP compared to soil ploughless loosening with a straight or bent legs cultivator.

Deep soil loosening with a bent leg cultivator increased the amount of macro- (>30 µm in diameter) and meso- (0.2–30 µm in diameter) pores in the top- and sub-soil layers but reduced the amount of micropores (<0.2 µm in diameter) by 19% within 5–30 cm soil layer compared to direct drilling application.

Soil loosening with both a bent and straight legs cultivator were the most effective tillage methods to increase PAW content within the top- and sub-soil layers. PAW content in conventionally tilled and direct drilled treatments was lower on average by 23% and 18%, respectively, as compared to deep soil loosening with straight and bent legs cultivator. The highest NCER (4.12 µmol m<sup>-2</sup> s<sup>-1</sup>) was registered after deep (to 30–35 cm depth) soil loosening performed with the bent leg cultivator, having a 50 cm spacing between the legs.

**Keywords:** luvisol, deep ploughless loosening, direct drilling.

## CONSEQUENCE OF LONG-TERM CONTRASTING SOIL MANAGEMENT: SOIL PROPERTIES AND WHEAT ROOTS DISTRIBUTION

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Many studies have been done worldwide on soil structural composition, soil organic carbon (SOC) sequestration, whereas most of published results were obtained in conditions different from the soil type, texture and climate conditions of the Nemoral-2 environmental zone. The objective of this study was to estimate the cumulative effects of 17 years of conventional tillage (CT) and no-tillage (NT) in combination with straw removal or return on SOC accumulation, soil pore-size distribution (PSD), water release characteristics (WRC) and winter wheat root growth within a plough layer of Cambisol. The investigations were carried out at the Institute of Agriculture, LRCAF on loamy Cambisol in 2015.

In CT, residue return caused decrease in root length density (Ld), volume (V) and mass density (Md) within 0-10 cm soil layer. Root diameter (D) under residue return increased only within top layer. Within 0-10 cm depth, Md positively correlated with the content of soil storage pores (SP) and (SOC) and inversely correlated with coarse water-stable aggregates (WSAc). Ld increased with decreasing of bulk density (BD) and WSAc, D increased with increase of BD, SP and SOC. Within 10-20 cm depth, the Ld, D, V and Md significantly positively correlated with soil SP, SOC and inversely correlated with BD. The Ld positively responded to increase in WSAc.

In NT, residue return caused decrease in Ld and increase in D, V and Md within 0-10 cm soil layer. Md positively correlated with rising of soil fine water-stable aggregates (WSAf). Ld and D responded to most of the soil properties. Ld increase and D reduction were registered under increase in WSAf and SOC (NT with residue removal), while increase in BD, WSAc and SP on background with residue return caused decrease in Ld and increase in D. Within 10-20 cm depth, Md and Ld positively correlated with soil WSAf, SP and SOC and inversely correlated with BD.

**Keywords:** Cambisol, no-tillage, soil structure, soil organic carbon, wheat roots.

# THE INFLUENCE OF SOIL TILLAGE AND FERTILIZATION ON WHEAT PHYSIOLOGICAL TRAITS

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This study set out to determine the effect of different fertilization systems under three tillage practices in combination with crop residues or without them on spring wheat and winter wheat physiological traits. The study was carried out at Institute of Agriculture, LAMMC in a long-term field trial established in 1999. Two treatments of residue management (returned and removed) were used. Tillage treatments: no-tillage (NT), reduced tillage (RT) and conventional tillage (CT) were used as the main plots; fertilization: without fertilizers (1), moderate rates (2) and maximum rates of NPK (3) were used as sub-plots. The measurements of physiological traits, chlorophyll index (SPAD) and maximum quantum efficiency of PSII photochemistry (Fv/Fm), were made five times.

It was established that the influence of straw management and tillage on SPAD differed in spring and winter wheat crops. The residue returning significantly decreased SPAD of spring wheat, whereas straw significantly increased SPAD of winter wheat in most of the cases. Tillage impact on SPAD of spring wheat was insignificant in most of the cases; however, SPAD of winter wheat was significantly influenced by the tillage. Fertilization was the main factor explaining 17.2-43.8% and 17.1-56.8% of the total variability of SPAD of spring and winter wheat respectively.

Straw management influence on the maximum quantum efficiency of PSII photochemistry (Fv/Fm) was negative and significant in most of the cases in spring and in winter wheat. The influence of tillage on Fv/Fm was inconsistent and not significant. Fertilization played a crucial role in Fv/Fm data variation, Fv/Fm significantly increased with increasing NPK rates in most of the cases.

The correlation between SPAD and grain yield was strong in winter wheat, and SPAD caused 18-62%, whereas SPAD governed only 7-24% of the grain yield data variation in spring wheat.

**Keywords:** fertilization, Fv/Fm, soil tillage, SPAD, wheat.

# **BOG RESTORATION FOR GREENHOUSE GAS EMISSIONS SEQUESTRATION AND CLIMATE CHANGE MITIGATION**

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The restoration of the bog hydrological regime can be accelerated by filling up the drainage ditches.

As climate change issues have recently been raised, it is necessary to ascertain if the generation of a positive long-term impact on the bog flora and fauna does not leave a negative long-term impact on global warming. This needs to be established prior to the degraded bog restoration. Aerobic conditions support higher CO<sub>2</sub> emissions and reduction of CH<sub>4</sub> emissions. When the groundwater level is restored, the flora and fauna of the bog gradually returns, the bog begins to accumulate CO<sub>2</sub>, but increases the CH<sub>4</sub> emissions.

During the study, literature analysis, processing and interpretation of existing data were carried out. The most valuable data set used for the study is the LIFE REstore project LIFE14 CCM/LV/001103 greenhouse gas (GHG) data obtained during the project with the closed chamber technique, collected in 42 places throughout the territory of Latvia in 2017.

Bogs are the source of most terrestrial CH<sub>4</sub> but act as accumulators of CO<sub>2</sub>, and N<sub>2</sub>O. Artificial drainage turns bogs into sources of CO<sub>2</sub> and N<sub>2</sub>O. Greenhouse gas emissions from bogs are dependent on rainfall, soil moisture, pH level, air temperature, freeze-thaw, fertilisation, root activity and other factors. Therefore local, rather than global, conditions determine the GHG emissions. The fact that GHG emissions are influenced by local factors is supported by data from REstore project, which shows that actual GHG emissions from bogs in Latvia are about half lower than the IPCC emission factors. Another proof of the bog restoration importance is the research carried out in Estonia in 2015, which concluded that net GHG emissions in the restored bogs were reduced by approximately half relative to those in the abandoned bare peat site for three years following the restoration.

