1st Nordic-Baltic REACH
conference organised by NJF

RESOLVING ENVIRONMENTAL AND CLIMATE CHANGE ISSUES IN AGRICULTURE

PROGRAMME and BOOK of ABSTRACTS

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RESOLVING ENVIRONMENTAL AND CLIMATE CHANGE ISSUES IN AGRICULTURE

October 8–9, 2024

Lithuanian Academy of Sciences

Vilnius, Lithuania

PROGRAMME and BOOK of ABSTRACTS

Scientific Committee:

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Agriculture in the Nordic and Baltic region shares common challenges, such as short growing seasons and cold temperatures. Climate change influence agriculture and food and feed security in the Nordic and Baltic region in many ways, such as rising temperatures, changes in precipitation patterns, increased frequency of extreme weather events, and the risk of pests and diseases. These challenges can have significant economic, social and production consequences. Research plays a key role in providing solutions for how the agricultural sector can respond to these challenges and how it can valorise new opportunities.

The organising committee welcomes participants with diverse perspectives to attend the conference "Resolving Environmental And Climate Change issues in agriculture" (REACH). The event is intended to bring together researchers and experts with backgrounds in fields such as plants, soil, environment, animals, technology, economics and social sciences. The conference is an excellent opportunity to meet fellow researchers and experts from various fields of agriculture to exchange ideas, share experiences, and establish new networks and partnerships. Conference participants will have the opportunity to present scientific results and discuss the latest developments, challenges, and solutions.

Main topics of the conference

All presentations related to resolving environmental and climate change issues in agriculture are welcomed.

Topics of conference abstracts:

1. Technological solutions for a cleaner agri-food system.

2. Biodiversity, plant and soil health in a new climate.

3. Sustainability and animal production.

4. Economics, social impacts and life cycle sustainability assessments.

5. Modelling of agriculture, food system, environmental, climate change and European policy issues.

PROGRAMME

Tuesday, 8 October

	9.30–9.50	**Registration,** coffee		
	9.50–10.10	**Opening ceremony:** Acad. Prof. Dr habil. Zenonas Dabkevičius, Acad. Prof. Dr Baiba Rivža, Acad. Prof. Dr habil. Vidmantas Stanys, Prof. Dr Jarkko Niemi		

Plenary session I

		Moderators:	**Prof. Dr Jarkko Niemi and Dr Skaidrė Supronienė**	
PLENARY SESSION	10.10–10.30	Heikki Lehtonen	How to integrate necessary actions and solutions to climate and environmental sustainability challenges in economically viable agriculture?	Natural Resources Institute Finland
	10.30–11.00	Per Hansson	Nordic–Baltic agricultural research collaboration for sustainable agriculture	The Nordic Joint Committee for Agricultural and Food Research, Sweden
		Moderators:	**Assoc. Prof. Dr Anastasija Novikova and Per Hansson**	
Section 1	11.00–11.15	Anastasija Novikova	Challenges in social protection and farmer well-being in EU agriculture	Vytautas Magnus University, Lithuania
	11.15–11.30	Linas Stabingis	Career planning among the students in the Baltic and the Nordic countries	Marijampole Higher Education Institution, Lithuania
	11.30–11.45	Jarkko Niemi	An analysis of transitioning to peat-free food chain in South Ostrobothnia	Natural Resources Institute Finland
	11.45–12.00	Baiba Rivža	European policy issues and their influence on modernisation of Latvian agricultural sector	Latvia University of Life Sciences and Technologies
	12.00–13.00	Lunch		
		Moderators:	**Prof. Dr Edita Baltrėnaitė-Gedienė and Prof. Dr Biruta Bankina**	
Section 2	13.00–13.15	Arman Shamshitov	The effect of conservation agriculture practices on soil microbial functional diversity and metabolic activity in *Endocalcaric-Epigleyic Cambisol*	Lithuanian Research Centre for Agriculture and Forestry
	13.15–13.30	Biruta Bankina	Leaf blotch as emerging disease in faba bean sowings	Latvia University of Life Sciences and Technologies
	13.30–13.45	Edita Baltrėnaitė-Gedienė	Dynamic factor method – a tool on chemical element uptake by plants under climate change	Vilnius Gediminas Technical University, Lithuania
	13.45–14.00	Gabija Vaitkevičiūtė	The effect of fluctuating temperatures on winter wheat: from physiology to transcriptome	Lithuanian Research Centre for Agriculture and Forestry
	14.00–14.15	Shervin Hadian	Promoting sustainable agriculture using endophytic bacteria from *Artemisia* spp.	Lithuanian Research Centre for Agriculture and Forestry
	14.15–14.30	Ina Alsiņa	Wheat yield and its quality in a changing climate	Latvia University of Life Sciences and Technologies
	14.30–14.45	Monika Toleikienė	Effect of biofertilisers on soybean growth under changing climatic conditions	Lithuanian Research Centre for Agriculture and Forestry
		Moderators:	**Acad. Dr Žydrė Kadžiulienė and Prof. Dr Heikki Lehtonen**	
Section 3	13.00–13.15	Katrīna Kārkliņa	Evaluation of the European pear rust severity in local pear cultivar 'Kazraušu bumbiere' seedlings and their genetic diversity revealed by SSR molecular markers	Latvia University of Life Sciences and Technologies
	13.15–13.30	Linas Balčiauskas	Small mammal diversity and body condition in agricultural environments	Nature Research Centre, Lithuania
	13.30–13.45	Mahbubjon Rahmatov	Resilient crop diversification through millets diversity in the Baltic Sea Neighbourhoods	Swedish University of Agricultural Sciences, Sweden
	13.45–14.00	Maryna Zhylina	Biochar production for soil improvement from agricultural residues	Riga Technical University, Latvia
	14.00–14.15	Raminta Skipitytė	Does inoculation help to fix atmospheric nitrogen in soybean growing in a cold climate?	Lithuanian Research Centre for Agriculture and Forestry
	14.15–14.30	Žydrė Kadžiulienė	Legume-rich leys enhance agronomic benefits and other ecosystem services into agroecosystems	Lithuanian Research Centre for Agriculture and Forestry
	14.30–14.45	Zahra Bitarafan	Climate changes require adjustment of glyphosate doses to achieve the same control level of noxious weeds	Norwegian Institute of Bioeconomy Research, Norway
	14.45–15.10	Group photo, coffee		

