VYTAUTAS MAGNUS UNIVERSITY
AGRICULTURE ACADEMY

5th International Scientific Conference
AgroEco2024: Agroecosystem Sustainability:
Links between Carbon Sequestration in Soils, Food Security and Climate Change
Vytautas Magnus University, Agriculture Academy, Lithuania, 16-18 October, 2024

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

International scientific conference

AgroEco2024
PROGRAMME AND ABSTRACTS

2024

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The conference addresses main issues related to soil health and food towards a chemical pesticide-free agriculture

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PROGRAMME

16 October (Wednesday) **VMU Agriculture Academy, Studentu str. 11, Akademija, Kaunas Reg., Central Building 505**	
9^{00}–9^{30}	**Opening of the Conference AgroEco2024** Prof. Dr. Astrida Miceikienė, *Chancellor of Agriculture Academy Vytautas Magnus University;* Assoc. Prof. dr. Rytis Skominas, *Director of Bioeconomy Research Institute, Agriculture Academy, Vytautas Magnus University;* Saulius Jasius, *Ministry of Agriculture; Dr. Žydrė Kadžiulienė, Lithuanian Academy of Sciences, Lithuanian Research Centre for Agriculture and Forestry*; Assoc. Prof. Dr. Aida Adamavičienė, *Dean of Agronomy Faculty, Vytautas Magnus University; Prof. Dr. Zita Kriaučiūnienė, Agriculture Academy, Vytautas Magnus University*
EE Time	***Plenary Session*** ***Moderators: Prof. Dr. Jerzy Weber, Assoc. Prof. Dr. Aida Adamavičienė***
9^{30}–10^{00}	**How to increase soil carbon?** Prof. Dr. Yakov Kuzyakov *University of Goettingen , Germany*
10^{00}–10^{30}	**Past and present trends in agroecosystem sustainability: insights from the Rothamsted Long-Term Experiments** Prof. Dr. Andrew Gregory *Rothamsted Research, United Kingdom*
10^{30}–11^{00}	**Coffee break, Poster presentations, Conference photo**
11^{00}–11^{30}	**Advances in the agricultural usage of phosphorus: new insights from a decade of collaborative research in Germany** Prof. Dr. Peter Karl Leinweber *Soil Science University of Rostock, Germany; Vytautas Magnus University Agriculture Academy, Lithuania*
11^{30}–12^{00}	**Carbon and nitrogen cycling in high-elevation hay meadows: understanding processes and management for improved agroecosystem productivity and health** Prof. Dr. Urszula Norton *University of Wyoming, United States of America*
12^{00}–12^{30}	**Long-term experiments on agroecosystem sustainability and soil management in Lithuania** Prof. Dr. Zita Kriaučiūnienė *Vytautas Magnus University Agriculture Academy, Lithuania*
12^{30}–13^{30}	**Lunch, poster presentations**

	Oral presentations Sessions 1–3
	VMU Agriculture Academy, Studentu str. 11, Akademija, Kaunas Reg., Central Building 505
	Session 1: Soil health and carbon sequestration for sustainability; Session 2: Soil and crop management towards a chemical pesticide-free agriculture; Session 3: Biodiversity, crop and production diversification
	Moderators: Dr. Livija Zarina, Assoc. Prof. Dr. Rimantas Vaisvalavičius
13^{30}–13^{45}	**Approaches to evaluate soil health** Yakov Kuzyakov *University of Goettingen , Germany*
13^{45}–14^{00}	**Regenerative agriculture and carbon farming: natural solutions for climate change mitigation** Muhammad Ayaz[1], Sidra Tul Muntaha[2], Zita Kriaučiūnienė[1] *[1]Vytautas Magnus University Agriculture Academy, Lithuania* *[2]University of Agriculture, Peshawar, Pakistan*
14^{00}–14^{15}	**Enhancing pea plant growth and microbial diversity through endophytic bacteria isolated from *Artemisia* species** Shervin Hadian[1], Skaidre Supronienė[1], Donald Smith[2] *[1]Lithuanian Research Centre for Agriculture and Forestry, Lithuania* *[2]McGill University Quebec, Canada*
14^{15}–14^{30}	**Effectiveness of microbiological preparations in synthetic mineral nitrogen compensation** Livija Zarina *Institute of Agricultural Resources and Economics, Latvia*
14^{30}–14^{45}	**Long-term field agricultural experiments of the Institute of Agriculture, Warsaw University of Life Sciences – SGGW, Poland: characterization of scientific potential** Łukasz Uzarowicz, Wojciech Stępień, Tomasz Niedziński, Irena Suwara, Aneta Perzanowska, Zdzisław Wyszyński, Krzysztof Pągowski, Beata Michalska-Klimczak *Institute of Agriculture*, *Warsaw University of Life Sciences – SGGW*, *Poland*
14^{45}–15^{00}	**Influence of strip-till and conventional plowing on winter rape crop** Darija Jodaugienė, Justas Blockis, Edita Mažuolytė-Miškinė, Rita Pupalienė, Lina Marija Butkevičienė, Aida Adamavičienė, Gabrielė Antanavičienė, Ilona Vagusevičienė, Rita Čepulienė *Vytautas Magnus University Agriculture Academy, Lithuania*
15^{00}–15^{15}	**Correlation between water content and lenticel number in fruits of some apple cultivars**

	Albulena Qamili–Tahirbegolli[1], Kimete Lluga Rizani[1], Sonata Kazlauskaite[2], Smajl Rizani[3], Ismet Babaj[3] *[1]University of Prishtina, Kosovo* *[2]Vytautas Magnus University, Lithuania* *[3]University of Business and Technology, Kosovo*
15^{15}–15^{30}	**CAP interventions and farmers' actions to preserve and enhance biodiversity in the agrarian landscape in Lithuania** Vlada Vitunskienė, Lina Lauraitienė *Vytautas Magnus University Agriculture Academy, Lithuania*
15^{30}–15^{45}	**Coffee break, poster presentations**
	Oral presentations in Parallel Sessions 4–5 **VMU Agriculture Academy, Studentu str. 11, Akademija, Kaunas Reg., Central Building 505** **Session 4: Precision farming and digital technologies** **Session 5: Food quality and safety** ***Moderators: Prof. Dr. Andrew S. Gregory, Assoc. Prof. Dr. Jurgita Kulaitienė***
15^{45}–16^{00}	**Assessing the effectiveness of digital and green transformation in EU agriculture** Audrone Ispiryan, Kristina Šermukšnyte-Alešiūnienė *Vytautas Magnus University Agriculture Academy, Lithuania*
16^{00}–16^{15}	**Effects of site-specific seeding technologies on winter wheat productivity, energy consumption and environment** Marius Kazlauskas[1], Kęstutis Romaneckas[1], Indrė Bručienė[1], Vilma Naujokienė[1], Sidona Buragienė[1], Dainius Steponavičius[1], Abdul M Mouazen[1,2], Egidijus Šarauskis[1] *[1]Vytautas Magnus University Agriculture Academy, Lithuania* *[2]Ghent University, Belgium*
16^{15}–16^{30}	**Plant seed germination and seedling growing in leaf extract of milk thistle** Rita Pupalienė, Ieva Pečiulytė *Vytautas Magnus University Agriculture Academy, Lithuania*
16^{30}–16^{45}	**Effect of amino acids on sweet basil (*Ocimum basilicum* L.) biological properties under drought conditions** Justina Deveikytė[1], Aušra Blinstrubienė[1], Natalija Burbulis[1], Aldona Baltušnikienė[2] *[1]Vytautas Magnus University Agriculture Academy, Lithuania; [2]Lithuanian University of Health Sciences, Lithuania*
16^{45}–17^{00}	**The potential for the introduction of Kernza® perennial grain in the Nordic-Baltic region** Zita Kriaučiūnienė[1], Katarina Arvidsson Segerkvist[2], Anne-Kjersti Bakken[3], Rita Čepulienė[1], Ola Hallin[2], Lars T. Havstad[3], Uffe Jörgensen[4], Indrek Keres[5], Marjo Keskitalo[6], Mailiis Korge[5], Matas Krivickas[1], Jurgita Kulaitienė[1], Johanna Leppälä[6], Evelin Loit-Harro[5],

	Valentin Picasso[7], Thomas Prade[2], Nijolė Vaitkevičienė[1], Wendy Waalen[3], Ernestas Zaleckas[1], Linda-Maria Dimitrova Mårtensson[2] *[1]Vytautas Magnus University Agriculture Academy, Lithuania* *[2]Swedish University of Agricultural Sciences, Sweeden* *[3]Norwegian Institute of Bioeconomy Research, Norway* *[4]Aarhus University, Denmark* *[5]Estonian University of Life Sciences, Estonia* *[6]The Natural Resources Institute, Finland* *[7]University of Wisconsin-Madison, United States of America*
17^{00}–17^{15}	**Food security challenges in Azerbaijan** Kushvar Mammadova, Gunay Verdiyeva *Azerbaijan State Agricultural University, Azerbaijan*
	Oral presentations in Parallel Session 6 **VMU Agriculture Academy, Studentu str. 11, Akademija, Kaunas Reg., Central Building 520** **Session 6: Climate change adaptation and mitigation** ***Moderators: Prof. Dr. Peter Karl Leinweber, Assoc. Prof. Viktorija Vaštakaitė-Kairienė***
15^{45}–16^{00}	**Scots pine genetic studies of vegetation in southern Lithuania in the Allerød: The case of Pamerkiai** Jurata Buchovska[1], Darius Danusevičius[1], Linas Daugnora[2], Algirdas Girininkas[2] *[1]Vytautas Magnus University Agriculture Academy, Lithuania* *[2]Institute of Baltic Region History and Archaeology, University of Klaipėda, Lithuania*
16^{00}–16^{15}	**Decreased soil water content effects on the toxicity of triclosan to oilseed rape (*Brassica napus* L.)** Diana Miškelytė, Jūratė Žaltauskaitė *Vytautas Magnus University Agriculture Academy, Lithuania*
16^{15}–16^{30}	**Assessing agriculture's effects on Lithuania's ecological footprint: the NARDL approach** Algirdas Justinas Staugaitis, Daiva Makutėnienė *Vytautas Magnus University Agriculture Academy, Lithuania*
16^{30}–16^{45}	**Factors influencing merchantable timber amount in Lithuanian forests** Edgaras Linkevičius, Almantas Kliučius *Vytautas Magnus University Agriculture Academy, Lithuania*
16^{45}–17^{00}	**The impact of mineral nutrition on the management of fungal diseases in leafy vegetables** Viktorija Vaštakaitė-Kairienė[1], Darius Jermala[2], Neringa Rasiukevičiūtė[2], Kristina Bunevičienė[2], Alma Valiuškaitė[2] *[1]Vytautas Magnus University Agriculture Academy, Lithuania* *[2]Lithuanian Research Centre for Agriculture and Forestry, Lithuania*

17^{00}–17^{15}	**Soil quality assessment in long-term experiment using soil quality indexes** Jūratė Aleinikovienė, Vaida Steponavičienė, Justinas Blažukas, Vaclovas Bogužas, Jolita Greblikaitė, Rolandas Rakštys *Vytautas Magnus University Agriculture Academy, Lithuania*
17^{15}–17^{45}	**Concluding remarks and discussions** **Central Building 520** ***Moderators: Prof. Dr. Kęstutis Romaneckas, Assoc. Prof. Dr. Aida Adamavičienė, Prof. Dr. Zita Kriaučiūnienė, Prof. Dr. Vaclovas Bogužas.*** **Participants:** Prof. Dr. Yakov Kuzyakov, *University of Goettingen*, *Germany*; Prof. Dr. Andrew Gregory, *Rothamsted Research*, *United Kingdom*; Prof. Dr. Peter Karl Leinweber, *Soil Science University of Rostock*, *Germany*; *Vytautas Magnus University Agriculture Academy*, *Lithuania*; Prof. Dr. Urszula Norton, *University of Wyoming*, *United States of America*, Prof. Dr. Jerzy Weber, *Wroclaw University of Environmental and Life Sciences*, *Poland*
19^{00}–22^{00}	**Conference dinner with cultural program** Raudondvaris Manor Orangery, Pilies takas 1, Raudondvaris, Kaunas Reg.
17 October (Thursday)	
9^{30}–14^{00}	**Field trip Rotušės a. 28, Kaunas, Lithuania** **- Excursion to the Museum of the History of Lithuanian Medicine and Pharmacy** **- Guided Excursion to the Old Town of Kaunas** Coordinators: PhD Student Erika Jakienė, Assoc. Prof. Dr. Dovilė Levickienė, Researcher Dr. Aušra Rudinskienė, Prof. Dr. Zita Kriaučiūnienė, *Vytautas Magnus University Agriculture Academy, Lithuania*
14^{00}–17^{00}	**End of the Conference with the Cultural programme of the 100th anniversary of the VMU Agriculture Academy** **VMU Agriculture Academy, Studentu str. 11, Akademija, Kaunas Reg., Central Building 505**
18 October (Friday) **VMU Agriculture Academy, Universiteto str. 8a-211, Akademija, Kaunas Reg.**	
9^{00}–17^{00}	**The meeting of the project: Soil management effects on soil organic matter properties and carbon sequestration (SOMPACS)** https://upwr.edu.pl/en/research/projects/national-centre-for-research-and-development/sompacs-en Prof. Dr. Jerzy Weber, *Wroclaw University of Environmental and Life Sciences, Poland;* Prof. Dr. Vaclovas Bogužas, Prof. Dr. Zita Kriaučiūnienė, *VMU Agriculture Academy, Lithuania*
17^{00}	**Closing of the conference program**

POSTER PRESENTATIONS

Soil health and carbon sequestration for sustainability

1. **Soil properties changes under long-term different organic fertilization**
Edyta Hewelke[1], Jerzy Weber[2], Peter Leinweber[3], Lilla Mielnik[4], Andrzej Kocowicz[2], Elżbieta Jamroz[2], Vaida Steponavičienė[5], Vaclovas Boguzas[5], Marek Podlasiński[4], Dariusz Gozdowski[1], Aneta Perzanowska[1], Łukasz Uzarowicz[1]
[1]*Warsaw University of Life Sciences (SGGW), Warsaw, Poland*
[2]*Wroclaw University of Environmental and Life Sciences, Wroclaw, Poland;* [3]*University of Rostock, Germany*
[4]*West Pomeranian University of Technology, Szczecin, Poland*
[5]*Vytautas Magnus University Agriculture Academy, Lithuania*