This research demonstrates that bog restoration may effectively mitigate the negative climate impacts of the degraded bogs.

**Keywords:** drainage, GHG emissions, IPCC emission.

# INFLUENCE OF BIOLOGICAL PREPARATIONS ON SOIL NITROGEN AND PHOSPHORUS CONTENT IN THE SPRING WHEAT CROP

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Intensifying production of agriculture, rising prices of energy resources and the EU ecological policy goals are forcing farmers to seek solutions to reduce industrial and production costs and energy resources. At the same time, new and efficient measures are sought to increase soil fertility and quality.

The experiment was conducted in 2015–2017 in the Experimental Station of Aleksandras Stulginskis University, in Calc(ar)i-Endohypogleyic Luvisol, a semi-neutral ( $\text{pH}_{\text{KCl}}$  6.8), highly phosphorous ( $226.6 \text{ mg kg}^{-1} \text{ P}_2\text{O}_5$ ), mid-potassium-level ( $105.0 \text{ mg kg}^{-1} \text{ K}_2\text{O}$ ), mid-humus-level (2.33%) soil, in order to evaluate the effect of biological preparations BactoMix2, BactoMix5 and Rhizobacterin on nitrogen and phosphorus content in the soil.

The experiment was carried out in three repetitions in a spring wheat crop. Experiment variants: 1) biological preparations were not used, 2) biological preparation BactoMix2 (*Enterobacter* V-402 D and 409 D), norm  $1.0 \text{ l ha}^{-1}$ , 3) biological preparation Rhizobacterin (associative nitrogen-fixing bacteria *Klebsiella planticola* 5), norm  $2.0 \text{ l ha}^{-1}$ , 4) biological preparation BactoMix5 (*Bacillus subtilis* V-845 D and V-843 D, *Pseudomonas aurantiaca*, *Bacillus megatarium* and *Brevibacillus sp.*), norm  $1.0 \text{ l ha}^{-1}$ . Variants were arranged randomly. The size of the initial field was  $240 \text{ m}^2$ , the size of accounting field was  $128 \text{ m}^2$ .

At the beginning of the experiment in 2015 nitrogen content in the soil varied from 0.132 to 0.136%. After harvest of the spring wheat higher soil nitrogen content was detected in the fields sprayed with biological preparations. In the fields sprayed with Rhizobacterin nitrogen content in the soil increased significantly – 31.6%. The similar trend is established in 2016 and 2017.

Phosphorus content at the beginning of the experiment in the soil varied from 230.3 to  $242.7 \text{ mg kg}^{-1}$ . The highest amount of phosphorus in the soil was increased by the use of biological preparation Rhizobacterin. The amount of phosphorus in the soil was increased 24.8% compared to the amount of phosphorus in the soil at the beginning of the experiment. Biological preparation BactoMix5 increased phosphorus content in the soil 4.7 % and preparation BactoMix2 – 1.7% during three years.

**Keywords:** biological preparation, nitrogen and phosphorus content, spring wheat.

# IMPACT OF CHANGES IN LULUCF ACCOUNTING RULES ON THE ACHIEVEMENT OF CLIMATE CHANGE MITIGATION GOALS

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Land use, land-use change and forestry (LULUCF) sector plays an important role in climate change mitigation. Long-term goal of carbon neutral economy in the second half of this century depends on the LULUCF ability to sequester GHG emissions in biomass and soil. With reference to the Paris Agreement, accounting rules of GHG emissions and removals in the LULUCF sector have been recently heavily discussed in the European Union, seeking of trustworthy inclusion in the assessment of Union's GHG emission reduction target. Therefore, this study aims not only to examine the differences in LULUCF accounting rules since the Kyoto Protocol 1<sup>st</sup> Commitment period but also to analyse Lithuanian situation regarding the LULUCF sector and its potential to generate credits from carbon sequestration in different land-uses. According to the reported annual GHG emissions and removals, the LULUCF sector has a potential to absorb significant part of Lithuania's GHG emissions. Analysis of the sector's potential to provide credits for other sectors' GHG emission mitigation according to the accounting rules has been carried out in three different scenarios. Study results show the importance of land-use change development in order to maintain commitment set in the regulation for climate change mitigation in EU until 2030.

**Keywords:** land-use change; GHG inventory; sequestration; emissions; removals; climate change mitigation; policy achievement.

## FUNGAL COMMUNITIES IN INFECTED WHEAT STEM BASES

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Stem base diseases of wheat are widespread and dependent on agronomic practices and the interaction between plants and microorganisms, mainly fungi.

Various pathogens can be found on wheat stem bases, however, there are many fungi whose role on wheat stem bases is unknown. In Latvia and worldwide, there are only a few studies on wheat stem base fungal communities as one whole.

The aim of this study was to estimate winter wheat stem base fungal communities and their variations dependent on cropping systems.

This study is a part of a large, multisided two-factorial field experiment established at the Research and Study farm “Peterlauki” of the Latvia University of Life Sciences and Technologies: A – soil tillage system, and B – crop sequence. The study was carried out in 2012–2017, except for 2014, when winter wheat did not overwinter.

Altogether, 4881 isolates were obtained from wheat stems with stem base disease symptoms, of which 56% were wheat stem base and root rot causal agents, 38% were other fungi, 5% were other pathogens, and 1% were wheat leaf blotch causal agents. Crop sequence and soil tillage had no significant effect on the spectrum of wheat stem base and root rot pathogens. Wheat stem base disease was mainly caused by *Oculimacula* spp. (46%), *F. avenaceum* (20%), *F. culmorum* (13%), and *M. nivale* (13%). *Phaeosphaeria* spp. was the most widespread non-pathogenic fungus in wheat stems but ecological niche of this fungus is unknown.

Future investigations are required as the gathered data is still insufficient to make final conclusions on factors that influence wheat stem base fungal communities.

**Keywords:** *Microdochium*, *Fusarium*, *Oculimacula*, *Phaeosphaeria*

**Acknowledgement:** the research was funded by the State research programme and grant of Ministry of Agriculture “Influence of minimal soil tillage on its fertility maintenance, development and distribution of pests as well as crops’ yield and quality in resowings”.