		Moderators:	**Dr Olga Sokolova and Dr Silvia Gaiani**	
Flash 1	15.10–15.15	Jurga Jankauskienė	Sustainable farming practices: harnessing biostimulants for enhanced crop and weed management	Nature Research Centre, Lithuania
	15.15–15.20	Gunita Bimšteine	Haplotype diversity and molecular phylogeny within *Alternata* and *Arborescens* lineages from tomatoes	Latvia University of Life Sciences and Technologies
	15.20–15.25	Liudmyla Kozeko	Response of psammophytes *Secale sylvestre* host and *Alyssum desertorum* Stapf to soil flooding	National Academy of Sciences of Ukraine and Nature Research Centre, Lithuania
	15.25–15.30	Silvia Gaiani	A database for Nordic Baltic sustainable food systems	University of Helsinki, Finland
	15.30–15.35	Olga Sokolova	Evaluation of apple scab susceptibility in cultivar 'Gala' on ten different rootstocks	Latvia University of Life Sciences and Technologies
	15.35–15.40	Jānis Kaņeps	Genetic diversity of *Pyrenophora tritici-repentis*	Latvia University of Life Sciences and Technologies
	15.40–15.45	Laila Dubova	Effect of soil tillage system on soil microbiological activity	Latvia University of Life Sciences and Technologies
	15.45–16.00	NJF recognition ceremony		
	19.00–21.00	Conference dinner		