2. **Does long-term no-till farming improve soil health and crop productivity?**
Aneta Perzanowska, Edyta Hewelke, Jerzy Weber, Darek Gozdowski, Paweł Szacki, Łukasz Uzarowicz
Warsaw University of Life Sciences, Wrocław University of Environmental and Life Sciences, Poland

3. **Quantitative – qualitative properties of biochar from fiber hemp**
Kęstutis Žiūra, Egidijus Zvicevičius, Vita Tilvikienė, Marius Mickevičius
Vytautas Magnus University Agriculture Academy, Lithuania

4. **The impact of monoculture and crop rotation combinations on soil CO_2 emission of maize (*Zea mays* L.)**
Mindaugas Dorelis, Vaclovas Bogužas
Vytautas Magnus University Agriculture Academy, Lithuania

5. **Effect of crop rotation on abundance of microscopic fungi in the soil of winter rye (*Secale cereale* L.) crop**
Fatma Yilamz[1], Nijolė Maršalkienė[2], Lina Skinulienė[2], Vaclovas Bogužas[2]
[1]*Hatay Mustafa Kemal University, Turkiye*
[2]*Vytautas Magnus University Agriculture Academy, Lithuania*

6. **The influence of the long-term catch-crop application on the structure of humin fraction**
Jerzy Weber[1], Elżbieta Jamroz[1], Lilla Mielnik[2], Riccardo Spaccini[3], Andrzej Kocowicz[1], Irmina Ćwieląg-Piasecka[1], Danuta Parylak[1], Magdalena Dębicka[1]
[1]*Wrocław University of Environmental and Life Sciences, Poland*
[2]*West Pomeranian University of Technology in Szczecin, Poland*
[3]*Research Center CERMANU, University of Naples, Italy*

7. **Long-term effects of tillage, crop residues, and intercropping combination on soil health**
Giedrius Žiūraitis, Vaida Steponaviciene, Jūratė Aleinikovienė, Vaclovas Bogužas
Vytautas Magnus University Agriculture Academy, Lithuania

8. **Effect of fertilizers from meat bone meal with biostimulants on soil physicochemical properties**
Rita Čepulienė[1], Ernestas Zaleckas[1], Vilma Naujokienė[1], Egidijus Šarauskis[1], Laura Alzhanova[2] Quirijn de Jong van Lier[3], Zita Kriaučiūnienė[1]

[1]*Vytautas Magnus University Agriculture Academy, Lithuania*
[2]*Almaty Technological University, Kazakhstan*
[3]*University of São Paulo, Brazil*

9. **Effects of long-term crop rotation, rye monoculture and continuous black fallow on soil enzyme sucrase and urease activity**
Lina Skinulienė[1], Aušra Marcinkevičienė[1], Jerzy Weber[2], Vaclovas Bogužas[1], Edyta Hewelke[3]
[1]*Vytautas Magnus University Agriculture Academy, Lithuania*
[2]*Wroclaw University of Environmental and Life Sciences, Poland*
[3]*Warsaw University of Life Sciences (SGGW), Warsaw, Poland*

Soil and crop management towards a chemical pesticide-free agriculture

10. **Changes in soil physical and chemical properties of multi–crop cultivation**
Jovita Balandaitė[1], Rasa Kimbirauskienė[1], Aušra Sinkevičienė[1], Aušra Marcinkevičienė[1], Austėja Švereikaitė[1], Ugnius Ginelevičius[1], Kęstutis Romaneckas[1], Marek Marks[2]
[1]*Vytautas Magnus University Agriculture Academy, Lithuania*
[2]University of Warmia and Mazury in Olsztyn, Poland

11. **The influence of cover crop mixtures on soil properties under conventional and organic farming conditions**
Aušra Marcinkevičienė, Aušra Rudinskienė, Lina Skinulienė, Lina Marija Butkevičienė, Donatas Samaitis
Vytautas Magnus University Agriculture Academy, Lithuania

12. **The influence of winter cover crops and their incorporation methods on soil biological properties**
Aušra Marcinkevičienė, Rimantas Velička, Robertas Kosteckas, Arūnas Čmukas
Vytautas Magnus University Agriculture Academy, Lithuania

13. **Research on different varieties of winter wheat**
Karolina Jackevičienė, Aušra Sinkevičienė, Gabrielė Černiauskaitė, Inesa Sinkevičiūtė, Augustas Sederevičius, Kęstutis Romaneckas, Rasa Kimbirauskienė
Vytautas Magnus University Agriculture Academy, Lithuania

14. **Enhancing soil texture and productivity in arid regions: integrating arbuscular mycorrhizal fungi for sustainable soil improvement in Tabuk, Saudi Arabia**
Muhammad Shahbaz Khalil, Tariq Butt
Swansea University, United Kingdom

15. **Effect of electromagnetic field and bacterial treatment of wheat seeds on plant vegetation**
Martynas Lazauskas[1], Ernestas Zaleckas[1], Andrius Grigas[1], Oleksandr Karnaukh[2]
[1]*Vytautas Magnus University Agriculture Academy, Lithuania*

24. **The influence of nitrogen deficiency during winter wheat vegetation on the amount of other macro and micro elements in the plant and roots**
Ernestas Petrauskas[1], Ernestas Zaleckas[1], Paulius Mykolaitis[2], Vytautas Petkus[2], Mantas Lukoševičius[2], Andrius Stankevičius[3]
[1]Vytautas Magnus University Agriculture Academy
[2]Kaunas University of Technology
[3]Vilnius Gediminas Technical University, Lithuania

25. **Usage of spectral reflectance sensors in maize growing technology**
Linas Marcinkevičius, Ernestas Zaleckas, Lina Skinulienė, Ernestas Petrauskas
Vytautas Magnus University Agriculture Academy, Lithuania

26. **Effectiveness of the biological approach to lowering CO_2 levels in soil**
Kristina Lekavičienė, Vilma Naujokienė, Egidijus Šarauskis
Vytautas Magnus University Agriculture Academy, Lithuania

Food quality and safety

27. **Glycoalkaloids changes during ripening in different *Solanum* species**
Jūratė Staveckienė, Jurgita Kulaitienė, Viktorija Vaštakaitė-Kairienė, Brigita Medveckienė
Vytautas Magnus University Agriculture Academy, Lithuania

28. **Influence of the addition of vegetable and animal raw materials on the physical properties of tea buns**
Laura Rakauskaitė, Jurgita Kulaitienė
Vytautas Magnus University Agriculture Academy, Lithuania

29. **The influence of spontaneous solid-phase fermentation on the quality of the leaves of the fireweed**
Marius Lasinskas, Elvyra Jarienė, Ewelina Hallmann, Aloyzas Velička, Aistis Petruškevičius,
Vytautas Magnus University Agriculture Academy, Lithuania

30. **Influence of zoocompost and harvesting time on honeysuckle leaves quality**
Erika Jakienė, Nijolė Vaitkevičienė, Juozas Pekarskas
Vytautas Magnus University Agriculture Academy, Lithuania

31. **Varroa destructor treatment with essential oils**
Aurelija Šaluchaitė, Povilas Mulerčikas, Aurelija Ramanauskaitė, Vilius Juodzevičius
Vytautas Magnus University Agriculture Academy, Lithuania

32. **The effect of matcha (*Camellia sinensis* L.) and moringa (*Moringa oleifera*) leaf powder additive on the physical properties of the cupcakes**
Emilija Viknė, Dovilė Levickienė
Vytautas Magnus University Agriculture Academy, Lithuania

33. **The influence of light intensity and nutrient media on the colour parameters of radish and fennel microgreens**
Aušrinė Simonavičiūtė, Viktorija Vaštakaitė-Kairienė, Jūratė Staveckienė
Vytautas Magnus University Agriculture Academy, Lithuania

34. **Recovery of lipophilic compounds from different cultivars of blackberry (*Rubus fruticosus* L.) pomace by supercritical CO_2 and conventional extraction methods**
Indrė Čechovičienė, Živilė Tarasevičienė, Ewelina Hallmann, Marcin Kruk, Jonas Viškelis; Pranas Viškelis
Vytautas Magnus University Agriculture Academy, Lithuania

35. **Enhancing of linseed oil oxidative stability by the addition of selected freeze-dried vegetables**
Grzegorz Dąbrowski, Weronika Limanowska, Dorota Ogrodowska, Sylwester Czaplicki, Iwona Konopka
University of Warmia and Mazury in Olsztyn, Poland

36. **Quality of the garlic (*Allium sativum* L.) stored in controlled atmosphere chambers**
Aurelija Paulauskienė, Živilė Tarasevičienė
Vytautas Magnus University Agriculture Academy, Lithuania

37. **Impact of pretreatment methods on the quality properties of *Nigella sativa* L. cold-press cake residual**
Valdas Laukagalis[1], Živilė Tarasevičienė[1], Indrė Čechovičienė[1], Mindaugas Visockis[1], Anna Kieltyka-Dadasiewicz[2]
[1]Vytautas Magnus University Agriculture Academy, Lithuania
[2]University of Life Sciences in Lublin, Poland

38. **Investigation on quality parameters and adaptation of sweet cherry varieties in Afghanistan climatic conditions**
Atefi Rahmatullah, Hashimi Sayed Ahmad Asim, Ebadi Sayed Khalifatullah
Baghlan University, Afghanistan

Climate change adaptation and mitigation

39. **Fungi present in the organic and mineral soil layers of common (*Quercus robur* L.) and Northern red (*Q. rubra* L.) oak tree plantations**
Nijolė Maršalkienė, Svajūnė Grubinskaitė, Vitas Marozas
Vytautas Magnus University Agriculture Academy, Lithuania

40. **Evaluation of the introduction of Kernza® perennial grain in Lithuania in the early stages of development**
Matas Krivickas, Rita Čepulienė, Ernestas Zaleckas, Nijolė Vaitkevičienė, Jurgita Kulaitienė, Zita Kriaučiūnienė
Vytautas Magnus University Agriculture Academy, Lithuania

41. **Significance of mineral nitrogen transformation and microbial community stabilisation affected by organic and biological amendment**
Audrius Jakutis[1], Jūratė Aleinikovienė[1], Lina Skinulienė[1], Muhammad Tahir Khan[1], Regina Skuodienė[2], Ewald Sieverding[3]
[1]Vytautas Magnus University Agriculture Academy, Lithuania;
[2]Lithuanian Research Centre for Agriculture and Forestry, Lithuania;
[3]Universität Stuttgart, Germany

ABSTRACTS

ORAL PRESENTATIONS

HOW TO INCREASE SOIL CARBON?

Yakov Kuzyakov

Department Department of Soil Science of Temperate Ecosystems
University of Göttingen, Germany
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The talk provides an overview about the broad range of approaches increasing and / or stabilizing the organic and inorganic carbon (C) in soil. Individual processes of C input by shoots and roots, their transformation and utilization by soil microorganisms will be discussed.

The input by root residues and rhizodeposits will be evaluated based on the total assimilated plant C, and it will be presented that the contribution of roots to soil C is 2-3 times larger that of the shoots. Linear accumulation of organic matter by biochar application will be accompanied by the improvements of soil properties and larger root growth. Important part will be devoted to the recycling of microbial C in soil within the turnover of organic matter and microorganisms. Optimal pH ranges for C stabilization by Fe and Al oxides, Ca bridges and clay minerals will be discussed and consequences for long-term C stabilization will be developed.

Special focus will be given to the C sequestration processes in subsoil and aggregate formation by mycorrhiza and glucoproteins. Carbon output processes are grouped for destabilization including priming effects, and decomposition leading to complete mineralization and CO_2 efflux.

Finally, the approaches to save the huge stock of inorganic C from N fertilization induced soil acidification and CO_2 release will be discussed. The importance of carbonates for soil fertility, ecosystem functions and sustainability as well as stabilization of organic C will be discussed.

Concluding, increasing and stabilizing the C stocks in soil is a very complex issue, and consequently, complex management solutions considering natural and climatic conditions are necessary.

Key words: *Soil organic matter, Carbon sequestration, Aggregate formation, Soil carbonates*

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APPROACHES TO EVALUATE SOIL HEALTH

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Assessment of soil health requires complex evaluation of properties and functions responsible for a broad range of ecosystem services. Numerous soil quality indices (SQI) have been suggested to evaluate specific groups of soil functions, but comparison of various SQI is impossible because they are based on a combination of specific soil properties. To avoid this problem, we suggest an SQI-area approach based on the comparison of the areas on a radar diagram of a combination of chemical, biological and physical properties. The new approach is independent of the SQI principle and allows rapid and simple comparison of parameter groups and soils.

Another approach analyzing the resistance and sensitivity of properties to degradation is suggested for a detailed evaluation of soil health. The resistance and sensitivity of soil properties are determined through comparison with the decrease of soil organic carbon (SOC) as a universal parameter responsible for many functions. The SQI-area and resistance/sensitivity approaches were tested based on the recovery of Phaeozems and Chernozems chronosequences after the abandonment of agricultural soils. Both the SQI-area and the resistance/sensitivity approaches are useful for basic and applied research, and for decisionmakers to evaluate land-use practices and measure the degree of soil degradation.

At the end, important and unresolved questions are discussed: What are the indicators of soil health: Pools or fluxes? When individual soil properties and potentials are crucial? What are the spatial and temporal scales of soil health?

Key words: *Ecosystem stability, Land quality, Land degradation, Soil health, Soil management, Soil organic matter*

PAST AND PRESENT TRENDS IN AGROECOSYSTEM SUSTAINABILITY: INSIGHTS FROM THE ROTHAMSTED LONG-TERM EXPERIMENTS

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The Rothamsted Long-Term Experiments (LTEs) in the UK are the oldest continuous agronomic experiments in the world, with the 'Classical' experiments of Lawes and Gilbert dating back to the 1840s-1850s. Originally established to examine the effect of inorganic fertilisers and organic manures on crop yield and nutrient cycling, they have become increasingly important as a research platform to examine wider agroecosystem sustainability. The long history of different treatments on the LTEs has resulted in gradients of measurable soil physical, chemical, and biological properties and functions, which collectively define soil health, and this has been manifest in observable differences in the growing crops. All changes have occurred against a backdrop of a changing climate. Here we introduce some of the key findings on the relationship between agronomic management and agroecosystem sustainability reported on the Rothamsted LTEs.