## THE EFFECT OF SOWING TIME ON *ALTERNARIA BRASSICAE* AND *PHYLLOTRETA* SPP. SPREADING IN SPRING OILSEED RAPE CROP

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The field experiments were conducted at the Experimental Station of Aleksandras Stulginskis University in 2016–2017. The aim of the experiment was to evaluate the influence of sowing time on spreading of pests and diseases in spring oilseed rape crop. The first sowing occurred when soil reached physical maturity, the other sowing dates were every 5 days in 2016 and every 7 days in 2017.

In 2016–2017, the rape seedlings in the plots of the latest sowing were significantly more damaged compared with those of earlier sowing dates. In 2016–2017, *Phyllotreta* spp. was more intensively spread in the crops sown in April, and rape seedlings were significantly more damaged.

In 2016, there was a very strong statistically significant correlation between the sum of positive temperatures for the 10-day period up to the sowing of rapeseed and the prevalence of *Phyllotreta* spp. in crops:  $r = 0.98$ ,  $P \leq 0.05$ , and the damage intensity of rape seedlings by *Phyllotreta* spp. of (BBCH 10-19):  $r = 0.92$ ,  $P \leq 0.05$ . The warmer the weather was before rape sowing, the more active *Phyllotreta* spp. was. In 2017, strong correlations were established between the number of *Phyllotreta* spp. and the intensity of crop damage by *Phyllotreta* spp. and the crop density 3 days after the emergence:  $r = -0.82$ ,  $P \leq 0.05$ ;  $r = -0.89$ ,  $P \leq 0.01$ , and 7 days after the emergence of spring rape:  $r = -0.81$ ,  $P \leq 0.05$ ;  $r = -0.88$ ,  $P \leq 0.01$ .

**Keywords:** spring oilseed rape, sowing time, diseases, pests.

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



# APPLICATION OF BIO-PREPARATIONS IN ORGANIC SPRING RAPESEED CROP AND THE HUMUS CONTENT EFFECT ON SOIL PROPERTIES

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Soil properties have been shown to be closely related to agricultural activities, various soil factors and climate. Scientists and farmers are looking for methods to sustain and increase soil fertility in order to achieve high and good quality agricultural production. The application of sustainable technologies and bio-preparations in agriculture could increase biological activity of the soil, which has been proved to be a powerful indicator of soil quality. Field experiments were carried out in 2014–2016, at the Experimental Station of Aleksandras Stulginskis University (54°53' N, 23°50' E), Kaunas District, Lithuania. The aim of the research was to estimate the effects of bio-preparations and the humus content on the soil biological activity by using non-chemical weed control methods (thermal, mechanical and self-regulation) in the organic spring rapeseed crop (*Brassica napus* L. spp. *oleifera annua* Metzg.) cultivated in soil with regular and thickened humus layers. Experiments showed that the activity of soil enzymes urease and saccharase, number and mass of earthworms, and CO<sub>2</sub> emission from the soil depended on the meteorological conditions. In the soil of both humus layer types, the highest average number and mass of earthworms as well as the strongest activity of saccharase and urease were identified in the plots of self-regulation, compared with thermal and mechanical weed control. The positive effect of the bio-preparations on the abundance of earthworms and the activity of soil enzymes was established in the droughty year of 2015. The application of mechanical and thermal weed control methods without bio-preparations decreased CO<sub>2</sub> emission from the soil, while their combination with bio-preparations increased it. In both the 2014 and 2015 experimental years, in the soil with a regular humus layer, strong correlations between the number of earthworms and oilseed rape root length (in 2014 –  $r = 0.94$ ,  $P < 0.05$ ; in 2015 –  $r = 0.85$ ,  $P < 0.05$ ) as well as between the number of earthworms and root area (in 2014 –  $r = 0.86$ ,  $P < 0.05$ ; in 2015 –  $r = 0.85$ ,  $P < 0.05$ ) were established. In 2014–2016, strong and very strong correlations were established between the number and mass of earthworms (in 2014 –  $r = 0.94$ ,  $P < 0.01$ ; in 2015 –  $r = 0.91$ ,  $P < 0.05$ , in 2016 –  $r = 0.89$ ,  $P < 0.05$ ). In the soil with a thickened humus layer, strong and very strong correlations between saccharase activity and organic carbon content in the soil (in 2015 –  $r = 0.97$ ,  $P < 0.01$ ; in 2016 –  $r = 0.87$ ,  $P < 0.05$ ) were established.

**Keywords:** bio-preparations; humus, biological activity; soil enzymes; CO<sub>2</sub> emission; earthworms.

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

# THE IMPACT ON SOIL CO<sub>2</sub> EMISSIONS BY TREE PLANTATIONS COMPOSITION, STRUCTURE AND CLIMATIC FACTORS

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The aim of the investigation was to evaluate the impact of planted native and alien tree species on the compositions and abundance of ground vegetation species as well as on soil respiration, and chemical and biological properties. The study was performed in the biome of temperate mixed forests in the monoculture stands of native (*Acer platanoides* L., *Alnus glutinosa* L., *Betula pubescens* Ehrh., *Quercus robur* L., *Tilia cordata* Mill., *Carpinus betulus* L., *Picea abies* (L.) H.Karst., *Pinus sylvestris* L.) and alien (*Aesculus hippocastanum* L., *Larix eurolepis* Henry., *Larix sibirica* Lebed., *Thuja occidentalis* L.) trees, which, in 1958–1965, were planted near Kaunas, Lithuania. The same climatic and soil conditions were present in the area; the soil type was Endocalcari-Epihypogleic Cambisols with an anthropogenic influence. The average annual temperature was 6.0–6.5 °C, while rainfall was 600–650 mm. The data was collected in 2014–2017. The species composition and projection cover of shrubs, herbs and mosses were recorded in 10 1 m<sup>2</sup> plots in each stand. Soil respiration was measured with portable CO<sub>2</sub> analyser ADC BioScientific LCpro+ System in 10 randomly selected points. Soil moisture and soil temperature were electrochemically measured with portable instrument ‘Wet’ at the depth of 5 cm in the same points. Composite soil samples from the 10 points were collected randomly from each stand in three replicates at the depth of 0–10 cm. The concentration of organic carbon (C), total nitrogen (N), available phosphorus (P<sub>2</sub>O<sub>5</sub>) and potassium (K<sub>2</sub>O) was determined. The soil microbiota was assessed as well. The results showed differences in shrubs, herbs and mosses among the stands of different tree species. The ground vegetation was reduced in *Carpinus betulus*, *Aesculus hippocastanum* and *Thuja occidentalis* L. stands due to a dense canopy cover. The monoculture stands of tree species had a different impact on soil respiration, which increased in the sequence: Thuja < Quercus < Larix < Betula. Compared with deciduous tree stands, soil respiration rate was about 27% lower in coniferous tree stands. Significant factors, which correlated with soil respiration, were soil temperature and humidity, soil nutrient concentration and cover of herbs layer.