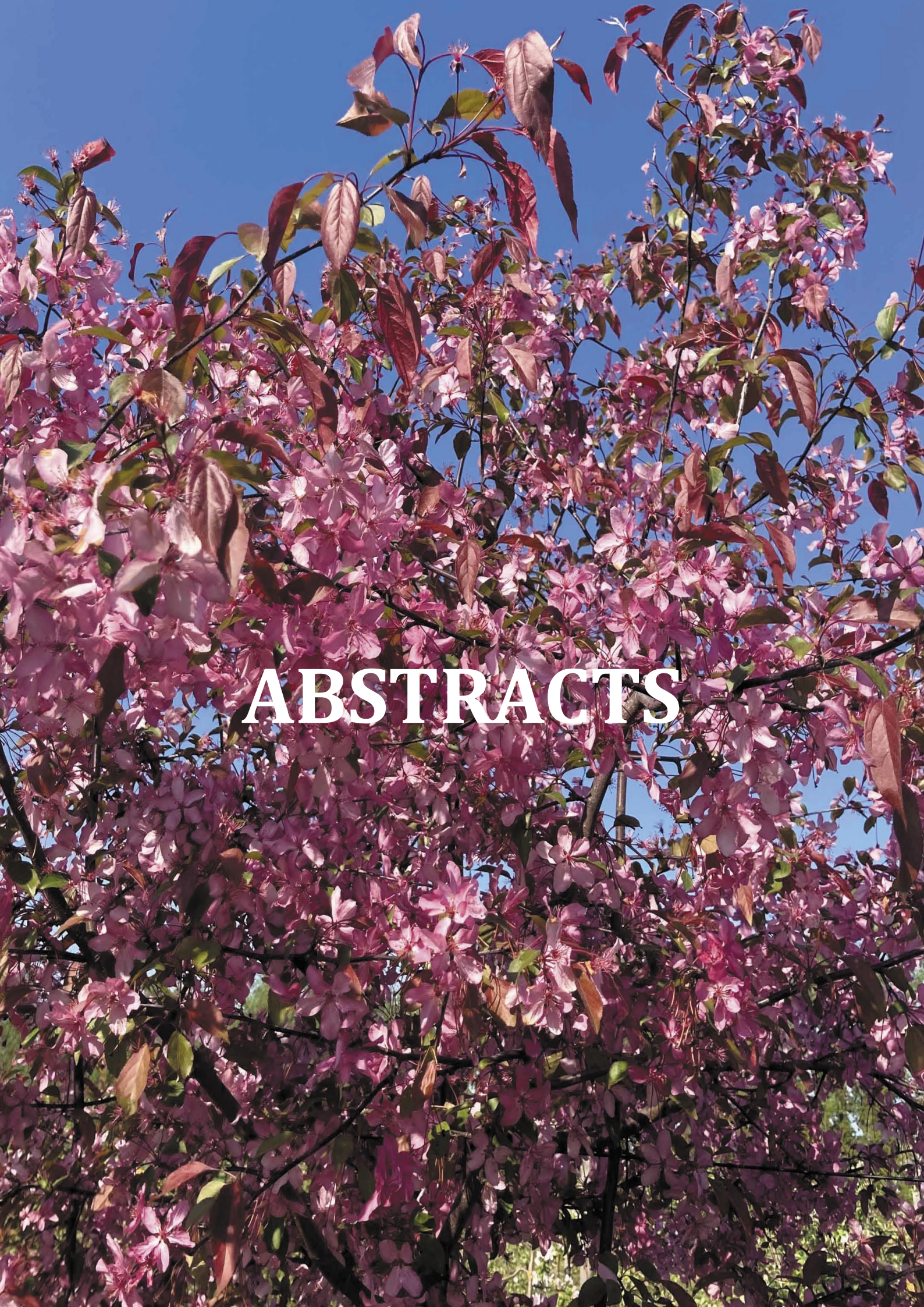
Wednesday, 9 October

	8.30–9.00	**Registration**		

Plenary session II

		Moderators:	**Acad. Prof. Dr Baiba Rivža and Dr Linas Stabingis**	
PLENARY SESSION	9.00–9.30	Ainis Lagzdins	Challenges and solutions to reduce nutrient losses and transport from agricultural areas	Latvia University of Life Sciences and Technologies
	9.30–10.00	Lillian Øygarden	Climate change – new challenges and need of adaptation strategies for Nordic-Baltic agricultural production systems	Norwegian Institute of Bioeconomy Research, Norway
	10.00–10.15	Coffee		
		Moderators:	**Dr Neringa Rasiukevičiūtė and Dr Lillian Øygarden**	
Section 4	10.15–10.30	Livija Zarina	Effectiveness of microbial fertiliser to replace synthetic nitrogen	Institute of Agricultural Resources and Economics, Latvia
	10.30–10.45	Erik Alexandersson	UPSCALE – Upscaling crop performance monitoring by linking satellite and field biosignatures	Swedish University of Agricultural Sciences, Sweden
	11.05–11.20	Ona Auškalnienė	Weed control perspective in the context of sustainable agriculture	Lithuanian Research Centre for Agriculture and Forestry
	11.20–11.35	Thomas Bawin	Growth and spectral response of northern and southern forage cultivars under variable temperature regimes	The Arctic University of Norway
	11.35–11.50	Skaidre Suproniene	Relationship between soil carbon pools and aggregate stability under no-till and diversified agricultural management practices	Lithuanian Research Centre for Agriculture and Forestry
	11.50–12.05	Neringa Matelionienė	Assessing the sensitivity of *Fusarium* spp. from crops and weeds to triazole fungicides	Lithuanian Research Centre for Agriculture and Forestry
		Moderators:	**Dr Agnė Veršulienė and Prof. Dr Ainis Lagzdins**	
Section 5	10.15–10.30	Kęstutis Venslauskas	Life cycle assessment of fish by-products processing and utilisation	Vytautas Magnus University Agriculture Academy, Lithuania
	10.30–10.45	Furkan Yigit	The role of entrepreneurial risk taking in farm profitability and growth: the influence of farm and farmer characteristics	University of Helsinki, Finland
	11.05–11.20	Christian Andreasen	Laser weeding: A technological solution for a cleaner environment	University of Copenhagen, Denmark
	11.20–11.35	Agnė Veršulienė	Impact of cereal/legume intercropping system on physical cereal root parameters and C sequestration	Center for Physical Sciences and Technology, Lithuania
	11.35–11.50	Liudmyla Kozeko	Foliar application of proline and GABA modulates chaperone system response to drought in *Arabidopsis thaliana*	National Academy of Sciences of Ukraine and Nature Research Centre, Lithuania
	11.50–12.05	Inga Morozova	Impact of green manure mixtures on winter wheat yield in organic farming	Institute of Agricultural Resources and Economics, Latvia
	12.05–13.05	Lunch		

		Moderators:	**Dr Karolina Barčauskaitė and Dr Karoliina Rimhanen**	
Section 6	13.05–13.20	Karolina Barčauskaitė	Plant nutrient recovery from secondary raw materials: applications and risk assessment	Lithuanian Research Centre for Agriculture and Forestry
	13.20–13.35	Gražina Kadžienė	Soil properties and wheat productivity in the headlands and non-compacted field in two different soil types	Lithuanian Research Centre for Agriculture and Forestry
	13.35–13.50	Neringa Rasiukevičiūtė	InNoBaHort – Nordic-Baltic horticulture: innovative and sustainable	Lithuanian Research Centre for Agriculture and Forestry
	13.50–14.05	Amer Ait-Sidhoum	Dairy farmers' perceptions on nutritional measures reducing greenhouse gas emissions in Finnish milk production	Natural Resources Institute Finland
	14.05–14.15	Karoliina Rimhanen	How dairy production adapts to warmer conditions: making the future more tangible through climate change adaptation-stories	Natural Resources Institute Finland
		Moderators:	**Dr Livija Zarina and Dr Alma Valiuškaitė**	
Flash 2	14.15–14.20	Ahmed Aldow	Predicted changes in distribution and richness of crop wild relatives under climate change scenarios in Northeast Africa	University of Birmingham, United Kingdom
	14.20–14.25	Alma Valiuškaitė	Calcium effect on lettuce *Alternaria* spp. growth *in vitro*	Lithuanian Research Centre for Agriculture and Forestry
	14.25–14.30	Ameer Hamza	Evaluating the effect of liming and manuring on composition and stability of soil aggregates in an acidic soil over 50 years period	Lithuanian Research Centre for Agriculture and Forestry
	14.30–14.35	Monica Aviles	Carbon dioxide emissions with conventional nitrogen fertilisation and impact on soil fertility by burning waste in wheat production in Baja California, Mexico	Autonomous University of Baja California, Mexico
	14.35–14.40	Neringa Rasiukevičiūtė	Alternative plant protection strategy for strawberry quality improvement	Lithuanian Research Centre for Agriculture and Forestry
	14.40–14.45	Azka Javaid	Green clean-up strategy for the removal of contaminants from water using bacterial isolates as biosorbent	University of Wah, Pakistan
	14.45–14.50	Ahmed Salah Ahmed	Comprehensive analysis of the effect of renewable energy on the stability of the environment	Cairo University, Egypt
	14.50–14.55	Ewunetu Tazebewa	Traditional smallholder plantation charcoal production system improvements for sustainable charcoal production and low carbon emissions in the subtropical highlands of Ethiopia	University of Gondar and Injibara University, Ethiopia
		Moderators:	**Dr Gražina Kadžienė and Dr Shervin Hadian**	
Flash 3	14.15–14.20	Greta Paulauskienė	Maximum yield potential in the context of sustainability. Is it compatible?	Lithuania
	14.20–14.25	Elžbieta Jankovska-Bortkevič	The effect of proline, putrescine and DFMA on the response to the increasing low temperature stress in *Brassica napus*	Nature Research Centre, Lithuania
	14.25–14.30	Giedrius Žiūraitis	Long-term straw management and tillage for climate resilience in agroecosystems sustainability	Vytautas Magnus University Agriculture Academy, Lithuania
	14.30–14.35	Mariam Zareyan	Physiological and genetic reactions of winter wheat to drought under the influence of probiotic microorganisms and calcium	Nature Research Centre, Lithuania
	14.35–14.40	Yeganeh Arablousabet	Possibilities to enhance soil moisture and nutrient retention using air nanobubble-saturated water	Vytautas Magnus University, Agriculture Academy, Lithuania
	14.40–14.45	Omar Aweis Ali	Transforming lignocellulosic biomass into valuable bioresources: pathways towards development of sustainable bioeconomy	Darul Hikmah University, Somalia
	14.45–14.50	Sasan Aliniaeifard	PhotoRhizomaster: high throughput phenotyping system based on chlorophyll fluorescence imaging for studying stress responses	University of Tehran, Iran
	14.50–14.55	Enock Asante Osei	Inter-monthly variability of pineapple (*Ananas comosus*, MD2) plant water requirement in Ghana: implications for planting period adjustment	University for Development Studies, Ghana
	14.55–15.15	Coffee		
	15.15–15.40	Closing ceremony		
	16:00–18.00	Conference tour		