Arguably, the key agroecosystem function is net primary production, and we demonstrate the effect of fertilisers and manures on increasing crop yields, the effects of liming on nutrient availability, and how micronutrient concentrations in cereal grains have changed in modern crop varieties. We also demonstrate the interrelationship between agronomic management, soil organic carbon (SOC) and soil physical properties. The effect on soil structure – the arrangement of soil particles in aggregated units with internal and surrounding pore networks – has implications for the role of agroecosystems in regulating water and air. We also demonstrate that long-term management, and especially its effect on soil nutrients and SOC, affects soil microbiology including the microbiome. This controls nutrient delivery to plants and the ability of soil to be a sink or source of greenhouse gases. Related to this, we discuss our findings on how agronomic management has affected SOC and the role of C sequestration in soils to mitigate climate change. We demonstrate that injudicious application of fertiliser and manure can lead to nutrient losses, and we also observe accumulations of microplastics in agricultural soils in recent decades.

The Rothamsted LTEs, within the family of global LTEs, continue to yield new insights into agroecosystems and how they may be managed to achieve sustainability goals.

Key words: *agronomic management; climate change; net primary production; soil health;microbiology; water and air regulation*

ADVANCES IN THE AGRICULTURAL USAGE OF PHOSPHORUS: NEW INSIGHTS FROM A DECADE OF COLLABORATIVE RESEARCH IN GERMANY

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In response to expected future shortage of mineable global phosphate rock reserves, and obvious environmental problems from current non-sustainable use of phosphorus German government has funded two substantial multi-disciplinary research projects for periods of nine years each: the Leibniz science campus "Phosphorus Research Rostock" (https://wissenschaftscampus-rostock.de/) and the project InnoSoilPhos („Innovative solutions to sustainable phosphorus management", https://www.innosoilphos.de/).

This keynote lecture reports some highlights and new insights from the projects in which the authors had coordinator functions. At the atomic scale of soil chemistry the application of computational chemistry revealed a detailed picture of the phosphate binding by pedogenic Fe-(oxyhydro)oxides, and how it can be overcome. Major results are the computational modelling of phosphate binding at goethite surfaces, indicating the formation of primarily mono-protonated bidentate rather than monodentate complexes. These binding motifs changed after Fe-oxide surfaces have been covered partly with organic molecules using zeta (ζ) potential measurements and sorption isotherms complementary to quantum-chemical modelling. Molecular-biology research indicated that diazotrophic *Bradyrhizobium* spp. bacteria associated, e.g., with the common catch crop serradella (*Ornithopus sativus*) were also capable for P mineralization. Furthermore, molecular biology works aimed at isolating and testing bacterial candidates for P-mobilizing inoculums. From experiments at the plot and field scale, it was concluded that current P fertilizer recommendation often are excessive, meaning that farmers waste money for P fertilizer without adequate yield effects. Furthermore, we gained new insights into the P-fertilizer effects of recycling materials such as bone char and biochar from sewage sludge. At the farm and field to catchment scale, socio-economic investigations disclosed farm-specific P-fertilizer application patterns, and hot spots and -moments of P losses from fields and sub-catchments that are released to the Baltic Sea. Finally, policy recommendations were worked out for obtaining a better use of the limited global resource phosphorus.

LONG-TERM EXPERIMENTS ON AGROECOSYSTEM SUSTAINABILITY AND SOIL MANAGEMENT IN LITHUANIA

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Improved management practices must integrate unique differences in climate and site-specific soil properties, including the use of cover crops and/or appropriate crop residue management to enhance carbon sequestration. The accumulation of soil organic carbon may depend on the type of agricultural use and crop rotation applied. Three long-term field experiments: crop rotation collection, since 1967; tillage systems, since 1988; and sustainability of agroecosystems, since 2000, are being conducted at the Vytautas Magnus University Experimental Station in Lithuania and are continuing until now. The aim of the crop rotation study is to estimate the long-term effect on soil organic carbon sequestration potential in different crop rotations. The aim of the research on tillage systems and sustainability of agroecosystems is to assess the effects of long-term reduced and no-tillage, combined with the use of crop residues and cover crops, on organic carbon stocks and sequestration rate. The crop rotation experiment showed that continuous bare fallow without manure fertilisation, compared to crop rotation, reduces the amount of organic carbon in the soil by up to 2 times, the carbon management index by 2–5 times and poses the greatest risk to the potential of carbon sequestration in agriculture. The results of the long-term agroecosystem sustainability experiment indicate that no-tillage with cover crops, both without and with straw, increases the organic carbon stock by 1.2 to 1.8 times compared to deep ploughing. The results of the tillage systems experiment show that long-term low-intensity tillage, which increases the stratification of organic carbon stocks in the soil, especially no-tillage, has a positive effect on soil quality indicators in the upper soil layer and helps to restore and increase organic carbon stocks. The long-term application of these measures can ensure a more sustainable use of soil without reducing the productivity of agricultural crops.

Acknowledgements: We acknowledge CLIMAGRO LT Research Infrastructure and BioTec.

Key words: *crop rotation, carbon sequestration, soil organic carbon, no-till, reduced tillage, ploughing*

REGENERATIVE AGRICULTURE AND CARBON FARMING: NATURAL SOLUTIONS FOR CLIMATE CHANGE MITIGATION

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The study highlights the critical mechanistic data to support carbon farming through using biochar's (BC) ecological restoration advantages, highlighting its role in climate chnage mitigation. Recognizing the substantial influence of specific feedstock sources and pyrolysis parameters on BC efficacy, this research aims to address these gaps through an extensive investigation into the potential benefits of BC application in ecological restoration. The methodology involves a systematic exploration of BC's effects from latest literature on various aspects of agricultural sustainability, including its ability to support crop growth, improve nutrient bioavailability, facilitate co-composting, enhance consumption efficiency, and contribute to water quality restoration. The main results of the study reveal that BC usage results in a net negative carbon (C) footprint, mitigates heavy metal pollution, and enhances soil and ecosystem health. In bioenergy production, BC serves as a versatile resource for generating renewable energy, reducing waste, and facilitating C sequestration. Advanced BC techniques, such as tailored pyrolysis processes and activation methods, further enhance its effectiveness in ecosystem restoration and sustainable resource management. Furthermore, the research identifies deficiencies in current literature and proposes future research directions to advance understanding of BC application. Overall, the study underscores the importance of considering feedstock and pyrolysis variables in BC research and highlights the potential for BC to contribute to ecological sustainability. However, concerns regarding potential health implications for humans in agricultural contexts warrant further investigation and risk assessment to ensure safe and sustainable BC application.

Key words: *biochar application; carbon farming; ecological ctewardship; zero waste economy*

EFFECTIVENESS OF MICROBIOLOGICAL PREPARATIONS IN SYNTHETIC MINERAL NITROGEN COMPENSATION

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From the environmental and economic aspect, the use of inorganic nitrogenous fertilizer becomes a threat. One alternative is to use biological nitrogen-fixing bacteria to fix atmospheric nitrogen. Various microbiological preparations are already available to crop production producers, but their potential possibilities have not been fully elucidated. With the aim to find out the effectiveness of using the commercially available microbiological preparation *Azotobacterin* in compensating mineral nitrogen, in 2022 the Institute of Agro-Resources and Economics (AREI) started demonstration studies in winter wheat 'Skagen". The soil in the experimental field had agrochemical parameters typical for the region. The sowing rate was 500 germinating seeds per 1 m^2. Five variants were compared, spraying the preparation at 5 and 7 L ha^{-1} during sowing and in spring, at the resumption of vegetation, one and two times. The obtained results show that the replacement of synthetic nitrogen with the microbiological preparation Azotobacterin, which, according to the recommendations of the product manufacturer, contributes to the attraction of up to 50 kg of N from the atmosphere, ensures an equivalent amount of harvest, compared to the control option.

Acknowledgment

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Key words: *nitogen biofertilizer, atmospheric nitrogen fixation, winter wheat*

ENHANCING PEA PLANT GROWTH AND MICROBIAL DIVERSITY THROUGH ENDOPHYTIC BACTERIA ISOLATED FROM *ARTEMISIA* SPECIES

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Microorganisms play a crucial role in agriculture by promoting plant growth and reducing the dependency on chemical fertilizers. Endophytic bacteria, residing within plant tissues, offer innovative solutions for sustainable agricultural practices. This study investigates the effects of endophytic bacteria isolated from *Artemisia* species on the growth and microbial diversity of *Pisum sativum* (pea plants). Sixty-one bacterial strains were isolated from the root, stem, and leaf tissues of four *Artemisia* species and identified through 16S rDNA sequencing. Two isolates, AR11 and AR32, from the roots of *Artemisia absinthium*, were selected to evaluate their influence on pea plant growth compared to control plants.

Following four weeks of inoculation, metagenomic analysis using PacBio sequencing revealed significant differences in microbial diversity between the inoculated and control plants. Pea plants treated with AR11 exhibited increased root and shoot length, alongside a more diversity of microbial community, as indicated by Shannon and Simpson diversity indices. The AR11 treatment enhanced the abundance of beneficial bacterial genera such as *Pseudomonadales* and *Flavobacteriales*, known for their roles in plant growth promotion and biocontrol. Conversely, AR32 had a lesser impact on both plant growth and microbial composition.

These results demonstrate the strong potential of the AR11 bacterial strain as an effective bioinoculant, significantly promoting plant growth and fostering a more diverse microbial community in the pea plants. AR11 presents a promising alternative to chemical fertilizers, contributing to more sustainable and environmentally friendly agricultural practices.

Home message: This study demonstrates that the endophytic bacteria AR11, isolated from *Artemisia absinthium*, significantly enhances the growth of *Pisum sativum* (pea plants) and enriches microbial diversity. This study underscores the importance of exploiting endophytic bacteria to boost crop productivity and maintain plant microbial diversity.

Key words: *Endophytic bacteria, Artemisia spp., pea plants, metagenomic analysis*

LONG-TERM FIELD AGRICULTURAL EXPERIMENTS OF THE INSTITUTE OF AGRICULTURE, WARSAW UNIVERSITY OF LIFE SCIENCES – SGGW, POLAND: CHARACTERIZATION OF SCIENTIFIC POTENTIAL

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Long-term field agricultural experiments of the Institute of Agriculture, Warsaw University of Life Sciences – SGGW, Poland operate in central Poland. The experiments includes fields in three locations: Skierniewice, Chylice and Miedniewice. The fertilization experiments in Skierniewice were established in 1921 on Luvisols. These experiments are the oldest existing experiments in Poland and one of the oldes in the world. The experiments have been carried out in various fertilization combinations (Ca, CaNPK, NPK, CaPK, CaPN, CaNK, PK, PN, KN, farmyard manure) including control plots with no fertilization. The four crop rotation are applied: 1) 5-field crop rotation, 2) rotation without manure and legumes, 3) rotation without manure with legumes and 4) 3 long-term monocultures (rye, potatoes and triticale). The fertilization and tillage experiments in Chylice were established on Phaeozems. The fertilization experiments were established in 1955. The effects of organic and mineral fertilization in a four-field crop rotation with and without fine-seed bean is compered. The tillage experiments were set up in 1975 to investigate the effect traditional moldboard plough and conservation zero-tillage on soil properties and crop yield. In 2011, some plots with direct sowing were replaced into plots with no-till cultivator. Experiments in Miedniewice were established in 2011 on Luvisols. Plant cultivation is carried out in a 3-field intensive rotation with a predominance of cereals. Also, 4-field integrated rotation is carried out with the root crop, beans and cereals. For part of the field, the organic farming certificate has also been obtained. In the part of intensive and integrated production system tillage, experiment was also established with three tillage systems: conventional moldboard plow, ploughless tillage with a cultivator and strip-till (introduced in 2020 instead of direct sowing). There is also a permanent meadow in Miedniewice. Some research was financed by EJP SOIL program, NCBR project EJPSOIL/I/78/SOMPACS/2022 and through the partners of the Joint Call of the Cofund ERA-Nets SusCrop, FACCE ERA-GAS, ICT-AGRI-FOOD and SusAn under the 'ConnectFarms' project.

Key words: *long-term field experiments, fertilization experiment, tillage experiments, organic field*

INFLUENCE OF STRIP-TILL AND CONVENTIONAL PLOWING ON WINTER RAPE CROP

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Interest in no-till technologies is growing all over the world, one of which is strip tillage. Strip-till has many advantages compared to traditional sowing machines. One of the biggest advantages is significantly lower soil preparation and sowing costs. Optimum conditions are created for rapid plant germination and rapid development of the root system. When sowing directly into the stubble, moisture is maintained, better conditions are created for overwintering, and plant residues on the soil surface prevent erosion. However, simplified tillage technologies require significantly more knowledge, otherwise you can be disappointed with them.

To that aim, in 2023–2024 in the Educational Farm of VMU fields, studies were conducted comparing strip-till with conventional plowing technology. Preparation for wintering was set at the end of October when the weather cooled down. The number of plant leaves, growth cone, mass of the upper part, root length, diameter, root mass and dry matter content were evaluated. The winter rapeseed crop was evaluated before flowering. Plant height, mass of roots, stems and leaves, amount of accumulated nutrients (NPK), and chlorophyll concentration in leaves were determined. After the rapeseed ripened, the research was repeated, and the same parameters as in the previous stage were set.

Winter rape plants in strip-till were smaller and less prepared for winter than in the conventional field. Similar results were obtained in the winter rapeseed crop in the beginning flowering stage. In the ploughing technology, the plants were taller, accumulated more nitrogen, phosphorus and potassium, and a higher concentration of chlorophyll was found in the leaves. Before harvesting, the situation was similar, the plants in strip-till were lower and the yield was lower. However, one of the reasons for the negative results is that after sowing plants with wide spacing, the same rate of seed was sown as when sowing plants with narrow spacing – in ploughing technology. Therefore, the plants more competed with each other and the results were worse. When applying strip-till technology, one should also think about reducing the amount of seeds.