**Keywords:** soil respiration, CO<sub>2</sub> emission, soil moisture, soil temperature, carbon.

# THE IMPACT OF NON-CHEMICAL WEED CONTROL ON SOIL BIOLOGICAL PROPERTIES IN THE WINTER RAPESEED AGROCENOSIS

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The aim of this study was to determine the influence of non-chemical weed control methods (thermal, mechanical and smothering) on the abundance of earthworms and the activity of soil enzymes in agroecosystem of winter rape (*Brassica napus* L. spp. *Oleifera biennis* Metzg.) grown in soil with regular (23–25 cm) and thickened (45–50 cm) humus layers.

Field experiments were conducted in 2014–2017 at the Experimental Station of Aleksandras Stulginskis University. The soil of the experimental site is Endocalcaric Endogleyic Luvisol. The following three non-chemical weed control methods were examined (Factor A): 1) thermal (using water steam), 2) mechanical (inter-row loosening), and 3) smothering (self-regulation) as well as bio-preparations (Factor B): 1) without bio-preparations, 2) with bio-preparations. In the thermal and mechanical weed control treatments, winter oilseed rape was grown with an inter-row spacing of 48 cm and in weed smothering treatments with an inter-row spacing of 12 cm.

Soil biological properties depended on meteorological conditions and weed control method applied in winter rapeseed crop. In soil with regular humus layer, the highest average number and the mass of earthworms in the ploughing layer were determined in plots with mechanical and thermal weed control using biological preparations, whereas in the soil with thickened humus layer – without the use of biological preparations, in comparison with the plots with weed smothering method. On average, the highest levels of soil enzymes saccharase and urease activity were found in the plots with smothering weed control and usage of biological preparations compared to the plots with thermal and mechanical weed control. There was a positive, strong and significant correlation between the mass of earthworms and the activity of the enzyme saccharase in the soil ( $y = 12.7 + 0.22x$ ,  $r = 0.85$ ,  $P < 0.05$ ).

**Keywords:** non-chemical weed control, bio-preparations, earthworms, soil enzymes.

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

## **YIELD AND QUALITY OF MALTING BARLEY GRAIN DEPENDING ON NITROGEN FERTILISATION AND APPLIED FUNGICIDES**

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Among the different types of barley use, the highest quality requirements are put on the grain for brewing purposes. Barley grain quality is influenced by climatic, genetic and agrotechnical factors. Malting barley should be characterized by low protein content in the grain, high germination energy, high accuracy and levelling and good grain health.

The main objective of this work is to determine the response of malting barley (Class variety) to the level of nitrogen fertilization, varied chemical plant protection, under various soil conditions, using the latest generation of fungicides and the Route biostimulator.

The article is based on the results obtained in the 3-year research cycle (2008-2010) in a two-factor field experiment. Factor I – nitrogen fertilisation levels (N): 0 kg N ha<sup>-1</sup>, 40 kg N ha<sup>-1</sup>, 80 kg N ha<sup>-1</sup>, 120 kg N ha<sup>-1</sup>. Factor II – fungicide protection levels: no chemical protection, moderate protection, full protection, full protection + biostimulator.

The grain of spring barley cultivated on the soil of complex 4 (after potatoes), always fulfilled the requirements of class I brewing properties. The spring barley grain grown on the soil of complex 2, after winter wheat, had worse quality parameters, especially when 120 kg N ha<sup>-1</sup> and lower levels of fungicide protection were applied.

The increase of nitrogen rate caused the increase in infestation of spring barley plants by fungal diseases, especially compared with the non-fertilized plants.

The spring barley yield varied due to meteorological conditions, experimental factors and their interaction. The highest yields of spring barley were obtained from plots fertilized with nitrogen at 80 and 120 kg ha<sup>-1</sup> with full fungicide protection along with Route biostimulator. Protein content in spring barley grain increased with increased nitrogen fertilisation rate.

**Keywords:** chemical protection, malting barley, grain, nitrogen fertilisation.

## NUTRITION VALUE OF ROSEHIPS

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Rosehips are the aggregate fruits of shrubs belonging to the *Rosa* genus of the *Rosaceae* family that are widely used for food, cosmetics and pharmaceutical industries. Rose fruits contain a large range of important dietary antioxidants. The high antioxidant activity mainly attributed to ascorbic acid and carotenoids represents mainly lycopene,  $\beta$ -carotene, tocopherols and fatty acids. The healing properties and benefits of these berries have been known to the body since ancient times, but in Lithuania, rose hips was mostly investigated as a decorative plant for recreational zones, however, there are no scientific studies on their nutritional value and therapeutic properties.

The objective of these investigations was to determine nutrition value for five different rosehip species (*R. rugosa*, *R. rugosa rubra*, *R. rugosa alba*, *R. canina*, *R. villosa*), growing in Pakruojis area in Lithuania. Using the standard methods it was determined: dry matter content (%) – while drying samples in 105 °C temperature until stable mass; amount of protein (% DM) – using Kjeldahl method; amount of fibre (% DM) – using Henneberg-Stohmann method; amount of ashes (% DM) – using gravimetric method, while dry burning testing material, amount of fat (% DM) – using Soxhlet extraction method.

According to the data obtained in this work the biggest amount of fibre was accumulated in rose hip flesh of *R. canina* species (13.75 % DM). The highest amounts of dry matter and ash were determined in *R. rugosa* hip flesh (respectively 95.43 % and 5.95 % DM.) *R. rugosa alba* species demonstrated the highest amount of proteins (4.79 % DM.) The essential highest amount of fat was found in *R. rugosa rubra* hip flesh (2.03 % DM), the lowest – in *R. canina* hip flesh (0.30 % DM).

The results of our research showed that the nutritional value of rosehip species growing in Lithuania differed too much.