ABSTRACTS

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FLASH PRESENTATIONS

KEYNOTE SPEAKERS

3rd / 5th topics:
Sustainability and animal production /
Modelling of agriculture, food system, environmental, climate change and European policy issues

Climate change – new challenges and need of adaptation strategies for Nordic-Baltic agricultural production systems

Lillian Øygarden

Norwegian Institute of Bioeconomy Research (NIBIO)

Presenting author: Lillian Øygarden, e-mail lillian.oygarden@nibio.no

The expected climate changes give challenges to the agricultural production systems of the Nordic and Baltic countries and the need for adaptation strategies. The northern areas can expect increased temperature, wetter conditions, changes in winter conditions with freezing and thawing periods and drought periods in some areas. In the northern areas, there are both regional and seasonal variations, requiring local adaptation.

Higher temperature and longer growing season influence the cropping possibilities in agriculture; possibilities for higher yields, increase the number of harvests, extend the cropping areas for some crops and possibilities for growing other crops than today. However, there are many uncertainties about the extent to which such opportunities can be utilised and what are the best adaptation possibilities and strategies to compensate for negative consequences. The challenges are related not only to plant survival in winter, increased risks to plant health (plant diseases, insects, and weeds), but also to management practices such as sowing, harvesting, tillage, and plant protection.

There are distinct seasonal variations in challenges or threats to agricultural production and recommended seasonal adaptations. Agriculture should be prepared for multiple factors in different seasons of the year as well as extreme conditions. In spring, both unexpected drought and very wet conditions can delay the sowing of annual crops. Strategies involve possibilities of changing to alternative crops, e.g., from cereal to forage production. Spring or summer droughts can be followed by very wet autumn. Extreme events that can occur in different seasons of the year have very serious consequences and are difficult to prepare for. Adaptation includes water control in the landscape, agricultural management practices, irrigation, drainage, improved soil health, machine development and use of robots, cropping in tunnels, etc. Climate change challenge the soil and water conservation and measures to reduce the environmental impact.

Keywords: climate change, agricultural production systems, seasonal changes, extreme events.

5th topic:
Modelling of agriculture, food system, environmental, climate change and European policy issues

How to integrate necessary actions and solutions to climate and environmental sustainability challenges to economically viable agriculture?

Heikki Lehtonen

Natural Resources Institute Finland (Luke)

Presenting author: Heikki Lehtonen, e-mail heikki.lehtonen@luke.fi

Agriculture has caused significant greenhouse gas emissions, biodiversity loss, eutrophication of surface water, and nitrate problems in ground waters. There are significant challenges in adaptation to climate change. Contrary to expectations, the farm economy is weak on average, despite increased specialisation and labour productivity. Because farms are different, many sustainability increasing options are needed. Economic models at the farm and sector level based on optimisation can include alternative ways of production, the benefits of cropping diversification, and technical, nutritional and policy changes. The sensitivity of the model outcomes can be tested for exogenous prices and policies. Cropping diversification may reduce the need of chemical fertilisers and plant protection and increase crop yields due to pre-crop effects in crop rotation, and other effects. This may increase farm incomes. The results suggest that there are real possibilities to develop more sustainable production and food systems, if changes in production, consumption, and trade are made consistently. Sustainable practices may benefit farm economies, but some farms will lose, especially those which are locked in unsustainable practices and have weak economy. Land use related targets and policies, e.g., peatland restoration, pose challenges, and opportunities for some farms and regions. While agriculture must find also other feasible and profitable ways of operation, e.g., cropping diversification, peatland restoration, biogas, and nutrient recycling, markets and society should provide better incentives for diversified production and other sustainable practices. Unsustainable practices should be taxed, as damage to the climate or environment is little included in market prices. The transition to sustainability in food systems is still more at the beginning than the end, as agricultural and food systems often resist changes.

Keywords: sustainable agriculture, farm economy, cropping diversification, climate smart agriculture.