Key words: *winter rape, strip-till, preparation for wintering, amount of nutrients, chlorophyll concentration*

CAP INTERVENTIONS AND FARMERS' ACTIONS TO PRESERVE AND ENHANCE BIODIVERSITY IN THE AGRARIAN LANDSCAPE IN LITHUANIA

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Continued intensification of agriculture led to severe habitat and species diversity in the farmed landscape in Europe. In 2022 EU's farmland bird index was 33% below its 2000 value what shows a relative decrease in species abundance in the farmland. In response to growing public concern on environmental issues, the European Commission has introduced agri-environmental measures (AEM) as a financial incentive-based element of the Common Agricultural Policy (CAP) Pillar 2 for the years 2007-2022 and Eco-schemes as an element of the Pillar 1 for the years 2023-2029. The general purpose of these measures and schemes is to encourage farmers to protect and improve soil, environment, landscape and biodiversity, and to support climate change mitigation. However, several studies have shown that the conditions for disbursing agri-environmental payments were not sufficiently rigorous for generating tangible environmental benefits.

For this presentation, we reviewed the history, current use, payments, and efficiency of agri-environmental and Natura 2000 measures, and Eco-schemes under the CAP that encourage Lithuanian farmers to preserve and enhance biodiversity in the agricultural landscape. To achieve these goals, both time and space analyses of the implementation of AEM, eco-schemes and Natura 2000 on agricultural land in Lithuania were used.

We found that the public expenditure (EU and national) on AEM and NATURA 2000 accounted for about 1.9% (i.e. nearly 136 million EUR) of total funding for the CAP and national support for Lithuanian agriculture in 2014-2022. The findings of our study and other studies show that farmers are slow to engage in both measures in fertile land areas. In 2022 Lithuanian farmland bird index was 55% below its 2000 value. The majority of this decline occurred since the middle of the last decade (an average of -7% per year in 2014-2022). We conclude that the positive effects on biodiversity of the examined measures were modest. It can be expected that the new environmental measures of the Eco-scheme have the potential to correct these weaknesses of AEM. For 2023-2029 approximately 18% (i.e. over 730 million euros) of the total budget of Lithuania's CAP Strategic Plan is allocated to fund the direct payments under Eco-schemes (excluding activities on arable land using certified seed) and Natura 2000.

Key words: *Common Agricultural Policy (CAP), agri-environmental measures, eco-scheme payments, biodiversity conservation support schemes, biodiversity, Farmland birds index, agricultural landscape*

EFFECTS OF SITE-SPECIFIC SEEDING TECHNOLOGIES ON WINTER WHEAT PRODUCTIVITY, ENERGY CONSUMPTION AND ENVIRONMENT

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The technological process of seeding is very important in the production of cereals because seed germination, growth, yield and its qualitative parameters depend on the quality of seeding. Variable rate and variable depth precision seeding technology is relatively new and has many unanswered questions. The aim of this work was to investigate the influence of precision seeding of winter wheat according to variable rate and variable depth on grain yield, to evaluate different technological processes of seeding in terms of agronomical, energy and environmental aspects, and to compare the obtained results with conventional seeding technology. Experimental field studies were conducted in 2020–2023 using conventional uniform seeding and fertilization rates (URS) and different precision seeding technologies such as variable rate seeding (VRS), variable rate seeding and variable depth (VRSD), and variable rate seeding, variable depth and variable rate fertilization technologies (VRSD+VRF). Precision seeding was performed using a variable rate seeding map generated from soil electrical conductivity data obtained by field surface scanning with the apparent soil electrical conductivity instrument EM-38 MK2 (Geonics Ltd, Canada). The results of experimental studies showed that the highest winter wheat grain yield in the first research year was achieved in the VRS technology (7.78 Mg ha^{-1}), in the second – in the VRSD technology (8.74 Mg ha^{-1}), and in the third – in the VRSD+VRF technology (4.64 Mg ha^{-1}). The energy and environmental analysis reported that the best energy and environmental efficiency results were achieved using the same VRSD technology, with the highest energy efficiency ratio (8.81) and the best GHG emission efficiency ratio (10.31), and the lowest environmental pollution per ton of winter wheat grain produced. In the development of innovative and environmentally sustainable winter wheat production, it is very important to find the right balance between the benefits to the farmer and the damage to the environment.

Key words: *Site-specific seeding, soil properties, winter wheat, proximal sensing, yield parameters, environment*

PLANT SEED GERMINATION AND GROWING IN LEAF EXTRACT OF MILK THISTLE

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The milk thistle is rarely cultivated in Lithuania. In the past it was grown as an ornamental plant. Now farmers are starting to grow it for various purposes. There is a lot of information in the foreign scientific literature about the benefits, biology and growing conditions of this plant. It has also been found to have strong allelopathic effects. The aim of the experiment – to investigate the allelophatic effect of milk thistle on the germination and growing of shoots and roots of *Brasssica napus* and *Vicia faba*.

Treatments of the laboratory experiment (concentrations of milk thistle leaf extract): 1. 0 % (distilled water); 2. 1 %; 3. 3 %; 4. 5 %. Extract preparation. 20 g of crushed milk thistle leaves have been weighed on an accurate balance (3 decimal places). 200 ml of distilled water was added and kept in the laboratory for 24 hours. After this it was filtered. Extracts of the concentrations indicated were prepared by dilution. Distilled water was used in the control (0 % concentration). The experiment was carried out in 4 replicates. A filter paper slide was placed in the Petri plate and moistened with 10 ml (15 ml for beans) of a prepared extract of the appropriate concentration. 20 seeds of the plant were germinated in each Petri dish. The Petri dishes were stored in a climate-controlled chamber at 24 °C under 12 hours day/night light. Germination was counted and shoots and roots measured after 5 days.

The germination of winter oilseed rape seeds was significantly influenced by the concentration of the leaf extract. No significant effect of extract concentration was found on the growth of oilseed rape shoots. Winter oilseed rape roots were more sensitive to the increasing concentration of the leaf extract compared with been roots. The 5% extract decreased the length of winter oilseed rape roots by 5.3 times compared to distilled water.

The germination of fodder bean seeds was significantly influenced by the concentration of the extract of the milk thistle. The growth of bean shoots was not significantly affected by the extract of milk thistle leaves.

The remains of milk thistle have an allelopathic properties. This plant leaf extract has a significant effect on the germination, shoot and root growth of winter oilseed rape and fodder bean.

Key words: *Allelophaty, Silybum marianum, Brassica napus, Vicia faba*

EFFECT OF AMINO ACIDS ON SWEET BASIL (OCIMUM BASILICUM L.) BIOLOGICAL PROPERTIES UNDER DROUGHT CONDITIONS

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Sweet basil (*Ocimum basilicum* L.) is an endemic annual spicy herb plant of the mint family (Lamiaceae). The chemical composition of bioactive compounds in sweet basil is extremely rich and diverse on plant genetic, ontogenetic, seasonal variations, environmental factors. Worldwide, the most significant economic losses are due to drought stress and extreme temperatures on plants' morphological, physiological, and biochemical characteristics, which limites crop productivity and quality. Safe, effective, and environmentally friendly methods are continually being sought to enhance the levels of biologically active compounds in plants. The aim of the study was to evaluate the effect of phenylalanine and tryptophane on the content of chlorophyll, phenolic, and the antioxidant activity of basil under drought conditions. The experiment was carried out at VMU Agriculture Academy in a controlled-environment growth chambers with five cultivars of sweet basil: 'Aromatico Della Riviera Ligure', 'Cinnamon', 'Lemon', 'Palla Compato' and 'Toscano'. One group of seedlings were sprayed with 20 mg L^{-1} of phenylalanine and the other group with 20 mg L^{-1} of tryptophane. Three days after amino acids treatment, half of the plants from each group were exposed to 45 ± 5% water deficit substrate humidity, or grown under well-watered conditions. Foliar spraying with phenylalanine and tryptophane to drought-stressed plants increased the chlorophyll *a* and *b* content. Application of phenylalanine significantly increased the total phenolic content (TPC) in the cultivar 'Aromatico Della Riviera Ligure', while foliar spraying with tryptophane increased TPC of 'Palla Compato' and 'Toscano'. A significant increase in antioxidant activity was found in the cultivar 'Lemon' after the application of tryptophane when measured by the DPPH method. In conclusion, application of amino acids can improve sweet basils biologocial properties and special attention should be paid to sweet basil's potential use as a natural food preservative, use as an additive for the development of new functional products or to improve the quality of food products.

Key words: *Ocimum basilicum* L.*, antioxidant activity, phenolic, amino acids*

SCOTS PINE GENETIC STUDIES OF VEGETATION IN SOUTHERN LITHUANIA IN THE ALLERØD: THE CASE OF PAMERKIAI

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This report presents the results of geological and genetic analyses of Allerød sediments in southern Lithuania based on a studied outcrop on the bank of the river Merkys, which consists of both terrigenous and limnic-biogenic strata. The lower part is composed of glaciofluvial beds deposited during the initial stages of the Late Pleistocene. The glaciofluvial sediments are covered by a ~1 m thick bed of limnic-biogenic strata, i.e. gyttja with interlayers of sand. Gyttja is enriched by numerous remains of terrestrial and limnic flora, including megafossils of Scots pine (*Pinus sylvestris* L.) and birch (*Betula* sp., subsect. *Albae*). The tree megafossils were dated to the GI-1d/GI-1b transition (Vs-3010, 11780 BP).

The results of aDNA tests on the wood showed a relatively close genetic association between the *P. sylvestris* aDNA sample and that of present-day Scots pine typical for wetland populations, suggesting its predominance and corresponding to the palaeoenvironmental regime at the site during the first half of the Allerød warming. Moreover, the results of the genetic survey correlated positively with those obtained during an analysis of Early Holocene Scots pine stumps discovered at the bottom of the Baltic Sea. Genetic studies of wood are particularly important for describing the spatial and temporal vegetation dynamics during the Postglacial, including the identification of refugium areas, migration routes and genetic lineages of particular tree taxa. Based on the data obtained, the positive correlation of genetic records proves the prevalence of the northern type B haplotype, i.e. the flourishing of the Scots pine from the so-called northern refugium in what is now southern Lithuania during the Lateglacial Interstadial.

***Key words**: Pinus sylvestris L., DNA, postglacial, Merkys*

THE IMPACT OF MINERAL NUTRITION ON THE MANAGEMENT OF FUNGAL DISEASES IN LEAFY VEGETABLES

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Fungal diseases cause up to 70% of crop yield reductions and post-harvest losses. While chemical fungicides are used for the purpose of controlling plant diseases, there are numerous hazards related with the development of pathogen resistance to chemicals as well as concerns regarding the environment. The connection between mineral nutrition and the control of plant diseases is known; however, the interactions between mineral nutrients and pathogens in leafy vegetables, particularly during post-harvest storage, have not been well reported.

In this study, we evaluated the influence of different concentrations of Ca (40, 60, 80 ppm), Mg (20, 40, 60 ppm) and N (80, 120, 180 ppm) on fungal pathogens *Alternaria* spp. and *Botrytis* spp. spread on sweet basil (*Ocimum basilicum* cv. 'Italiano Classico') grown in hydroponic systems. The basil leaves were artificially inoculated with 6 mm fungi discs and kept at 4˚C and 22˚C. The measurements of pathogens' spread were done after 2, 4, and 6 days after inoculation (DAI). The results demonstrated that pathogen spread was reduced by low temperature, regardless mineral nutrition of basil. Plants were more susceptible to *Botrytis* than *Alternaria*. However, the mineral nutrition influenced the spread of *Alternaria* more than *Botrytis*. It was found that Ca 40 ppm led to significantly lower spread of *Alternaria* at 22˚C at 6-DAI compared to Ca 120 ppm. Mg 60 ppm suppressed the spread of *Alternaria* at 4-DAI and 6-DAI compared to Mg 40 ppm. The lowest spread of *Alternaria* was in basil grown wih N 120 ppm than compared to N 180 ppm at 6-DAI. The concentration of Ca and Mg did not influence the spread of *Botrytis* at 22˚C. N 120 ppm led to significantly lower spread of *Botrytis* at 4-DAI. To sum up, the spread of fungi in basil depends on temperature in which basil are kept. The mineral nutrition strategies can be used to control the spread of *Alternaria* in basil at 22˚C. It is recommended to grow basil in low concentration of Ca (40 ppm), high of Mg (80 ppm), and basic of N (120 ppm) to supress the spread of *Alternaria* at 22˚C. It is recommended to use the basic concentration of N (120 ppm) to supress the spread of *Botrytis* at 22˚C.

Acknowledgement. This project has received funding from the Research Council of Lithuania (LMTLT), agreement No S-MIP-23-20.

Key words: *Alternaria, basil, Botrytis, calcium, magnesium, nitrogen*

DECREASED SOIL WATER CONTENT EFFECTS ON THE TOXICITY OF TRICLOSAN TO OILSEED RAPE (*BRASSICA NAPUS* L.)

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Due to the rising amounts of antimicrobial agents in the environment and the lack of knowledge on their ecotoxicity, there is growing concern regarding their effects on the environment. One of the most widely used antibacterial compounds in both personal care and pharmaceutical products is triclosan (TCS), which is also a commonly detected emerging organic contaminant in the environment. Physiological or morphological endpoints of whole-organism analysis are typically used in reported studies of TCS toxicity to terrestrial plants. To identify underlying toxicity mechanisms, more indepth investigations of TCS-induced effects at the biochemical plant level are required. Furthermore, climate change is an issue that is becoming more and more serious and might have a significant impact on life on the Earth. The influence of climate parameters on the ecotoxicity of antimicrobials, particularly TCS, is little understood. The main objective of this study was to evaluate drought effect on triclosan toxicity to oilseed rape *(Brassica napus L.). B.napus* were grown in TCS-contaminated soil (10-400 mg kg^{-1}) under different soil water contents (5% and 30% SWC). *B.napus* morphological (dry weight, length of the roots and shoots), biochemical indicators (the activity of enzymes), and the damage of oxidative stress (lipid peroxidation) were detected. Drought enhanced the negative effect of triclosan on the above-ground part of *B. napus* and led to oxidative stress.