**Keywords:** rosehips, flesh, species, nutrition value.

## DETERMINATION OF FLAX RUST L2 AND L9 RESISTANCE ALLELES IN LATVIAN ORIGIN FLAX (*LINUM USITATISSIMUM*) GENOTYPES

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Flax is a well-known crop around the world and it is also growing in Latvia. One of the factors that affect the choice of varieties for cultivation is their resistance to diseases. Flax rust caused by the fungus *Melampsora lini*, is one of the most devastating flax diseases. In the infected field, this can lead to serious losses of seed yield and fibre quality. Flax resistance to *Melampsora lini* is determined by the system “gene-for-gene”, the flax has a resistance (R) gene, a pathogenic – avirulence (Avr) gene. Flax has 34 genes known in this system, which are arranged in seven loci – D, K, L, M, N, P and Q.

The aim of the study was to determine flax rust resistance alleles of L2 and L9 in Latvia flax genetic resources using a molecular marker method.

Lc1 and Lc3 primers for PCR were used, and the PCR products were digested with MboI restriction enzyme, and obtained fragments were separated in polyacrylamide gel. The reference varieties ‘Stewart’ and ‘Bison’ were first tested, followed by 39 samples from Latvian genetic resources.

It was found that most samples from Latvia do not contain any of these two alleles. L2 allele was detected in four samples, and L9 – seven samples.

These molecular markers can be successfully used in marker-based breeding. This would allow you to quickly determine which genotype (variety, line or hybrid) contains resistance allele.

**Keywords:** flax (*Linum usitatissimum*), flax rust (*Melampsora lini*), L resistance alleles, fungal diseases.

# TESTING THE CRITERIA OF SOIL RESOURCES UNDER NATIONAL AND INTERNATIONAL SOIL CLASSIFICATION

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The soil cover introduces information on the exploratory locality soil. Lithuania is a small country and geographically is variegated place. Lithuanian classification system is based on the characteristics of soils the FAO (1998) and is divided into 12 groups under similar word reference base. The World Reference Base (WRB) is the international standard for soil classification system and the general rules of classification consist of three steps and relevant main diagnostic criteria of diagnostic horizons.

General profile information, soil formation factors, site characteristics, soil and soil description data are described in the form of soil description, which was prepared according to the guidelines of soil in field description.

Although the evaluation criteria of diagnostic horizons, properties and materials and its allocation to the systematic soil elements are clear, however, its position according to the national and international classification differs. According to the Lithuanian classification, Cambisols are fertile soils formed in the plains of the Middle Lithuanian lowland or in deluvium deposits. Podzols are acid infertile soils formed on non-carbonate sandy and fluvioglacial deposits. If compared with the WRB, Cambisols are combined soils with at least an incipient subsurface soil formation of the mountainous terrain in medium and fine textured materials derived from a wide range of rock. Podzols have an illuvial horizon with accumulation of black organic matter and/or reddish iron oxides formed on weathering materials of siliceous rock.

Although the evaluation criteria of diagnostic horizons, properties and materials and its allocation to the systematic soil elements are clear, however, its position according to the national and international classification differs. Numerous research studies show that there is a need of a powerful tool for the soil diagnostics which is very close to the international standards.

**Key words:** Cambisols, classification, deposits, Podzols, soil.

## QUALITY OF NATURALLY FERMENTED CUCUMBERS

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Fermentation is one of the popular processing methods for cucumber preservation known from ancient times; it enables the extension of the shelf life and develops specific flavours. The fermentation of cucumbers is accomplished by a partial breakdown of the carbohydrates by specific microorganisms that are naturally present on vegetables.

The object of the investigation was four different cultivars of cucumbers: 'SV 4097CV F1', 'Akord F1', 'Mirabelle F1', 'Mandy F1' ecologically grown in a private farm in Kėdainiai district (55°17' N, 23°58' E), Lithuania. The aim of the research was to evaluate chemical composition of fermented cucumbers stored for 10 weeks.

The amount of dry matters (DM), soluble solids (SS), ascorbic acid (AA), potassium (K), nitrates (NO<sub>3</sub><sup>-</sup>), pH was analysed by standard methods. The fermented cucumber pulp hardness was analysed by texture analyser "TA.XTplus" (UK) and the peel colour by analyser "ColorFlex EZ" (USA). Sensory analysis of cucumbers was performed.

DM and SS contents of cucumbers in the end of storage significantly decreased in all varieties from 1.1 to 1.2 times. AA content significantly increased during the fermentation process and in the end of storage was from 59 to 64% higher (3.68–5.44 mg kg<sup>-1</sup>). The amount of K significantly decreased up to 136.75–142.18 mg kg<sup>-1</sup>. NO<sub>3</sub><sup>-</sup> content of fermented cucumbers has increased slightly, significantly changed only in 'SV 4097CV F1', increased from 155.97 to 190.70 mg kg<sup>-1</sup>. Cucumbers pH after two weeks of fermentation varied from 5.1 to 3.9. After four weeks to the end of the storage pH stabilized and varied from 3.8 to 3.9.

Texture analysis showed that cucumbers mesocarp hardness mostly changed from the second to the fourth week of the storage, decreased 2.2 times. At the end of storage cucumbers of 'Akord F1' variety were the firmest. Cucumber colour at the beginning of the storage was greener than after 10 weeks of storage.

Sensory analysis showed that after 10 weeks of storage 'SV 4097CV F1' and 'Mirabelle F1' varieties cucumbers had the best taste, also 'Mirabelle F1' cucumbers had the best appearance.

**Keywords:** chemical composition, fermentation, sensory analysis, texture.



# IMPROVEMENT OF COLD TOLERANCE OF WINTER OILSEED RAPE BY EXOGENOUS AMINO ACIDS

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Research was carried out during 2014–2017 at the Experimental Station of Aleksandras Stulginskis University on Calc(ar)i-Endohypogleyic Luvisol (LVg-n-w-cc). The effect of exogenous amino acids on cold tolerance of linear cultivar ‘Cult’ of winter oilseed rape (*Brassica napus* L. spp. oleifera biennis Metzg.) was studied. In autumn the plants were sprayed with L-proline and L-glutamic acid one or two times. Biometric parameters of winter oilseed rape prepared for wintering, amount of endogenous proline and over-wintering of plants were evaluated. It was determined that exogenous L-proline and L-glutamic acid stimulated the growth of green mass of the winter rape surface, accumulation of dry matter and increase of the root neck diameter in the autumn period. The investigated concentrations of L-proline and L-glutamic acid stimulated more intensive synthesis of endogenous proline in winter oilseed rape plants during the preparation for wintering. The highest percentage of over-wintering has been determined in variants where plants in the autumn were sprayed two times with 30 mM l–l L-proline or 1.5 M l–l L-glutamic acid.