5th topic:
Modelling of agriculture, food system, environmental, climate change and European policy issues

Nordic-Baltic agricultural research collaboration for sustainable agriculture

Per Hansson

The Nordic Joint Committee for Agricultural and Food Research (NKJ)

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The Nordic Joint Committee for Agricultural and Food Research (NKJ) aims to promote and coordinate a knowledge-based agriculture and food sector in the Nordic countries. To achieve this, NKJ supports and funds joint Nordic cooperation in research areas covering agriculture, food, forestry, and fisheries. Key stakeholders include the Nordic Council of Ministers, national ministries, research councils, and Nordic researchers active in these sectors. Established in 1965 by the Nordic Council of Ministers, NKJ facilitates collaboration through networking activities that address key agricultural and food-related issues of Nordic importance. NKJ-supported projects must involve participants from at least three Nordic countries and produce results with significant regional impact. Baltic countries are welcome to participate in the projects. Through its work, NKJ fosters knowledge exchange, builds connections between researchers, and supports sharing research infrastructure and outcomes. Key activities include policy advice and analysis, development of meeting platforms, coordination efforts, and targeted funding initiatives.

For more information, follow our website www.nordicagriresearch.org and register for the newsletter.

Keyword: Nordic-Baltic cooperation.

1st topic:
Technological solutions for a cleaner agri-food system

Challenges and solutions to reduce nutrient losses and transport from agricultural areas

Ainis Lagzdins, Arturs Veinbergs, Ieva Siksnane, Linda Grinberga, Ritvars Sudars, Kaspars Abramenko

Latvia University of Life Sciences and Technologies

Presenting author: Ainis Lagzdins, e-mail ainis.lagzdins@lbtu.lv

According to the Helsinki Commission (HELCOM), eutrophication is still a major problem in the Baltic Sea, mainly caused by nutrient inputs from catchment areas with intensive agriculture. It is estimated that agriculture activities contribute more than 70–90% of nitrogen (N) and 60–80% of phosphorus (P) diffuse loads to the sea.

Latvia University of Life Sciences and Technologies has been responsible for the implementation of the Agricultural Runoff Monitoring Programme in Latvia since 1995. Regular and systematic water quality and quantity monitoring activities have been carried out in the catchments with a high share of agricultural land at five spatial scales, including groundwater (20 sites), experimental plots (1 site), subsurface drainage fields (6 sites), small catchments (10 sites), and rivers (23 sites). The results of long-term monitoring show large variations in N and P concentrations and losses between the monitoring spatial scales and site-specific conditions. Overall, N concentrations tend to follow seasonal patterns of water flow, having the highest concentrations during high flow conditions in winter and spring, while the lowest during low or no flow conditions in summer and autumn. Phosphorus is lost from agricultural areas mainly during occasional events such as intensive precipitation or snow melt, as these conditions are favourable for surface runoff.

Practical actions to reduce nutrient transport from agricultural areas to downstream water bodies have been implemented in the LIFE GoodWater IP project, as this project aims to improve the status of water bodies at risk in Latvia to achieve the environmental objectives determined by the EU Water Framework Directive (2000/60/EC). Four water bodies at risk with previously identified pressures from agricultural sources were selected for detailed investigation and practical activities, including V046 Eda, V093 Slocene, G264 Age, and L118 Auce. In these water bodies, measures such as sedimentation ponds, constructed wetlands, woodchip bioreactors, saturated buffers, and controlled drainage have been and will be established.

Keywords: monitoring, nitrogen, phosphorus, losses, water and nutrient retention measures.

ORAL PRESENTATIONS

1st / 2nd topics:
Technological solutions for a cleaner agri-food system /
Biodiversity, plant and soil health in a new climate

PhotoRhizomaster: high throughput phenotyping system based on chlorophyll fluorescence imaging for studying stress responses

Sasan Aliniaeifard[1, 2], Mohammad Hossein Sadeghi[1], Reza Hassani Nevisi[1], Mahboobeh Zare Mehrjerdi[1], Saadat Sarikhani[1]

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Chlorophyll fluorescence is widely recognised as a reliable indicator of photosynthesis functionality. In the present study, by utilising a high-throughput approach based on chlorophyll fluorescence, a robot-based system was developed to rapidly screen large populations of plants and obtain valuable data on stress responses. The methodology involved the use of specialised equipment capable of measuring and analysing chlorophyll fluorescence in a non-destructive manner. Controlled stress conditions were applied to the plant populations, and their fluorescence responses were measured using automated imaging systems. The system was consisted of a fully recyclable hydroponic platform containing 320 growing pots, the LED grow light panels, and a programmable electronic arm equipped with a chlorophyll fluorescence imaging camera. To study the response of plant population, photosystem II maximum quantum yield, photosystem II efficiency, and non-photochemical quenching were used. The collected data were then processed using advanced algorithms to extract meaningful parameters related to stress tolerance and performance. The developed high-throughput phenotyping technique showed promising results in assessing plant populations under stress conditions. By utilising chlorophyll fluorescence as an indicator, it was possible to identify differences in stress response between different plant genotypes.

This information can be invaluable for breeders and researchers in selecting stress-tolerant cultivars and developing targeted interventions to enhance crop productivity.

Keywords: controlled environment agriculture (CEA), photosynthesis, breeding, screening.

1st topic:
Technological solutions for a cleaner agri-food system

Laser weeding: a technological solution for a cleaner environment

Christian Andreasen, Eleni Vlassi, Najmed Salehan

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Presenting author: Christian Andreasen, e-mail can@plen.ku.dk

Laser weeding can contribute to less dependency on soil tillage and herbicides. Several research and commercial robots equipped with lasers have been developed to control weeds. A plant recognition system and a weed meristem detection system based on artificial intelligence can be used to locate and identify crop and weed plants, and mirrors can be used to direct a laser beam to the meristem of the weeds to destroy them with heat. Unlike mechanical weed control and herbicide application, laser weeding only exposes a tiny part of the field for treatment, and, therefore, it is the most site-specific weed control method achievable. Laser weeding does not disturb the soil and leaves behind only ashes from the burned plants. Hence, it is an eco-friendly method to control weed seedlings. The advantages and disadvantages of laser weeding were discussed and compared to other weed control methods.