***Key words**: Triclosan, Climate change, Brassica napus*

ABSTRACTS

POSTER PRESENTATIONS

LONG-TERM EFFECTS OF TILLAGE, CROP RESIDUES, AND INTERCROPPING COMBINATION ON SOIL HEALTH

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The long-term sustainability of agroecosystems heavily depends on effective soil management practices that enhance soil health. This study focuses on the interactions between tillage practices, crop residue management, and intercropping combinations, evaluating their effects on soil health indicators such as soil organic carbon (SOC), soil CO_2 emissions, and overall soil resilience. The research, initiated in 1999 at Vytautas Magnus University's Experimental Station, utilized a Soil Quality Index (SQI) to assess the combined influence of biological, chemical, and physical soil properties under different management regimes.

Key treatments included conventional deep ploughing, shallow ploughing, no-tillage with and without cover crops, and residue management practices such as straw removal versus spreading chopped straw. Results demonstrated that no-tillage combined with the incorporation of crop residues (chopped straw) significantly increased SOC levels, particularly in the top 0–10 cm layer. This combination also led to a marked reduction in soil CO_2 emissions, underscoring its potential for carbon sequestration and climate change mitigation. In contrast, conventional tillage showed higher CO_2 emissions and lower SOC accumulation over time.

The study further revealed that intercropping systems, particularly those with leguminous crops, improved nutrient cycling and contributed to higher SOC stocks. Long-term assessments also showed that no-tillage systems increased soil moisture retention and microbial activity, fostering improved soil structure and resilience. These findings suggest that a combination of reduced tillage, effective residue management, and intercropping can significantly enhance soil health, contributing to more sustainable agricultural practices in the face of climate change.

Keywords: *Sustainable agriculture, Soil management practices, Carbon sequestration, Soil CO_2 emissions reduction, Agroecosystem resilience*

SOIL PROPERTIES CHANGES UNDER LONG-TERM DIFFERENT ORGANIC FERTILIZATION

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The four variants of different organic fertilisation were selected from the over 100-year field experiment: control with arbitrary crop rotation; manure; legumes; and manure with legumes. Soil samples from A horizon were collected and analyzed for total organic carbon (TOC), fractional composition of humic substances, as well as TC-GC/MS. Humin fraction (HUM) was isolated from bulk soil and analysed for TC-GC/MS, UV-Vis and fluorescent properties. Plant available water, soil moisture, soil temperature, and CO_2 emission were measured in the field during the 2022 and 2023 growing seasons.
The results showed that organic fertilization for 100 years increased TOC in soil by 68%, 48%, and 32% for manure with legumes, manure alone and legumes alone, respectively. The fertilization with manure led to a significant decrease in the share of humic acids and a significant increase in the humin content in the soil material (expressed in g/kg of soil). TC-GC/MS results indicated that HUM was enriched in carbohydrates in comparing to the bulk soil, and application of legumes accompanied by maniure influenced the enrichment in carbohydrates in HUM, The UV-Vis and fluorescence analyses indicated that applicaton of manure with legumes and legumes alone contributes to the formation of HUM of more complex structure with more intense substitution in the aromatic ring.

Manure fertilization increased plant available water by 20% and 10% for manure and manure with legumes , while legumes alone decreased it by 11%. The analysis of CO_2 emissions showed that impact on CO2 emissions were mainly temperature-dependent.

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Keywords: *long-term field experiment; carbon sequestration; humin; plant available water*

THE INFLUENCE OF THE LONG-TERM CATCH-CROP APPLICATION ON THE STRUCTURE OF HUMIN FRACTION

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The humin is the fraction of soil organic matter that determines the quality and health of soil. Therefore, understanding the influence of different cultivation methods on the properties of this fraction is extremely important.

The aim of the study was to aassess the effect of using a catch crop on the structural properties of humin, which is considered the most recalcitrant fraction of soil organic matter. The research dealt with soil samples collected from a long-term field experiment on triticale cultivated with and without a catch crop. The experiment was established in 1991 at the Research and Education Station in Swojczyce, Wrocław University of Environmental and Life Sciences, Poland. The soil was a Dystric Cambisol derived from loamy sand of alluvial origin, containing 77% sand, 18% silt, and 5% clay. The plough layer (0–25 cm) had a slightly acidic reaction (pH_{KCl} 5.85–5.96), while total organic carbon content and total nitrogen ranged from 10.2 to 12.8 $g \cdot kg^{-1}$ and 0.8 to 1.1 $g \cdot kg^{-1}$, respectively. Soil samples were collected from A horizon in 2022 and analysed for total organic carbon content and fractional composition of humic substances, while humin was isolated from bulk soil and analysed for elemental composition and spectroscopic properties measured with UV-Vis, fluorescence and ^{13}C-CPMAS-NMR.

Soil cultivation with catch crop favoured formation of highly reactive humus substances, such as low-molecular-weight fraction and humic acids, and also resulted in a lower share of the humin fraction. The higher values of H/C and O/C atomic ratios of humin molecules originated from the soil where catch crop was applied pointed out that their structure is more abundant in oxygen-containing moieties and less aromatic. The UV-Vis, fluorescence and ^{13}C-CPMAS-NMR investigations confirmed a relatively higher share of oxygen-containing functional groups in humin isolated from the soil with catch crop rotation, also corroborating its greater aliphatic nature. In addition, fluorescence results suggested its smaller molecular size of humin and/or diverse substitution in the aromatic ring.

The results indicated that organic residues from catch crop quickly undergo the decay process and are transformed mainly into highly reactive humic substances, which can potentially improve soil health, while mineral fertilization alone without catch crop favours the stabilization and sequestration of carbon.

This research was financed by the EJP SOIL program (the National Centre for Research and Development, Poland, Grant No EJPSOIL/I/78/SOMPACS/2022.

Key words: *humin fraction, SOM, catch crop. long-term experiment*

EFFECT OF FERTILIZERS FROM MEAT BONE MEAL WITH BIOSTIMULANTS ON SOIL PHYSICOCHEMICAL PROPERTIES

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Organic fertilizers improve soil properties, increase humus and organic carbon reserves and make the soil more fertile. Meat and bone meal is a by-product of the meat processing industry and is increasingly used as an organic fertilizer. Granulated meat and bone meal may contain 75% or more organic matter. This fertilizer contains important nitrogen, phosphorus, potassium, calcium and other elements which are vital for agricultural crops. Moreover, organics fertilizers play a particularly important role in reducing the consumption of mineral fertilizers in agricultural production.

This work investigated the effect of granulated meat and bone meal (MBM) treated with biostimulants on soil physicochemical properties growing pak choy *(Brassica rapa* var. *Chinensis).* Parallel experiments were conducted without growing plants, just adding MBM and biostimulants to the growing media in the pots, according to the experimental design. Experiment was carried in greenhouse pot experiments in Vytautas Magnus University Agriculture Academy. Plants were grown in growing media (soil substrate) – soil was taken from Experimental Station fields. Growing media properties: neutral – pH 6.70, high phosphorus content – 213–318 mg kg^{-1} P_2O_5, moderate potassium content – 103–125 mg kg^{-1} K_2O, humus content 1.57–1.86%. Experimental treatments were: 1) granulated meat and bone meal MBM (control), 2) Bio1 (granulated MBM with biostimulant 1 used for soil improvement), 3) Bio2 (granulated MBM with biostimulant 2 for composting improvement). Observations were carried out in three stages: 1, 2.5, and 3 months after sowing. The experiment was carried out in four replications.

It was found, that granulated meat and bone meal (MBM) treated with biostimulants significantly ($P < 0.05$) reduced the total nitrogen content in the growing media at all stages of the study and tended to decrease the total phosphorus content. The biostimulant Bio2 significantly ($P < 0.05$) reduced the total potassium content in the growing media at all stages of the study. The electrical conductivity of the growing media was significantly ($P < 0.05$) lower in the growing containers with pak choy compared to those without plants and was not associated with the use of biostimulants.

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Key words: *biostimulants, Brassica rapa var. Chinensis, granulated meat bone meal*

EFFECT OF CROP ROTATION ON ABUNDANCE OF MICROSCOPIC FUNGI IN THE SOIL OF WINTER RYE (*SECALE CEREALE* L.) CROP

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The cultivation of winter rye (*Secale cereale* L.) differs from that of other cereals, and this crop affects the soil properties and soil fungi diversity in a peculiar way.

The abundance of microscopic fungi was investigated in extensive winter rye monoculture (without the use of fertilisers and herbicides), intensive rey monoculture (fertiliser+herbicide), intensive rotation (with row and green manure crop) rye crop soil and permanent black fallow soil. The experiment took place at the Vytautas Magnus University Experimental Station in Lithuania (54°53′ N, 23°50′ E). The investigation was performed in 2024 on winter rye "Matador".

At rye harvest (BBCH 90), the number of microscopic fungi was assessed by the plate dilution method in 0-5 cm, 6-10 cm and 11-20 cm depth soil layers. The highest average number of microscopic fungi in the 0-20 cm depth of the studied rye crop soil was ranked according to the following rotations: intensive rotation > extensive monoculture > intensive monoculture > black fallow. In soil layers of different depths, the highest number of fungi was found in the top – 0-5 cm, slightly lower in 10-20 cm and the lowest in the 6-10 cm depth. The highest average number of genus *Trichoderma* fungi, which are the main decomposers of plant residues in agrocultural fields, were the most abundant in intensive rotation and extensive monoculture rey crop soil, very low – in organic-poor permanent black fallow soil.

Key words: *rotation, soil, Corg, rye, fungi*

THE IMPACT OF MONOCULTURE AND CROP ROTATION COMBINATIONS ON SOIL CO_2 EMISSION OF MAIZE (ZEA MAYS L.)

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Soil is a major source of carbon dioxide (CO_2) and have large potential for soil carbon sequestration and atmospheric carbon reduction through soil CO_2 (S_{CO_2}) flux. Agricultural practices also influence S_{CO_2} emissions because they can alter soil organic matter. It is necessary to evaluate the carbon flux dynamics to understand the movement of carbon into and out of various environments.

The aim of this study was to evaluate the impact of monocropping and crop rotation combinations on S_{CO_2} emissions of maize (*Zea mays* L.). A field experiment was carried out in 2024 at Vytautas Magnus University Agriculture Academy in Lithuania (54°53′ N, 23°50′ E). The experiment was conducted with maize in intensive crop rotation with potatoes as previous crop and after intermediate crop winter rye for fodder (INT), maize monoculture without (MonoF0H0) and with fertilizers and herbicides (MonoFH), cattle-farm crop rotation following fodder beet as previous crop (CF), fodder then maize followed flax (FOD), and continuous bare fallow (CBF). S_{CO_2} emissions were measured using an Infra-Red Gas Analyzer to measure the S_{CO_2} efflux (μmol m^{-2} s^{-1}) with soil gas flux system LI-8100A, chamber 8100-103, and the analyser LI-8100A (LI-COR Inc.). Measurements were done at four phenological development stages (BBCH) of maize plants: 30-39 (late June); 50-59 (early July); 60-69 (end of July); 70-79 (late August – early September). The most intensive S_{CO_2} emissions were determined at BBCH 60-69. The significantly higher S_{CO_2} efflux was measured in maize, regardless BCCH, grown in INT, MonoF0H0, and FOD, compared to MonoFH and CF (up to 2.0 and 2.3 times), and CBF (up to 4.8 times higher). In addition, the lowest S_{CO_2} efflux was determined in CBF; however, it did not significantly differ from CF at BBCH 30-39, and MonoFH and CF at 70-79 BBCH levels of maize. Also, no significant difference was observed between MonoFH and CF, regardless BBCH of maize. To sum up, the S_{CO_2} efflux is important parameter to evaluate the soil gas emissions, but long-term carbon flux dynamics require to be studied to understand how carbon moves into and out of environment. Also, there are numerous factors like respiration of soil microorganisms and plant roots which must be taken into consideration.

Key words: *carbon, corn, gas emission, monocropping*.

CHANGES IN SOIL PHYSICAL AND CHEMICAL PROPERTIES OF MULTI–CROP CULTIVATION

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Purpose-grown multi-cropping systems (agroecosystems) offer the potential to increase organic carbon, nutrient content, soil bioactivity, etc. Multi-cropping is a valuable tool for nutrient management in crop rotations, as nutrients, such as nitrogen, taken up by one plant can be utilized by other plants in the system. Multi-cropping affects the whole soil biota by increasing the abundance, diversity, and activity of soil microorganisms. Regardless of all the positive aspects of multi-cropping, when following the principles of sustainable agriculture, it is necessary to gradually move to non-arable farming systems and thus increase environmental. Little research has been carried out in Lithuania and abroad on technologies for the combined cultivation of maize, hemp and faba bean crops under short growing conditions. The aim of this study was to assess the impacts of single crops and multi-crops on the soil's physical properties and chemical parameters.

A stationary field experiment was conducted in 2020–2022 at Vytautas Magnus University Agriculture Academy, Experimental Station. The soil of the experimental field is a deeper gleyic saturated loam (*Endohypogleyic-Eutric Planosol-Ple-gln-w*). The crops grown in the experiment were: maize (*Zea mays* L.), hemp (*Cannabis sativa* L.) and faba bean (*Vicia faba* L.), which were sown as single, binary and ternary crops.

Crop diversification had a significant impact on the decreasing of soil stability in single faba bean and binary maize–hemp crops. In crops with higher biomass, total nitrogen, available phosphorus and potassium decreased the most.