**Keywords:** cold tolerance, exogenous amino acids, endogenous proline, winter oilseed rape.

## LEGUMES AS FEED: ECONOMIC CONSIDERATION

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The area cropped with legumes has intensively increased in Latvia, thereby contributing to domestic protein self-sufficiency and the use of pulses in livestock farming. However, not enough research studies have been done on economic gains from the use of pulses in many livestock industries, particularly in unconventional livestock farming as deer farming.

For this reason, the research aims to identify changes in the productivity of red deer kept in captivity if including pulses in the diet of the deer.

The experiment was carried out for six months – from January to July – on four deer groups (n = 40). The diets of the experimental groups contained 20% ground pulses (peas, beans, lupine seeds).

Compared with the control group, the experimental groups demonstrated higher live weight gains (by 1.8, 2.1 and 4.9%), larger carcass weights (2.2%, 3.5%, 4.7%) and higher proportions of the valuable component of a carcass (shank, tenderloin) (4.1, 3.7 and 5.2%-points).

Feeding the deer a pulse diet resulted in economic gains from an increase in the productivity of the deer and a higher proportion of the valuable components of their carcasses.

**Keywords:** economic gains, deer farming, feed, legumes.

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## THE INFLUENCE OF DIFFERENT NITROGEN FORMS AND APPLICATION TIME ON WINTER WHEAT

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Nitrogen is a key element in the plant's mineral nutrition, which determines the fertility and quality of agricultural crops, but the excess of nitrogen has a negative impact on the environment.

To determine the influence of nitrogen forms and winter wheat development on the nitrogen, photosynthetic parameters and productivity of plant nutrition.

Analysis of soil done using standard methods acts:  $P_2O_5$  and  $K_2O$  – A-L, pH of soil – potentiometer, mineral nitrogen ( $N-NO_3 + N-NH_4$ ) – tintometer, total carbon – dry burning. Assimilation area of leaf – gage of WinDias, index of chlorophyll – spectrophotometer, level of nitrogen – method of Kjeldahl.

The research was carried out at the Experimental Station of Aleksandras Stulginskis University during 2015–2016 on medium textured loamy carbonaceous leached soil – Calc(ar)i-Epiphypogleyic Luvisols. The soil of the experimental field was the following: pHKCl 6.8–7.2; phosphorus ( $P_2O_5$ ) – 423–429 mg  $kg^{-1}$ ; potassium ( $K_2O$ ) – 157–163 mg  $kg^{-1}$ ; humus – 2.47–2.82%. The researchers explored the winter wheat crop (*Triticum aestivum* L.) variety 'Skagen' fertilized with amide ( $N-NH_2$ ), ammonium ( $N-NH_4$ ) and nitrate ( $N-NO_3$ ) forms of nitrogen fertilizers in different tillering stages (BBCH 21–29). 7 days after winter wheat was fertilized, the level of mineral nitrogen in the soil was on average 23.9% higher using ammonium–nitrate nitrogen form fertilizers than using amide nitrogen form ones. The index of chlorophyll and the area of leaves were essentially higher when ammonium–nitrate and amide forms of nitrogen fertilizers were used. The biggest effect on the index of chlorophyll and the area of leaves was achieved 16 days after the start of vegetation when plants were fertilized with ammonium–nitrate fertilizers. Plants fertilized with ammonium–nitrate fertilizers gave the biggest yield 4 days after the start of vegetation.

**Keywords:**  $N-NH_2$ ,  $N-NH_4$ ,  $N-NO_3$ , winter wheat, index of chlorophyll, assimilation area of leaves, yield.

## THE EVALUATION OF DISEASE RESISTANCE OF FLAX GENETIC RESOURCES

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Environmental conditions in flax growing regions are also suitable for the development of flax fungal diseases. The changing environmental conditions have the influence on development and productivity of the plant, and at the same time on the development of fungal diseases.

The goal was the evaluation of the development of the fungal diseases of flax at variably growing conditions and the determination of disease resistance of different flax genotypes.

An experiment was conducted to evaluate disease resistance of 25 fibre flax genotypes under field conditions for seedling stage and adult plants. The estimating of the genotype genetic parameters correlation between the hydrothermal coefficient and the area under the disease progress curve for plants and disease incidence in a seedling stage, as well cluster analysis for the stem, seed yield and resistance index were determined.

Significantly higher infection level on the flax genotypes of wilt (*Fusarium oxysporum* f. sp. *lini*), pasmo (*Septoria linicola*) and anthracnose (*Colletotrichum lini*) in humidity conditions was found. Stem break, browning of flax (*Polyspora lini*), powdery mildew (*Oidium lini*) and fusarium browning (*Fusarium* spp.) can spread in more dry conditions. The genotype influence of flaxseed internal fungal infection level identified the most prevalent two diseases of the causal agents *Fusarium* spp. and *Colletotrichum lini* in high humidity condition. The variety 'Rezekne' has the high resistance at the seedling stage and complete resistance for powdery mildew for the adult plant. Comparing two dendrogram results the genotypes of the first clusters represented higher yield and disease resistance potential with most promising genotype 'L11-11/11-97'.

Knowledge of study about flax fungal distribution and identify genetically diverse resistance genotypes are useful for genetic resources diversification in agriculture.

**Keywords:** *Linum usitatissimum*, genotypes, fungal diseases, resistance.

## **LONG-TERM IMPACT OF REDUCED INTENSITY TILLAGE SYSTEMS, STRAW AND GREEN MANURE COMBINATIONS ON SOIL PROPERTIES**

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Since 1999, a long-term field experiment has been carried out at the Experimental Station of Aleksandras Stulginskis University at 54°52'50 N latitude and 23°49'41 E longitude. The soil of the experiment site is Epieutric Endocalcaric Endogleyic Planosol (Endoclayic, Aric, Drainic, Humic, Episiltic) according to WRB (2014), texture at 0–20 cm depth is silty medium loam (33.7% sand, 50.3% silt, 16.0% clay), at 20–40 cm depth – silty light loam (35.4% sand, 51.1% silt, 13.5% clay). The objective of our investigations was to assess the long-term impact of reduced intensity tillage systems, straw and green manure combinations on soil physical properties and productivity. The soil samples have been analysed in the Agro-biological laboratory of Aleksandras Stulginskis University. Long-term application of reduced tillage results in a significant increase in soil penetration and soil shear resistance. The lesser the tillage depth, the higher the soil penetration and soil shear resistance. The effect of plant residue spreading is lower. Long-term tillage of different intensities and plant residue spreading as well as catch crop cultivation for green manure did not have significant effect on soil structure. Meanwhile, soil structural stability was highly dependent on soil tillage. Shallow rotovating before sowing increased soil structural stability by up to 1.8 times, incorporation of green manure of white mustard into the soil by a rotovator before sowing increased it by up to 2.0 times and direct drilling by up to 1.9 times, compared with deep ploughing.