Keywords: integrated weed management, non-chemical weed control, site-specific weed management, thermal weed control.

1st topic:
Technological solutions for a cleaner agri-food system

Foliar application of proline and GABA modulates chaperone system response to drought in *Arabidopsis thaliana*

Liudmyla Kozeko[1, 2], Sigita Jurkonienė[2]

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Considering the threat of frequent droughts in many European countries due to global climate change, it is urgent to find new environmentally friendly approaches to increasing the resistance of plants to water shortages. One promising approach is to treat plants with bioactive molecules that play a role in cell protection. Preliminary results of the study showed a positive effect of foliar treatment with the proteinogenic amino acid proline and the nonprotein amino acid γ-aminobutyric acid (GABA) on plant tolerance to drought. Molecular chaperones play a key role in protecting cell protein homeostasis. To understand the effects of exogenous amino acids on the chaperone system in the model plant *Arabidopsis thaliana* during drought development, the following were evaluated: (1) endogenous proline content, (2) expression of genes encoded heat shock proteins (HSPs) of different families, and (3) stress-inducible transcription factors (HSFs, bZIP60), which regulate the heat shock reaction. Plants at the rosette stage were sprayed with 0.1 mM proline, 0.1 mM GABA and their mixture and then subjected to gradual soil drying up to deep wilting following by rehydration. It was shown that both exogenous proline and GABA led to an increase of proline content in leaves. RT-qPCR-analysis also demonstrated significant influence of amino acids on the expression of target genes. Differences between the effects of amino acids were revealed. In addition, the mutual influence of proline and GABA (from positive to negative) was noted when they were used together, which indicates a complex relationship between their metabolism and functioning. The obtained results show the essential influence of exogenous amino acids on the dynamics and level of the reaction of the chaperone system, which indicates their positive effect on the plant protein homeostasis.

Keywords: proline, GABA, foliar application, drought tolerance, molecular chaperones.

Funding. EMBO SLG grant No. 5437-2023.

1st topic:
Technological solutions for a cleaner agri-food system

Traditional smallholder plantation charcoal production system improvements for sustainable charcoal production and low carbon emissions in the subtropical highlands of Ethiopia

Ewunetu Tazebew[1, 5], Shinjiro Sato[2], Solomon Addisu[3], Eshetu Bekele[4], Asmamaw Alemu[1], Berhanu Belay[5]

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Charcoal production from *Acacia decurrens* has shown significant benefits in enhancing livelihoods and increasing government revenue in Ethiopia. However, the current reliance on unsustainable traditional Earth mound kilns reduces these benefits, resulting in charcoal income and significant environmental damage. Therefore, there is a pressing need to improve the traditional charcoal production system. The objectives of this study were a case study of evaluating different improved charcoal production approaches on charcoal conversion efficiency, financial profitability, and gas emission reduction potential compared to traditional charcoal making in the Fagta lokoma district, in the highlands of Ethiopia. Charcoal was produced from *Acacia decurrens* small-scale plantation using improved kilns (Green mad retort, MRV portable steel, Casamance) and traditional Earth mound kilns with three replications of production. Statistical analysis revealed a noteworthy increase in charcoal conversion efficiency with the MRV steel kiln exhibiting significantly ($P \leq 0.001$) the highest efficiency (41.57%), followed by the Green mad retort (36.14%) and Casamance (34.07%). Conversely, the traditional Earth mound kilns displayed the lowest conversion efficiency (24%). The findings demonstrated that the improved charcoal-making kilns increased the efficiency of wood-to-charcoal conversion by 41–72% compared to traditional kilns. Moreover, the study reveals a notable in average charcoal income per hectare with significantly ($P \leq 0.001$) higher earnings (284,824.4 ETB) at MRV steel kiln, and lower-income (71,580 ETB) at traditional Earth mound kilns. The study also revealed that the improved charcoal-making kilns significantly ($P \leq 0.001$) reduced harmful gas emissions compared to the traditional Earth mound method. Reduction percentages were substantial for various gases: CO_2 (46–57.9%), CO (29.4–56.6%), NO (61.7–86.1%), NOx (56.6–86.2%), SO_2 (41–62.8%), and CH_4 (35.7–57%). The improved kiln technology has substantially enhanced the efficiency of charcoal conversion, resulting in beneficial effects through emissions reduction. To champion sustainability and cultivate positive socio-economic outcomes, it is imperative to extensively adopt these eco-friendly kilns in areas where charcoal production is prominent.

Keywords: *Acacia decurrens*, charcoal production, financial profitability of improved kilns, selected greenhouse gas emissions, sustainability.

1st topic:
Technological solutions for a cleaner agri-food system

Transforming lignocellulosic biomass into valuable bioresources: Pathways towards development of sustainable bioeconomy

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The continuous increase in world population has resulted in excessive demand for agricultural activities and subsequent generation of agrowastes. However, inappropriate management of agricultural residues have urged researchers worldwide for efficient disposal or adoption to effective management strategies. In recent years, various biorefinery approaches for production of high-value products from waste biomass have gained extensive attraction, majorly due to generation of multiple biological based products with complete utilisation of feedstocks and more importantly zero waste generation. Lignocellulosic biorefineries offer key facilities and essential targets for technological development. The major components of agriculture wastes represent lignocellulose fractions that are commercially exploited via lignocellulosic biorefinery platforms and contribute towards improving environment health. Biofuels and platform chemicals are the main value-added products derived from lignocellulosic biomass upon valorisation. Importantly, subsequent improvement and integrated biorefinery technologies will substantially aid for sustainable bio-economy. The present review is highlighted towards emphasising on valorisation of lignocellulosic waste through integrated anaerobic digestion based biorefinery for sustainable production of high value products like biogas, biohydrogen, bioethanol, phenolic compounds, enzymes, biofertilisers, animal feed and nutraceuticals. Although, biorefinery based valorisation are promising resource of bioproducts, yet efforts are still required to optimise the lignocellulosic integrated biorefinery processes as a feasible and cost-effective approach for deriving various value products promoting bio-economy.