Key words: *maize, hemp, faba bean, soil agregate-size distribution, soil stability, soil chemical properties*

THE INFLUENCE OF COVER CROP MIXTURES ON SOIL PROPERTIES UNDER CONVENTIONAL AND ORGANIC FARMING CONDITIONS

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Cover crop mixtures can improve soil properties, which can reduce soil loss and improve environmental quality. Field experiments were conducted in 2023 at Alvydas Samaitis' farm (Joniškis district, Lithuania) under conventional farming conditions and at Mindaugas Kubilius' farm (Panevėžys district, Lithuania) under organic farming conditions. The aim of the research was to determine the influence of different cover crop mixtures on soil properties. Treatments: 1) without cover crop mixture, 2) undersown cover crop mixture TGS BIOM 1 (*Lolium multiflorum* 30%, *Trifolium alexandrinum* 35%, *Trifolium resupinatum* 35%) (35 kg ha^{-1}), 3) post-harvest cover crop mixture TGS D STRUKT 1 (*Avena strigosa* 20%, *Fagopyrum esculentum* 15%, *Linum usitatissimum* 15%, *Trifolium alexandrinum* 15%, *Raphanus sativus* var. *longipinnatus* 10%, *Helianthus annuus* 10%, *Trifolium resupinatum* 5%, *Phacelia tanacetifolia* 5%, Ornithopus sativus 5%) (45 kg ha^{-1}), 4) post-harvest cover crop mixture TGS GYVA 365 (*Trifolium pratense* 25%, *Lolium perenne* 20%, *Sinapis alba* 10%, *Linum usitatissimum* 10%, *Pisum sativum* 10%, *Trifolium squarrosum* 5%, *Camelina sativa* 5%, *Fagopyrum esculentum* 5%, *Raphanus sativus* var. *longipinnatus* 5%, *Raphanus sativus* 5%) (30 kg ha^{-1}). Under organic farming conditions, soil shear strength did not differ significantly. When cover crop mixtures were grown in the conventional farm, soil shear strength was significantly 9.9 and 7.4% lower. Under conventional farming conditions, post-harvest mixtures significantly decreased mega-size aggregate content by 2.2 and 2.5 times, while increased macro-size aggregates content by 1.4 and 1.5 times. In the organic farm, post-harvest mixtures significantly reduced mega-size aggregate content by 5.0 and 8.6 times. Under organic farming conditions soil enzymes saccharase and urease activity did not differ significantly. In the conventional farm, post-harvest cover crop mixture, consisting of annual and perennial plant species, increased urease activity by 28.2%.

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Key words: *cover crop mixtures, conventional farming, organic farming, soil properties.*

THE INFLUENCE OF WINTER COVER CROPS AND THEIR INCORPORATION METHODS ON SOIL BIOLOGICAL PROPERTIES

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Cover crops are essential for soil ecosystem stability, carbon and nutrient cycling, and improving soil health. The field experiment was carried out in 2021–2023 at the Experimental Station of Vytautas Magnus University Agriculture Academy. The soil of the experiment was *Endocalcaric Amphistagnic Luvisol*. The aim of the research was to determine the influence of winter cover crops of different botanical families and their incorporation methods on the soil biological properties in the spring wheat (*Triticum aestivum* L.) 'Kapitol' agrocenosis under organic farming conditions. Experimental treatments: Factor A: methods of incorporation of cover crops into the soil: 1) deep ploughing (20 cm deep) in spring, 2) shallow incorporation (6 cm deep) in spring. Factor B: winter cover crops: 1) without cover crop, 2) crimson (incarnate) clover (*Trifolium incarnatum* Broth.) 'Kardinal' (10 kg ha^{-1}), 3) winter vetch (*Vicia villosa* Roth.) 'Rea' (50 kg ha^{-1}), 4) perennial ryegrass (*Lolium perenne* L.) 'Merkem' (10 kg ha^{-1}), 5) winter rye (*Secale cereale* L.) 'Elias' (50 kg ha^{-1}).

The highest number of earthworms was found in the experimental plots, where cover crop of winter rye (2022) and crimson clover (2023) were deeply ploughed. The highest biomass of earthworms was determined after deep incorporation of crimson clover and shallow incorporation of winter vetch. In 2022, significantly highest (from 32.0 to 83.8%) activity of the soil enzyme saccharase was determined after shallow incorporation of perennial ryegrass. In 2023, cover crops and their incorporation methods did not significantly affect the activity of the enzyme saccharase. In 2022, significantly highest (from 2.0 to 2.7 times) activity of the soil enzyme urease was determined after shallow incorporation of winter rye. In 2023, after deep and shallow incorporation of winter vetch and rye and shallow incorporation of crimson clover, enzyme urease activity was determined significantly from 45.5 to 90.0% higher than in the plots without cover crops. The activity of the soil enzymes urease and saccharase depended on the amount of organic matter in the soil (r = 0.72 and r = 0.74, $P < 0.05$).

Key words: *cover crops, incorporation methods, spring wheat, earthworms, soil enzymatic activity.*

INFLUENCE OF GROWING MEDIA ON INDICATORS OF PHOTOSYNTHESIS IN CUCUMBER

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Peat is the primary component of growing media used in greenhouses. However, peat substrate is made from drained peat bogs, which are a limited resource. Wood fiber could be an alternative to be used as a growing media for crops in controlled climates. The chemical properties of growing media interact and continuously change due to the small volume of the growing media, which is limited by the vegetative pod. Therefore, this study aims to gain new knowledge about the influence of the dynamics of nutrient decomposition on the photosynthesis indicators of cucumber plants when growing them in wood fibers and mixtures with peat substrate. Cucumbers (*Cucumis sativus* L.) were grown in media with different proportions of wood fiber.

The aim of the study was to evaluate the influence of wood fiber and mixtures with peat substrate on the photosynthesis parameters of cucumbers.

To achieve the research objective, the following goals were set: to determine the chlorophyll index in cucumber leaves at different stages of development; to determine the dry matter content in the above-ground part of the plants.

The experiment was conducted in 2021 at Vytautas Magnus University Agriculture Academy in the controlled climate greenhouse of the Joint Research Center for Soil and Forest Research and the Soil and Crop Ecology laboratory at the Experimental Station. Four different growing media were studied during the experiment: 1. Peat substrate (control) 100% peat; 2. Wood fiber 100%; 3. Wood fiber and peat in a 50:50 ratio; 4. Wood fiber and peat in a 25:75 ratio.

At the end of the experiment was found that the chlorophyll index in cucumber leaves increased until the peak of fruiting, and later decreased towards the end of fruiting, except for those grown in wood fiber. The chlorophyll index did not decrease at the end of the vegetation period for cucumbers grown in the wood fiber substrate, indicating that their vegetation was still ongoing, while plants in other growing media were already finishing their growth. The dry matter content in all media gradually increased towards the end of the growing period, with the highest content found in the 25:75 mixture and peat substrate, while the content in wood fiber was significantly (P<0,05) lower.

Acknowledgements: We acknowledge CLIMAGRO LT Research Infrastructure.

Key words: *wood waste (fiber), dry matter content, chlorophyll index.*

RESEARCH ON DIFFERENT VARIETIES OF WINTER WHEAT

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Farmers and wheat buyers should understand that a certain wheat genotype can produce grains of varying quality under different environmental conditions (Rozbicki et al., 2015). In our study, we hypothesized that different winter wheat varieties (Triticum aestivum L.) would have varying effects on weediness, productivity, yield quantity, and grain quality indicators.

The research was conducted at farmer Irmantas Černiauskas farm in the Anykščiai district during the years 2022–2023. The soil in the experimental field is loamy clay. The humus content in the soil ranged from 1.025% to 1.075%, phosphorus from 80.25 to 86.75 mg/kg, and potassium from 252.5 to 271.3 mg/kg. The following winter wheat varieties were studied: 1) 'Angelus'; 2) 'Euphoria'; 3) 'Informer' and their influence on crop indicators. The field experiment was set up using the split-plot method with 4 replications, resulting in a total of 12 plots. The plot sizes were: initial – 102 m^2 (6.0 m × 17.0 m), and accounting – 30 m^2 (15.0 m × 2.0 m). Agricultural crops were rotated in this order: spring barley, winter rapeseed, winter wheat.

The lowest protein content was found in the 'Informer' variety crops – 12.08%, which is 0.85 percentage points lower than in the 'Angelus' winter wheat variety. The protein content of the selected winter wheat (Triticum aestivum L.) varieties did not significantly differ. The significantly highest sedimentation value was found in the grains of the 'Euphoria' variety, which was 2.4 percentage points higher than in the 'Angelus' variety grains. The significantly lowest sedimentation value was found in the grains of the 'Informer' variety – 21.63. Comparing the sedimentation of 'Informer' grains with 'Angelus' grains, the results show that the sedimentation value of 'Informer' winter wheat grains was lower by 8.0 percentage points. It was found that the falling number of 'Angelus' and 'Euphoria' winter wheat grains was the same. The moisture content in the grains was significantly lower in the 'Euphoria' variety and significantly higher in the 'Informer' variety compared to the moisture content of the control variant grains. The average moisture content in the grains of the 'Euphoria' variety was 14.73%, which is significantly lower by 0.32 percentage points than in the grains of the 'Angelus' variety.

Thus, evaluating all the studied grain quality indicators, the best quality was observed in the grains of the 'Angelus' variety.

Key words: *winter wheat, different varieties, qualitative indicators.*

EFFECT OF ELECTROMAGNETIC FIELD AND BACTERIAL TREATMENT OF WHEAT SEEDS ON PLANT VEGETATION

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As humans population is increasing rapidly we run in many problems. One of the main problem is lack of food, which is calculated that global food demand expected to increase by 35 % to 56% between 2010 and 2050. One of the ways to decrease lack of food problem is to get a better yield starting from the seeds. There is a method to use electromagnetic field (EMF) as pre-sowing technique as it is inexpensive and environmentally friendly. By using EMF on seeds various experiments shows, that it can make changes in seeds germination and whole development of a plant. Another eco-friendly way of improving seed germination and growing might be a use of various bacteria. In this research we examined how *Triticum aestivum* seeds react to being affected by electromagnetic field for 6, 12 and 24 hours by 0.5 mT. Also as another factor it was chosen to use *Brevibacterium* sp.. At first all seeds were applied by 0.5 mT EMF for 6, 12 and 24 hours. After that there were prepared 32 pots with substrate and in each pot placed seeds. In half of the pots was used Brevibacterium sp. directly on wheat seeds, while in other pots were EMF impacted wheat seeds and control. In pots with *Brevibacterium* sp., bacteria was added weekly two more times. Plant growth parameters were analysed during vegetation period.

The research shows that the use of *Brevibacterium* sp. has an impact on plant development. Plants exposed to the bacteria were 12 % lower than in the control. The application of EMF had a positive effect on plant vegetation, but only when the duration of exposure was increased to 24 hours. In conclusion EMF on seeds has positive impact, when it is used for 24 hours, while usage of *Brevibaterium* sp. had negative impact on plant growth comparing to control. To have even better results in the future it should be considered to use another bacteria and to apply EMF (0.5 mT) on wheat seeds at least for 24 hours.

Key words: *electromagnetic field, Brevibacterium sp., seed treatment, wheat.*

ISOLATION AND SCREENING OF PLANT GROWTH-PROMOTING RHIZOBACTERIA FOR BIOLOGICAL CONTROL OF MAIN WINTER WHEAT PATHOGENS

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Recently in agriculture the use of synthetic chemical compounds and mineral fertilisers are increasing which is elevating environmental toxicity levels. As a response to this concern, there is a growing demand for environmentally friendly solutions. In recent years, the focus has shifted towards the development of cost-effective and ecologically sound organic products known as biostimulants. Biostimulants are natural preparations that improve the general health, vitality, and growth of plants and protect them against infections.

For this study, soil rhizosphere samples of winter wheat were collected from 5 Experimental Stations in Lithuania: Experimental Station of Vytautas Magnus University Agriculture Academy (VDU), and Experimental Stations of Lithuanian Research Centre for Agriculture and Forestry: Joniškėlio (JON), Vėžaičių (VEZ), Vokės (VOK), Rumokų (RUM). The isolation of soil microorganisms resulted in the purification of 50 morphologically different bacteria. Selection of N-fixing bacteria and bacteria dissolving insoluble P and K compounds was carried out. The antagonistic properties of the bacteria against *Zymeseptoria tritici* and *Fusarium graminearum* fungi were evaluated. The endospore-forming ability of the bacteria was determined. The results showed that 17 bacteria fixed N, 3 bacteria had the ability to convert insoluble P compounds into plant-available ones and 2 bacteria had the ability to solubilise plant-unavailable K compounds. The antagonistic properties such us the ability of the bacteria to release fungal growth inhibitory substances, were

exhibited by 10 bacteria against the fungus *Fusarium graminearum* and 5 bacteria against the fungus *Zymeseptoria tritici.* Two rhizobacterium were selected for further studies that promoted plant growth (PGPR), namely JON 8, which had the ability to fix N and dissolve insoluble P and K compounds, and RUM 4, which fixed N and dissolved insoluble P compounds. After evaluation of the antagonistic properties against *Zymeseptoria tritici* and *Fusarium graminearum* fungi, 2 bacteria were selected VDU 10 and VOK 2. The bacteria were identified by partial 16S rDNA sequence analysis and it was found that JON 8 is a *Pseudomonas kilonensis* species, RUM 4 is *Pseudomonas piscicola*, VDU 10 is *Peanibacilus tundrea* and VOK 2 is *Bacillus mycoides*.

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Key words: *biostimulants; Triticum aestivum; Zymeseptoria tritici; Fusarium graminearum*

EFFECTS OF CONVENTIONAL AND STRIP-TILL TECHNOLOGIES ON SOIL PROPERTIES

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Recently, environmentally friendly tillage systems are becoming more and more widespread. One of them is strip-till where it is sown directly into the stubble by cultivating only one-third of the land, and the interrows remain uncultivated. In one pass, the soil is cultivated in a narrow strip, the desired depth is fertilized, and the plants are accurately sown. This technology significantly reduces the cost of seedbed preparation, fuel and time. Plant residues left on the soil surface protect the soil from wind and water erosion, destruction of the soil structure, moisture loss and other negative effects.

To that aim, in 2023–2024 in the fields of the Educational Farm of VMU, studies were conducted comparing strip-till with conventional plowing technology. Soil temperature and moisture in the winter rapeseed crop were measured every 3–4 days from the second half of March to the beginning of May. Soil respiration was determined by the amount of CO_2 emitted by microorganisms in $\mu g\ kg^{-1}\ h^{-1}$ from 20 May until July 15. After harvesting winter rapeseed, the main agrochemical properties of the soil were determined: pH, total nitrogen, mobile phosphorus and potassium levels.

Research has shown that the soil warms up more slowly in the spring and is often wetter when strip seeding is used. This is especially true in the interrows where there are a lot of plant residues on the soil surface. However, with higher rainfall, soil moisture was higher in topsoil with ploughing technology, while lower soil temperatures were also found.