**Keywords:** tillage intensity, catch crop, residues, soil properties, crop productivity.

# THE INFLUENCE OF PRODUCTION TECHNOLOGY ON YIELD AND QUALITY PARAMETERS OF HARD SPRING WHEAT (*TRITICUM DURUM*)

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The yield and quality of wheat grains depend on genetic factors, as well as on habitat conditions and agrotechnical treatments applied.

The aim of the study was to assess the influence of crop intensity on technological usefulness of Polish spring wheat grain SMH 87.

The research was conducted in 2013–2014 years at the Experimental Station in Osiny, Poland. The factor was the type technology: integrated and intensive, which was diversified in terms of the doses of mineral fertilizers and the intensity of plant chemical protection. The hard spring wheat cultivar SMH 87 was used in the experiment. It is characterized by a high vitreous and hard endosperm. Pastas obtained from both light and wholemeal flour were highly evaluated during the sensory evaluation.

The shape of the pasta was typical for the corkscrew form, its colour was uniform and specific for the raw materials used, and the surface was free from cracks. The weight increase during the cooking was between 2,1 and 2,2 for light flour pasta and between 2,3 and 2,4 for the wholemeal pasta.

The grains of Polish durum wheat SMH 87 is a good raw material for the production of pasta flour, both light (low-extraction) and wholemeal. The applied cultivation technology (integrated, intensive) did not significantly affect the physical and chemical properties of the grain and its technological usefulness.

**Keywords:** hard wheat, grain yield, quality, integrated technology, intensive technology.

# AGROECOSYSTEM SUSTAINABILITY FOCUSING ON SOIL PROPERTIES WITH EMPHASIS ON ORGANIC MATTER QUANTITY AND QUALITY IN RELATION TO EROSION PROCESSES

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The presentation shows the possibility of identifying Chernozem sites strongly affected by soil erosion and assessing soil characteristics relating to the organic matter of the affected localities. The analysis takes a top-down approach, from a regional scale, through cadastres, to individual blocks of land, with the use of various methods of evaluation (GIS processing, degradation modelling, field sample analysis). The spectrum of soil properties including organic matter quantity and quality and related biochemical processes was studied in erosional and depositional areas of slopes in 48 selected localities. Differences were found not only in content but also the quality of organic matter expressed in carbon content in humic acids and in the C:N ratio. Likewise, in depositional areas of slopes there was a statistically higher activity of selected soil enzymes and production of arbuscular mycorrhizal fungi compared with erosional areas. Statistically high relevant dependence is described in between individual soil characteristics. From the results obtained at landscape and local level it is possible to model changes in the content of organic matter and other soil properties on a wider scale.

**Keywords:** chernozems, degradation modelling, erosion, soil properties, organic matter.

**Acknowledgements:** this research was supported by the Ministry of Agriculture of the Czech Republic (Projects No. QK1720303 and QK1810233).

# IMPACT OF EDIBLE COATINGS ON CHEMICAL CONTENT, MICROBIOLOGICAL CONTAMINATION AND PHYSICAL PROPERTIES OF BLUEBERRIES

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Blueberries are valued not only for their good taste but also chemical content. These berries are harvesting mature that why are very susceptible to structural, nutritional and biochemical changes. For the extension of shelf-life of berries can be used edible coatings which have a potential to protect products from external environmental factors and to maintain quality and safety during the storage.

The research was carried out at Aleksandras Stulginskis University the Faculty of Agronomy in the Institute of Agricultural and Food Science in 2017–2018.

The objective of this study was to determine the possibilities to prolong shelf-life and avoid microbiological contamination of blueberries using chitosan based edible coatings with peppermint essential oil. Blueberries of cv. 'Bluecrop' and 'Patriot' were immersed in prepared chitosan edible coating for 15 min, let to dry in the air for 4 hours and stored at 4 °C temperature for 27 days.

Standard methods were used to determine the amount of dry matter, soluble solids, pH, titratable acidity, texture and colour. There were counted colonies forming units of micromycetes by dilution plating (a surface-spread method) in blueberries after the storage. The amount of soluble solids at the end of the storage increases and the highest increase was observed in non – treated with chitosan coating blueberries. There was no statistically significant difference in the changes of berries pH during the storage. Despite that edible coatings provide a barrier to oxygen, reduce the metabolism and oxidation reaction rates, the amount of vitamin C decreased independently of the cultivar and the treatment. Appearance and firmness are the most critical quality attributes influencing consumer choice of products. The value of blueberries in the market depends on the colour of a product. The combination of chitosan and peppermint essential oil lead to more intensive colour retention to dark than in untreated and chitosan coated berries.

The least number of colony forming units of fungi was detected in both cultivars of blueberries covered with chitosan coating with essential oil of peppermint. Colonies forming units of fungi in 'Bluecrop' berries were  $1.0 \times 10^3$  and 'Patriot' –  $1.3 \times 10^3$ , in the contrast in non-treated blueberries contamination with micromycetes was respectively  $2.7 \times 10^3$  and  $1.4 \times 10^5$ .