Keywords: valorisation, lignocellulosic biomass, biorefinery, value-added products, bio-economy.

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1st topic:
Technological solutions for a cleaner agri-food system

UPSCALE – Upscaling crop performance monitoring by linking satellite and field biosignatures

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The Nordic and Baltic region includes the most northern arable area in the world and is predicted to experience greater changes in temperature and precipitation than the global average due to climate change (Roitsch et al., 2022). One way to increase agricultural resilience is to automatize monitoring of crop performance. To upscale monitoring covering large areas required remote sensing via satellites. However, for satellite-based information to be meaningful, links between different spatial levels from field to satellite levels need to be created. This linking is the basis of UPSCALE, which is a consortium of Nordic and Baltic academic institutions. With the focus on spring wheat, potato and forages, in 2023 and 2024, 50 × 50-meter plots together were established with farmers in six different locations in Lithuania, Northern Norway, and Southern Sweden. Time series proximal sensing with UAVs and handheld devices has been used to record growth, biomass and crop formation. In parallel, these crops are monitored under different climatic perturbations via high-throughput phenotyping in the National Plant Phenotyping Infrastructure (NaPPI) at the University of Helsinki and hyperspectral imaging in the ClimaLab at UiT. Together with University of Copenhagen, the enzymatic signatures for key enzymes of samples are determined. The project will run over three growing seasons, and some first results from both field and controlled climates performed during the initial phase of UPSCALE will be presented.

1st / 2nd topics:
Technological solutions for a cleaner agri-food system /
Biodiversity, plant and soil health in a new climate

Phosphorus solubilisation: Insights from microbial inputs research

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The excessive use of mineral fertilisers disrupts soil biological processes, necessitating the development of more efficient fertilisers that balance agricultural productivity and soil conservation. Despite the abundant amount of phosphorus in the soil, only a small fraction is available to plants due to its reactivity and tendency to form insoluble compounds, limiting plant uptake to 10–20% of applied phosphorus. Soil microorganisms play a crucial role in converting organic matter into plant-absorbable minerals, releasing organic acids and enzymes that solubilise phosphorus. To evaluate the effectiveness of microbial strains in enhancing phosphorus availability in fertilisers, a three-year collaboration between Nando and VDU Agriculture Academy doctoral student Justinas Anušauskas began in 2020. The study hypothesised that bacteria-enriched (*Paenibacillus azotofixans*, *Bacillus megaterium*, *Bacillus mucilaginosus*, and *Bacillus mycoides*) fertilisers could significantly affect the yield and economic viability of spring barley. Laboratory experiments showed *B. megaterium* and *B. mucilaginosus* effectively solubilise phosphorus, making it more accessible to plants and incorporating some into their biomass. These microorganisms not only boost yield potential but also alleviate phosphorus deficiency under reduced fertiliser application. The choice of additives (e.g., glycerol, water, and xanthan gum) is critical for ensuring microbial stability and effectiveness. Application technologies, such as spraying or mixing, are used to integrate these inoculants with fertilisers, enhancing nutrient delivery. Stability testing is essential to ensure the microorganisms remain viable over time, considering factors like storage conditions and the physical properties of fertilisers. Field experiments (2020–2022) demonstrated that microbial inoculants increased barley yields by 8%, 7%, and 17% each year compared to the control, indicating that biological enrichment can boost yields without increasing fertiliser rates. This was attributed to enhanced potassium and phosphorus availability in the soil. The study also found that microbial technology could replace approximately 100 kg of NPK fertiliser while maintaining harvest yield, highlighting its potential to improve fertiliser efficiency and reduce reliance on chemical inputs.

Keywords: bacterial inoculant, biologically enriched, mineral fertilisation, barley yield, cultivation efficiency, *Bacillus megaterium*, *Bacillus mucilaginosus*, adjuvants, carriers, application technologies, stability evaluation.

1st topic:
Technological solutions for a cleaner agri-food system

Effectiveness of microbial fertiliser to replace synthetic nitrogen

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From an environmental and economic point of view, the regulation of the use of nitrogen (N) resources has become particularly relevant. One of the possibilities to promote the fixation of already existing, freely available nitrogen in nature is the use of air nitrogen-fixing microorganisms living in the soil. Various microbiological products are already available to practitioners; one of them is the microbiological product produced on the bases of bacteria from Latvia soils. It has been hypothesised that innovative products are able to attract up to 50 kg ha^{-1} N from the air, thus avoiding the use of a corresponding amount of synthetically produced nitrogen. The research was conducted at the Institute of Agricultural Resources and Economics with the winter wheat cultivar 'Skagen'. The experiments were carried out on a sod podzol loamy soil with good agrochemical soil indicators typical to the region. Five variants were established for comparison: N160 ammonium nitrate without using microbiological product (control), and variants with the total amount of nitrogen N220, N200, N180, and N160, where potentially 50 kg N was supposed to be replaced using the microbiological product. Two years of research showed that the use of the microbiological product Azotobacterin for winter wheat promotes plant development. The size of the obtained yield depending on the total dose of nitrogen fertiliser changed depending on the size of the dose; however, there was only a significant difference between the highest (N220) and the lowest (N140) one. The hypothesis that replacement of synthetic nitrogen with a microbiological product gives the same yield was confirmed.

Keywords: winter wheat, fertilisation, microbiological products, sustainable agriculture.