Plant residues left on the soil surface, under a favourable temperature and humidity regime, stimulate the activity of soil microorganisms. For this reason, soil respiration – CO_2 release during the study period was found to be higher when applying strip-till compared to conventional ploughing technology.

The agrochemical properties of topsoil did not differ significantly after the winter rape harvest, except for total nitrogen content. Its amount was determined to be significantly higher using conventional plowing technology.

Key words: *Conventional plowing, strip-till, soil properties, winter rape, soil respiration.*

MAIZE PRODUCTIVITY IN LEGUMES-INTERCROPPED CULTIVATIONS

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The thematic of our research are contributes to one of the priorities under the Common Agricultural Policy (CAP) 2023–2027 reforms: the implementation of the EU's environmental protection and climate goals. Agriculture are central to the European Green Deal, and the CAP 2023-27 will be a key tool in reaching the ambitions of the Farm to Fork and biodiversity strategies. The current intensive crop cultivation technologies are energy-demanding and environmentally harmful in order to maximize plant productivity. Integrating intercropping with main crops can enhance and stabilize agroecosystems in the face of climate change.

The investigation was carried out in 2023 at the Vytautas Magnus University, Agriculture Academy, Experimental Station, Lithuania. The aim of the study was to assess the impact of single-crop and intercropped systems on maize biomass productivity. Treatments of the experiment:

1. Inter–row loosening (control 1, K1);
2. Inter–row mulching with weeds (control 2, K2);
3. Faba bean (*Vicea faba* L.) intercropped (LUP);
4. Crimson clover (*Trifolium incarnatum* L.) intercropped (PUD);
5. Persian clover (*Trifolium resupinatum* L.) intercropped (PED);
6. Blue–flowered alfalfa (*Medicago sativa* L.)intercropped (MEL).

2023 vegetative period was dry – 250 mm of precipitation was received. Ussual range is about 400–450 mm. That negativelly influenced on maize biomass development. Maize fresh biomass productivity showed minimal variation. It ranged from 1.38 to 1.93 kg m^{-2}. The highest fresh biomass of maize stems and leaves was observed in the plots with Persian clover, while the significantly highest dried matter biomass was recorded in the control K1 plots, reaching 0.69 kg m^{-2} or 6.9 t ha^{-1}. Significantly the highest fresh and dried average biomass of ear was found in the control K1 and K2 plots. Despite the moisture deficit, the dried matter average biomass of maize ear was high and ranged from 0.8 to 1.5 kg m^{-2} or 8.0 to 15.0 t ha^{-1}.

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Key words: *Zea mays* L., *biomass productivity, inter-cropping.*

EFFECT OF AUTUMN AND SPRING UNDERSOWN COVER CROPS ON WINTER WHEAT AGROCENOSIS SUSTAINABILITY

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Winter wheat's need for nutritional elements – fertilizers is quite high, and to satisfy it, large financial resources are needed. As the climate changes in the world, it also changes in Lithuania – the autumn period became longer, therefore, when winter wheat (*Triticum aestivum)* is sown after the precursors of valuable leguminous (for example, faba bean (*Vicia faba L*)) crops, a considerable part of the nutritional elements is washed away, washed away, evaporated etc.

In our experiment, winter wheat is cultivated with intercrops. Intercrops will grow next to and replace each other throughout the wheat growing season ("relay" principle) performing the functions of nutrient accumulation and conservation, weed and pest control, and soil protection.

The study will be carried out in the years 2023–2027 the Vytautas Magnus University Agricultural Academy Experimental Station, Lithuania. The aim of the research is to create effective multifunctional agrocenoses of intercropped and cover croped base of winter wheat, characterized by biodiversity, stability, high economic and energy sustainability. Treatments of the experiment:

Factor A: Autumn intercrops:
1. Without intercrops (control).
2. White mustard *(Sinapis alba).*
3. A mixture of peas *(Pisum sativum)* and oats *(Avena fatua).*
4. Buckwheat *(Fagopyrum esculentum).*

Factor B: Spring intercrops:
1. Without intercrops (control).
2. White clover (*Trifolium repens).*
3. Red clover (*Triticum aestivum).*
4. Rye vetch *(lot. Vicia sativa L.)* .

Agrocenoses with intermediate plants have already been widely studied both in Lithuania and abroad, but winter wheat agrocenoses with multifunctional cover crops constantly changing on the "relay" principle have not been studied. The results showed that highest concentration of chlorophyll (10.75) was found in winter wheat grown with autumn intercrops - oats and peas and spring intercrops red clover, which is significantly different compared to autumn intercrop mustard and spring intercrop red clover (6.69).

Keywords: *winter wheat, autumn and spring intercropps.*

THE INFLUENCE OF NITROGEN DEFICIENCY DURING WINTER WHEAT VEGETATION ON THE AMOUNT OF OTHER MACRO AND MICRO ELEMENTS IN THE PLANT AND ROOTS

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Wheat is one of the most important and widely cultivated crops in the world. As a staple food, wheat is critical to food security. Due to its global production, availability and relatively low cost, wheat is essential for feeding the rapidly increasing number of people on earth, especially in regions with limited access to other grains or proteins. In order to grow higher yields of wheat, it is necessary to use advanced cultivation technologies, one of the essential aspects of which is fertilization. However, in many countries, due to a lack of funds, farmers do not fertilize their fields with macro-fertilizers, or due to a lack of technological knowledge, the application of fertilizers is untimely, which may result in environmental pollution and not achieving the desired harvest.

Nitrogen deficiency during wheat vegetation can significantly affect the uptake, transport and balance of other macro- and micronutrients in both plant shoots and roots. Nitrogen plays a critical role in plant metabolism, particularly protein synthesis, enzyme activity, and overall plant growth. When nitrogen is deficient, it causes a number of physiological and biochemical changes that affect the uptake and distribution of other nutrients.

Fertilization is crucial for agricultural productivity and food security. Predetermined plant nutritional recipes and nutrient uptake are rarely controlled by changing fertilizer composition at various stages of the plant's life cycle. Not only the level of plant development, environmental conditions influence the chemical composition of plants. Nitrogen deficiency during wheat vegetation also strongly influences the chemical composition of the plant's aerial part and roots.

The effect of deficiency on winter wheat productivity and chemical composition (roots and shoots) has been evaluated in greenhouse pot (hydroponic) experiments in Vytautas Magnus University Agriculture Academy in 2023. Winter wheat grown hydroponically in a greenhouse under controlled conditions and from BBCH 13 to BBCH 61 was not fertilized with only nitrogen (received all other 11 major elements). In the control variant, wheat received all 12 micro and macro elements in its nutrition throughout the growing season. The experiment was carried out in 10 repetitions.

A constant lack of N during the growing season increases or decreases the amount of other micro-macro elements in wheat plants and roots. Nitrogen deficiency had a significant influence on winter wheat dry matter in aboveground parts of plants. Winter wheat growing under nitrogen deficiency was found to have significantly ($P < 0.05$) reduced plant weight and tended to reduce P, K, Mg, Ca, S, Zn and Cu content in the plant aboveground and a positive correlation was found. Meanwhile, a positive correlation with trace elements: Mo, Mn and Zn and a negative correlation with K, Ca, B, Cu and Fe was found in winter wheat roots.

Key words: *nitrogen*, *deficiency*, *nutrient elements*, *chemical composition*, *winter wheat*.

EFFECTIVENESS OF THE BIOLOGICAL APPROACH TO LOWERING CO_2 LEVELS IN SOIL

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Considering the interaction processes between anthropogenic activities and soil, soil compaction reduces soil aeration and water infiltration, and air-filled porosity, which can affect biological processes affecting CO_2 emissions. CO_2 emissions from soil are the second largest component of the carbon cycle and contribute to climate change. Given the current issues, this study aims to investigate the effects of biological approaches on soil properties and CO_2 from soil.

The research was carried out in Eastern Europe under the meteorological conditions of central Lithuania at the Academy of Agriculture of the Vytautas Magnus University. The area of the experimental field studies was divided into 8 experimental treatments with four replications. In autumn, winter wheat is sown in the first and second year, winter rapeseed in the third year. In spring, in the second half of april, after the resumption of plant vegetation, plants were sprayed with 4 different biopreparations (etheral oils, 40 herbal extracts, seaweed extract, mineral oils; *Azospirillum sp.* (N), *Frateuria aurentia* (K), *Bacillus megaterium* (P), seaweed extract; *Azotobacter chroococcum*, *Azospirillum brasilens*, phosforus, potassium; seaweed extract; *Azotobacter vinelandii*, humic acids, gibberelic acid, copper, zinc, manganese, iron, calcium) and their mixtures. The rate ranged from 1.0 to 4.0 l ha^{-1}. Biopreparations were mixed with water at 200 l ha^{-1}. The soil's total porosity and density were measured 1–2 hours before and after tillage. The CO_2 from the soil was measured in April, May, June, July, and August. Investigations were carried out for three years.

Experimental research showed that biopreparations used for three years decreased (approximately 20%) soil density significantly, and total porosity significantly increased (approximately 19%). The effect of biopreparation application on soil properties was most pronounced in the second and third years. The cumulative effect of biopreparation application on CO_2 emissions from soil was most pronounced in the third year. Evaluating the complex effectiveness of biopreparations (soil total porosity, density, and CO_2 emissions from the soil), it can be stated that the best effect was achieved in scenarios when used biological preparation mixtures.

Key words: *biomethod, total porosity, density, carbon dioxide, farming improvement.*

THE INFLUENCE OF SPONTANEOUS SOLID-PHASE FERMENTATION ON THE QUALITY OF THE LEAVES OF THE FIREWEEDS

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At present, the consumption of medical plants and functional foods is growing in the whole world. Fireweed is an important medicinal plant that has various pharmacological effects (antioxidant, anti-inflammatory, anticancer, and others), can improve the state of health and well-being, and reduce the risk of various diseases. The aim of this work was to investigate volatile compounds and sensory analysis in fireweeds leaves fermented for 24 and 48 h in solid-phase fermentation under different growing conditions: naturally grown, biodynamic, and ecologic. The quantitative descriptive analysis (QDA) of the fireweed beverages (2g per 200 ml of hot, not boiled water) was conducted in the accredited Laboratory of Sensory Analysis in the Chair of Functional Food and Sensory Research of the Warsaw University of Life Sciences (Poland) according to ISO standard 13299:2016. Sensory results demonstrated a variation depending on the growing condition during the vegetative period. When dominated warm and wet conditions – the sweet odor occurred, and organic samples were the best. Pungent, herbal, and foreign odors were strongly perceptible in the biodynamic samples. A hint of grassy and hay odor was detected in the natural samples. When it was warm and dry during the vegetation period significant differences among samples were found only in color evaluation. Naturally grown samples were darker compared to biodynamic and organic. The method of fermentation did not significantly affected odors, but had a significant impact on the color, sour and astringent taste, and the feeling of astringency of examined samples.

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Keywords: *solid-phase fermentation; odors; fireweed; ecology.*

THE INFLUENCE OF LIGHT INTENSITY AND NUTRIENT MEDIA ON THE COLOUR PARAMETERS OF RADISH AND FENNEL MICROGREENS

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With the increasing trend towards extreme climate, growers are turning to controlled environment agriculture, when growing conditions can be maintained. More than half of the world's indoor vegetables are leafy greens. In addition, to the variety of colours and flavours, leafy greens are nutritionally distinctive, rich in fibre, minerals, vitamins and antioxidants. The first factor in consumers' choice for leafy greens is visual appearance, followed by taste and nutritional qualities.

The aim of study was to determine the effect of light intensity and mineral nutrient concentrations in hydroponic solution on colour parameters (L*, a*, and b*) in radish (*Raphanus sativus* L., 'Sango') and fennel (*Foeniculum vulgare,* 'Romy') microgreens. A two-factor experiment was performed: factor A - different daylight integral for a constant photoperiod (12 hours) and varying light photosynthetic photon flux density, PPFD, (200, 250, 300 μmol m^{-2} s^{-1}); factor B – three hydroponic solutions of different mineral nutirent concentrations (basic solution (1) with concentrations of mg L^{-1} at N 80, Ca 48, P 13, K 85, Mg 27, S 35, B 0.11, Mo 0.13, Mn 0.05, Cu 0.05, Fe 1.3, Zn 0.7; 1.5 times lower (2) and higher (3) concentrations than in basic solution).

Radish and fennel microgreens were grown for 7 and 14 days, respectively, in pots with rockwool using a method of ebb and flow hydroponic system. Plants were grown under light spectrum provided by red (660 nm) and white (3000 K and 5000 K) light-emitting diodes.

The results demonstrated that the leafy fennel grown at a PPFD of 300 μmol m^{-2} s^{-1} and fertilised with the highest concentration of nutrient solution produced the darkest (39.07), the greenest (-8.17) and the most yellow (26.17) leaves. The brightness coordinate L* showed that the brightest radishes (26.70) grew at a PPFD of 300 μmol m^{-2} s^{-1} and a basic nutrient solution concentration. The highest PPFD and mineral nutrient concentration in media led to the most intense yellow colour of microgreens. To sum up, the color parameters can be affacted by agrotechnological means like lighting parameters and nutrient media to meet consumers expactations.

Key words: *cultivation strategies, artificial lighting, hydroponics, color coordinates, leafy greens.*

INFLUENCE OF ZOOCOMPOST AND HARVESTING TIME ON HONEYSUCKLE LEAVES QUALITY

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Honeysuckle (*Lonicera caerulea* L.) is characterized by a large composition of biologically active compounds: rich in anthocyanins and phenolic compounds. Although much research has been done on berries, there is still a lack of information on honeysuckle cultivation, fertilization, and other parts of the plant, such as leaves. Therefore, the the aim of this study was to evaluate the effects of zoocompost and harvesting time on honeysuckle leaves quality.