**Keywords:** blueberries, edible coatings, chemical content, physical properties, micromycetes.



## FISH PROCESSING BY-PRODUCTS UTILIZATION FOR SOIL AMENDMENT PURPOSES

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Two soils differing in pH value and in the texture have been taken for the experiment settlement – medium heavy loam and sandy loam. In order to examine the possibilities of fish processing wastes to improve soil properties, the methodology was elaborated, and the experiment started. Thus, after the preparation of fish bones, their powder was obtained and when mixed with the soil, it was placed into the special vegetative pots of 5 l in volume up to the thickness of 25 cm. The experiment has designed in 4 variants and 6 replications. The results obtained show that fish bones application has significantly influenced the increase of available phosphorus, mineral, nitrate and ammonium nitrogen content in the both experimentally tested soils. In general, the noticeable higher positive impact of fish bones application was observed in the sandy loam (forest) soil. The fish bones application have had positive effect on the content of available potassium, calcium and available sulfur in the medium heavy loam soil as well as on the content of available potassium, calcium, magnesium, total nitrogen and available sulfur in the sandy loam soil. In the case of magnesium and total nitrogen content, the increase was significant. Also, the fish bones application has decreased the acidity of sandy loam (forest) soil by 0.1–0.3 unit. Neither the amount nor the time of fish bones application did show any noticeable impact on soil pH value, magnesium and total nitrogen content in medium heavy loam soil. The organic carbon content remained unchanged both in medium heavy loam and sandy loam soils. Fish bones application has significantly influenced the increase of microbiota abundance in medium heavy loam (agricultural) as well as in sandy loam (forest) soils. However, the significantly by 2-9 times higher abundance was estimated in amended agricultural soils. Microbial biomass carbon and nitrogen in tested soils have been increasing along with fish bones application but not so drastically as microbial abundance. In amended agricultural soils the microbial biomass nitrogen was more than 2 times and carbon more than 3 times higher than in forest soils.

**Keywords:** fish by-products, soil amendment, chemical and biological properties.

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# THE INFLUENCE OF IRRIGATION ON THE CHEMICAL COMPOSITION AND COLOUR PARAMETERS OF *MENTHA SPICATA* 'MOROCCAN' MINTS

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*Mentha* plants are one of the most used plants in the world due to their medical properties. Water plays the most important role in growth and evolution of plants, as plants' stomata loftness and also photosynthesis intensity depend on water content regime. High level of oxygen has positive influence on plants' root system.

The research was carried out at Aleksandras Stulginskis University, Faculty of Agronomy, Institute of Agriculture and Food Science in 2017–2018. The research aim was to determine the influence of nano water (saturated with oxygen) on chemical composition and colour parameters of *Mentha spicata* 'Moroccan'. The study was performed by applying a pot experiment in completely randomised block design with tree replicates of each variant in the greenhouse, during the spring period of 2017. Mints were planted in Micherlich pots with pH 5.5–6.5 peat substrate. The plants were grown under 22/18 °C (day/night) temperature, with 8h photoperiods. Mints were irrigated with nano water and drinking water every 4 days, and fertilised 3-times every 2 weeks with nano water + complex NPK fertilisers (6-3.5-6) and drinking water + complex NPK fertilisers (6-3.5-6) of concentration 10 ml l<sup>-1</sup>. Mints were harvested 10 weeks after the plantation. Standard methods were used to determine the quality of water, the amount of dry matter, ash, chlorophylls and colour parameters of *M. spicata* 'Moroccan' dried at 30 °C temperature.

The results showed that the usage of water with different properties had no significant effect on dry matter and the crude ash content in the mint leaves. Dry matter and crude ash content were the highest in mints treated with fertilisers despite the used water. The highest content of chlorophyll *a* was in mints irrigated with nano water and fertilisers (108.39 mg 100g<sup>-1</sup>). Plants irrigated with drinking water and fertilisers were the least yellow (b\*) (18.94 NBS units), while the ones irrigated with nano water were the brightest (44.65 NBS units).

Fertilisation had positive influence on the content of dry matter, crude ash as well as chlorophylls. Nano water increased chlorophyll *a* content and brightness in mints.

**Keywords:** chemical composition, colour, nano water, *Mentha spicata*.

# REDUCED TILLAGE, LIME MATTER AND COVER CROP EFFECTS ON CLAYEY SOIL PHYSICAL STATE

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Clayey soils are susceptible to physical degradation in the case of intensive management. However, these soils require more intensive tillage to maintain proper physical state for grown crops. Reduced tillage under Northern Lithuania's heavy soil conditions has not been sufficiently investigated.

Investigations were carried out at the Joniškėlis Experimental Station of Lithuanian Research Centre for Agriculture and Forestry, in 2007–2016. Impact of different intensity tillage as well as its combinations with supplementary practices was evaluated on clay loam soil water content, dry bulk density, structure and aggregate stability.

This study examined the influence of deep and shallow ploughing, shallow ploughless tillage and its combinations with incorporation of lime sludge and cover crop for green manure and cover crop for mulch during winter without autumn tillage (no-tillage).

Soil water content at upper (0–15 cm) topsoil layer has increased after spring crop sowing using the ploughless tillage in autumn. However, due to reduced tillage the water content in topsoil markedly decreased when drought lasted a long time. Soil compaction in lower (15–25) topsoil layer increased when no-tillage, ploughless tillage and shallow ploughing were applied. However, soil dry bulk density in subsoil (25–35 cm) is less having applied ploughless tillage, compared to deep ploughing. Incorporating of lime sludge in combination with ploughless tillage helped to avoid the compaction and structure deterioration in upper topsoil layer, as well as increased aggregate stability.

Clayey soils are susceptible to no-tillage system and require the applying supplementary agronomic practices in combination with ploughless tillage.

**Keywords:** aggregate stability, clay loam, dry bulk density, water content.

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# EFFECTS OF THE EXTRACTS OF ORGANIC PRODUCTS ON THE SOIL MICROORGANISMS IN THE BIOLOGICAL POTATO PLANTATION

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The role of microorganisms to increase the soil fertility has been studied and found as very important. Activity of microorganisms summarily provided the organic part of the soil – humus.

The aim of the studies was to clear up influence of extracts of organic products on the soil microflora. The experiment was to realize the used extracts of vermicompost and peat in the organic breeding system from 2011 to 2012 at the Institute of Agricultural Resources and Economics Stende Research Centre. Early potato variety 'Borodjansky Rosovy' was selected. Peat elixir and vermicompost extract contain aerobic and anaerobic microorganisms (*Pseudomonas*, *Artrobacter* and *Clostridium*). The application of the microorganisms on tubers, plants and soil was influenced by the number of microorganisms in the soil. The highest number of the microscopic organisms (fungi) was influenced by vermicompost extract – treatment of tubers before planting, and tubers and plants three times during the vegetation period. It was found that the peat elixir was influenced by the number of microorganisms in the soil more than using vermicompost extract.

**Keywords:** microorganisms in the soil, extracts of organic products, potatoes.

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