The field experiment with the honeysuckle cultivar 'Indigo Yum' was carried out in 2024 in Alytus district (Lithuania) on the farm of edible honeysuckle. The bushes were planted in 2014. The experimental plots were arranged in a randomised design with four replicates for each treatment. The honeysuckle bushes were fertilized with black soldier fly (*Hermetia illucens* L.) larvae zoocompost at the beginning of the growing season at an application rate of 0 (unfertilised – control treatment), 1000, 1500, and 2000 kg ha^{-1} (four variants), respectively. The leaves of 'Indigo Yum' were harvested at different time: 1st harvest (27 April), 2nd harvest (40 days after 1st harvest), 3rd harvest (80 days after 1st harvest). During the study, the freeze-dried leafe samples were analyzed for chlorophyll, total carotenoids, total phenolic and total flavonoid compounds, and antioxidant activity.

The results showed that the highest content of total chlorophyll was found in the 1st harvest leaves of 'Indigo Yum' with application of 1000 kg ha^{-1} zoocompost. The maximum contents of total carotenoids were reached in the 1st harvest leaves with application of 1500 kg ha^{-1}. The highest total phenolic content was found in the 2nd harvest leaves with application of 2000 kg ha^{-1}. The maximum content of total flavanoid were research in the 2nd harvest leaves with application of 1500 kg ha^{-1}. The highest level of antioxidant activity was found in 3rd harvest leaves with application of 1500 kg ha^{-1} zoocompost.

Overall, an application of zoocompost can be suggested to farmers as an alternative and environmentally friendly strategy to improve the quality of honeysuckle leaves. Furthermore, it was found that leaf harvesting time had a significant impact on their quality parameters.

Key words: *honeysuckle*, *chlorophyll*, *total carotenoids*, *total phenolic*, *total flavonoids*, *antioxidant activity*.

VARROA DESTRUCTOR TREATMENT WITH ESSENTIAL OIL

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The health and survival of bees are critical factors impacting ecosystems and agricultural production globally. Worker bees (Apis mellifera) are essential for plant pollination; however, their populations have been declining rapidly due to various factors, including diseases and parasites. One significant threat to bee health is the Varroa destructor mite, which parasitizes bees by sucking their hemolymph and transmitting pathogens, leading to weakened and often dying bees. This study investigates the efficacy of thyme (Thymus vulgaris L.), clove (Syzygium aromaticum L.), and peppermint (Mentha piperita L.) essential oils in treating varroosis in bees. Conducted in three stages, the study includes two laboratory experiments to determine the optimal concentrations and toxicity of essential oils to bees, and a field experiment to assess their effects on mites. Mites and bees were collected using the carbon dioxide method and placed in Petri dishes with varying concentrations of essential oils. In the field experiment, wooden sticks impregnated with essential oils were placed in hives.

Results indicated that the highest concentration tested (2 mg/ml) was the most effective against Varroa destructor mites, achieving the highest mite mortality both after two and four hours. Within the first 24 hours, clove, thyme, and peppermint essential oils reached maximum mite mortality while maintaining low bee mortality. Specifically, thyme essential oil demonstrated the highest efficacy, with an average of 12.7 dead mites, compared to peppermint's 3.7. Additionally, hives treated with thyme essential oil had significantly lower mite counts (9.3 on average) compared to peppermint (26.3) and control (31.3) when using a double control dose of oxalic acid. These findings suggest that thyme essential oil is 70% effective in managing varroosis, offering a promising alternative to synthetic acaricides.

Key words: *Apis mellifera, Varroa destructor,* essential oils, varroosis, mite mortality.

CHANGES OF THE CONTENT OF GLYCOALKALOIDS DURING RIPENING IN DIFFERENT *SOLANUM* SPECIES

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Glycoalkaloids are a class of nitrogenous steroidal glycosides and are biologically active secondary metabolites commonly found in plants of the genus *Solanum.* These substances, which are known to be poisonous, are abundant in the human diet, including potatoes (*Solanum tuberosum*), tomatoes (*Solanum lycopersicum*), and aubergines (*Solanum melongena*). There is still a lack of data on how the different glycoalkaloids vary between different fruits. For example, not many studies look at how the glycoalkaloid content of fruit changes during ripening. Therefore, additional data on their analysis, toxicity, and bioavailability are needed to ensure food safety and bioactivity. This work provides an overview of the variation of glycoalkaloids in different *Solanum* species and at the ripening stage. The fruit extracts from the two years harvest were evaluated by mass spectrophotometry (MS). Mass spectrometry is an analytical technique that measures the mass-to-charge ratio of a charged particle. The method determines the mass of the particles to know the chemical structure of the sample or molecule. Three main glycoalkaloids have been identified in the fruit of *S.retroflexum*, *S.villosum*, and *S.nigrum* based on molecular weight: solamargin, solamarin, malonyl-solamargin. In *S. melanocerasum* fruits: solanigroside and solamargin. The molecular weights of the alkaloids detected ranged from 884,50 to 1117,54. The quantification of the total glycoalkaloid concentration was carried out based on an external calibration curve based on the pseudo-molecular ion $[M + H]^+$. The percentage variation is calculated from the peak area of the chromatograms. In all varieties, the glycoalkaloid content was estimated to decrease as the fruit ripened, with a reduction of up to 99,83 % of the glycoalkaloids detected in fully ripe fruit compared with fruit at the first ripe stage.

***Key words**: glycoalkaloids*, *solanum*, *ripening stage*.

QUALITY OF THE GARLIC (ALLIUM SATIVUM L.) STORED IN CONTROLLED ATMOSPHERE CHAMBERS

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During storage, garlic's chemical composition and quality change depending on the storage conditions and duration. To preserve garlic, optimal storage conditions must be selected. The study aimed to determine changes in the chemical composition of garlic during storage in a controlled atmosphere. The studies were carried out in 2022–2023 in the Laboratory of the Quality of Vegetable Raw Materials of the Open Acess Joint Research Centre of Agriculture and Forestry of the Vytautas Magnus University Agriculture Academy. Garlic was stored in controlled atmosphere chambers Besseling CA Systems (BesselingGroup, The Netherlands) for 135 days. Parameters used in controlled atmosphere chambers: chamber 1 – 0 °C temperature, natural air (0.03% CO_2, 21% O_2, 78% N_2 and 0.97% other gases); chamber 2 – 2 °C temperature, natural air; chamber 3 – 2 °C temperature, 5% CO_2, 3.5% O_2; 91.5% N_2. The relative air humidity in all chambers was 70%. All chambers held three samples of 1 kg each. Standard methods were used to determine garlic's mass losses, soluble solids, ascorbic acid content, titratable acidity, total phenolic content, antioxidant activity, and color changes. The results were analyzed by using a factorial analysis of variance (ANOVA). Fisher's Least Significant Difference test (LSD) was applied to the experimental results to assess significant differences between mean values at the significance level of $p < 0.05$.

Storage at 2 °C temperature, regardless of the air gas composition, indicated a natural mass loss of about 7% while storage at 0 °C made up only 3%. During storage, garlic soluble solids, ascorbic acid content, titratable acidity, total phenolic content, and antioxidant activity decreased. After 135 days of storage, the highest vitamin C content and antioxidant activity was of garlic in chamber 1 (0 °C, natural air), the highest content of soluble solids and phenolic compounds was of garlic in chamber 2 (2 °C, natural air), and the highest titratable acidity was of garlic in chamber 3 (2 °C, 5% CO_2, 3.5% O_2, 91.5% N_2). The garlic became lighter during storage.

Key words: *chemical composition, garlic, storage, quality.*

INVESTIGATION ON QUALITY PARAMETERS AND ADAPTATION OF SWEET CHERRY VARIETIES IN AFGHANISTAN CLIMATIC CONDITIONS

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The study is to evaluates commercial varieties of sweet and sour cherry, including 22 accessions of sweet cherry (Prunus avium) and 6 accessions of sour cherry (Prunus cerasus), housed in the National Collection fields located at Kabul PHD Centre (Badam Bagh) and Herat PHD Centre (Urdo Khan Farm).

To characterize all cherry accessions, the following parameters were assessed: time of flowering, ripening, and physical characteristics of fruit. Among the varieties, Blaze Star and Burlat were identified as early bloomers, while Ferrovia was recorded as the latest flowering variety. In terms of physical characteristics, the Ferrovia variety exhibited the highest fruit weight at 8.8 grams, with a length of 26.1 mm and a width of 23.7 mm. In contrast, the Blaze Star variety exhibited the lowest fruit weight at 5.4 grams, with a width of 17.3 mm, while the Burlat variety was noted for having the largest grading, classified as grade 27.

Significant variations were also observed in the chemical characteristics of the fruit, including differences in soluble solids content (Brix). The Sweetheart and Sumtare varieties had the lowest Brix values at 16%, while the Compact Stella variety had the highest Brix value at 22%. The overall average Brix value across all varieties was found to be 18.8%, with both Burlat and Santina exhibiting the highest pH levels at 3.64.

Additionally, the morphological characteristics of the trees and the productivity of these varieties were evaluated. Among the 12 varieties assessed, the Sweetheart variety demonstrated the highest yield, producing an average of 55 kg per tree, whereas the Ferrovia variety had the lowest yield, with only 13 kg per tree. This research was conducted over the years 2014 and 2015.

Keywords*: Cherry morphology, Physical and Chemical characters, Varieties, Brix, Caliper and pH Mater.*

EVALUATION OF THE INTRODUCTION OF KERNZA® PERENNIAL GRAIN IN LITHUANIA IN THE EARLY STAGES OF DEVELOPMENT

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Kernza® – Intermediate Wheatgrass (*Thinopyrum intermedium*) is a cooler climate perennial grass that has been cultivated as a perennial grain crop. Perennial cereals have great potential to become widely cultivated crops. Intermediate Wheatgrass (IWG) is attractive due to several aspects: due to their large root system and perenniality, the plants are excellent at reducing soil erosion and nutrient leaching, more efficiently accumulating organic carbon and are more resistant to drought and cold wheater. We can achieve environmental and economic benefits by sowing cereal-legume double crops so that the perennial crops are more self sufficient. Leguminous crops increases plant yield and nutritional value, weed suppression and fixes biological N.

The field experiment is being carried out from 2023 in Experimental Station of Vytautas Magnus University Agriculture Academy. The aim of experiment is to study the growth of IWG in Lithuanian climatic conditions. The experiment consists of five treatments, which include stands with sole crop of Kernza and dual crop of Kernza in mixture with red clover at different N fertilisation levels (0, 70 and 140 kg ha^{-1}): 1) Kernza+0N; 2) Kernza+70N; 3) Kernza+140N; 4) Kernza+red clover+0N; 5) Kernza+red clover+70N. Kernza® and red clover seeds were sown on July 12th. After 9 days the seed germination was calculated, and the crop density was evaluated on October 3rd. The plant measuerments that included root length, plant height and shoot number count was conducted on November 10th.

The results of experiment showed good potential of IWG introduction. All of the treatments showed suficient seed germination and, later on, crop density. Due to dry and hot climatic conditions the germination of IWG was slow and uneven, but later on the crop evened out and began to grow intensively. The IWG germination ranged from 10 to 30 sprouts in 1 m^2 and the density from 33 to 49 plants per 1 m^2. The plant measuerments showed that IWG compared to winter wheat had longer root system, the plants were higher and had more shoots.

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Key words: *Kernza®, Intermediate Wheatgrass, introduction, germination, density.*

FUNGI PRESENT IN THE ORGANIC AND MINERAL SOIL LAYERS OF ENGLISH (QUERCUS ROBUR L.) AND NORTHERN RED (Q. RUBRA L.) OAK TREE PLANTATIONS

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The study examined the influence of native English (*Quercus robur*) and alien Northen red (*Quercus rubra*) tree dominated plantations on the richness and predominant genera of culturable fungi in the otganic and mineral soil layers (0–4 cm and 5–8 cm). Studies were carried out in autumn (October) 2023 and spring (March) 2024 in dendropark of the University central part of Lithuania. The soil type - *Endocalcari- Epihypogleyic Cambisols,* stands age – 60–65 years.

The fungal abundance in the organic layer of English oak was much higher than of red oak, particularly in autumn. The situation in the mineral soil layers was different. The higher fungal abundance was found in red oak mineral soil layers, especially in the spring.

The structure of fungal genera differed in the oak plantations and in the three studied soil layers. In total, 248 fungal isolates were recovered from an organic and mineral layers of soil. The *Penicillium* genus dominated, accounting for more than 60% of the total population of fungi found in organic layer and was one of the most abundant fungi in all soil layers studied. Phyllosphere fungi, such as *Phoma* and *Cladosporium*, were also among the most common in the studied plantations, particularly in spring. Deeper in the soil, the dominance of certain genera decreased with the increase in *Trichoderma*, *Mucor*, *Mortierella*, and entomopathogenic fungi such as *Paecilomyces* and *Beauveria*. Fungi of the genera *Verticillium*, *Acremonium* and *Acrostalagmus* were found in the layers studied, but mainly in the 5–8 cm layer of mineral soil.

Key words: *fungi, soil, organic layer, mineral layer, tree plantation*.

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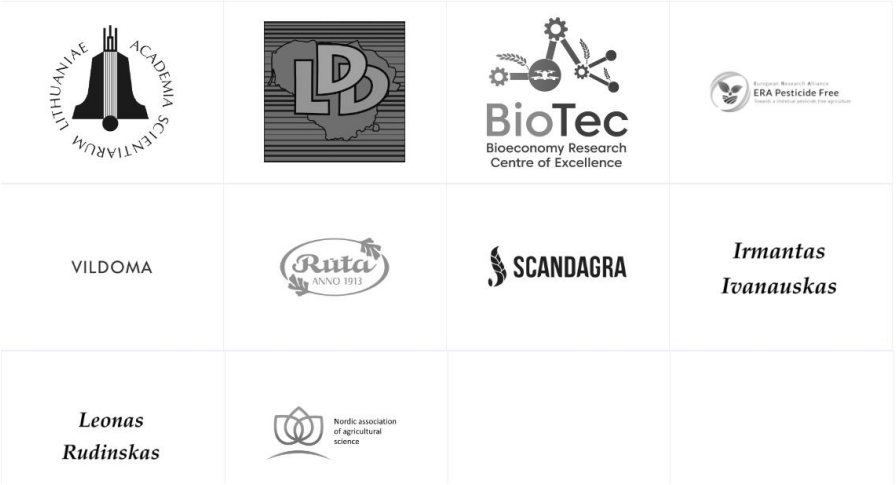

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