Funding. The study was carried out under the Latvian Rural Development Program 2014–2020 for the event "Knowledge transfer and information measures" of the sub-measure "Support for demonstration measures and within the framework of information measures".

1st / 2nd / 5th topics:
Technological solutions for a cleaner agri-food system /
Biodiversity, plant and soil health in a new climate /
Modelling of agriculture, food system, environmental, climate change and European policy issues

Climate change mitigation potential of trees in shelter belts of drainage ditches in cropland and grassland

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The aim of the research was to evaluate climate change mitigation potential of transformation of the buffer zones around drainage ditches into resilient, sustainable and self-sufficient shelter belts of woody crops ("biomass factories"), securing deliveries of high-grade sustainable biomass to the growing bio economy sector. Agroforestry – previously had not been recognised in Latvia, but is currently topical in EU, provides the perspective to apply the knowledge on management of fast-growing trees in a new setting. The research had been carried out at hemi-boreal climate region, data for calculations and measurements had been done in central and west part of Latvia. Phenological measurements were conducted based on remote sensing orthophoto maps taken once a month within the research area from a drone, at an altitude of 120 meters. By surveying the naturally formed vegetation on the drainage ditches of the territory of Latvia, it was found various species of common willow (*Salix* spp.), then white alder (*Alnus incana*), Norway spruce (*Picea abies*), raven (*Frangula alnus*), black alder (*Alnus glutinosa*), birches (*Betula pendula* and *B. pubescens*), vole (*Viburnum opulus*) and ash (*Fraxinus excelsior*), yew (*Padus avium*), and oak (*Quercus robur*). When maintaining the ditches, the trees growing on their sides are periodically cut down, so there are always juvenile, fast-growing trees in the buffer strips, the height of the longer-grown strips is 10–20 meters. Fast growing trees has more effective use of vegetation period – they flourish earlier and stay green longer as other tree species. The findings, calculations and new knowledge were obtained on the spontaneously occurred tree cover of amelioration ditches, short rotation forestry (SRF) and coppice (SRC) as well as on optimised mechanisation solutions in SRF and SRC will be relevant to in other regions of Europe and Baltic states.

Keywords: agroforestry, buffer belts, short rotation forestry.

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2nd topic:
Biodiversity, plant and soil health in a new climate

Evaluation of the European pear rust severity in local pear cultivar 'Kazraušu bumbiere' seedlings and their genetic diversity revealed by SSR molecular markers

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European pear rust, caused by the rust fungus *Gymnosporangium sabinae*, is a disease of significant economic impact. This fungus mainly targets leaves, impairing photosynthesis and damaging trees, which can lead to reduced yields. Currently, control methods rely on the fungicide application, as there are no fully resistant cultivars. However, recent research has identified potentially resistant seedling genotypes. Discovering new breeding material to develop European pear rust resistant cultivars would greatly enhance pear health, support environmentally conscious farming, and expand our understanding of pear resistance to pathogens. The study involved 71 pear 'Kazraušu bumbiere' seedlings, selected based on long-term disease severity assessments. The field evaluations, conducted in 2014–2024, took place in July, coinciding with the mid-point of the *G. sabinae* life cycle. Disease severity was assessed on a five-point scale, evaluating the entire tree. Initially, 26 genotypes were assessed through artificial inoculation in a greenhouse setting, followed by field assessments for 35 genotypes, and finally, all 71 genotypes were evaluated in the field and genotyped using 23 SSR markers. Long-term field evaluations yielded data identifying potentially resistant and susceptible genotypes as well as those exhibiting partial resistance. Among the initial group of 35 genotypes, 12 were classified as resistant, 14 as susceptible, and the remaining showed varying levels of resistance. The classification of "resistant" meant that no European pear rust symptoms were observed throughout the entirety of the evaluation period. SSR genotyping revealed the internal genetic structure of the seedling population, enabling the correlation of their resistance with their genetic background. This facilitates further investigation into potential resistance mechanisms.

Keywords: European pear rust, *Gymnosporangium sabinae*, SSR markers, disease evaluation.

2nd topic:
Biodiversity, plant and soil health in a new climate

Promoting sustainable agriculture using endophytic bacteria from *Artemisia* spp.

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Endophytic microorganisms present novel solutions to the challenges faced in modern agriculture, particularly in terms of sustainability and environmental impacts. This study focused on the ability of endophytic bacteria isolated from various *Artemisia* species to improve the growth and health of pea (*Pisum sativum* L.) plants. Sixty-one bacterial strains were isolated from the root, stem, and leaf tissues of the four *Artemisia* species, and identified through 16S rDNA sequencing. The isolates exhibited a variety of genera including *Bacillus*, *Pseudomonas*, *Enterobacter*, and *Lysinibacillus*. The strains AR11 and VR24 isolated from the roots of *A. absinthium* and *A. vulgaris* showed significant antifungal activity against *Fusarium oxysporum*, a common pea plant pathogen. In addition, isolates AR11, AR32, and CR25 demonstrated important plant growth-promoting properties such as phosphate solubilisation and nitrogen fixation.

A comparative analysis revealed that endophytic bacteria from *A. absinthium, A. campestris*, and *A. vulgaris* roots possessed properties conducive to both pathogen inhibition and plant growth enhancement. In particular, the AR11 strain with 100% similarity to *Bacillus thuringiensis* has emerged as a promising candidate for the development of microbial biofertilisers. These findings highlight the potential of these endophytic bacteria as eco-friendly alternatives to chemical fertilisers and pesticides, aligning with the goals for sustainable agricultural practices.

Keywords: endophytic bacteria, *Artemisia* spp., pea plants, *Fusarium oxysporum*, plant growth promotion.

2nd topic:
Biodiversity, plant and soil health in a new climate

Assessing the sensitivity of *Fusarium* spp. from crops and weeds to triazole fungicides

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Fusarium spp. cause diseases and quality losses in cereal crops. These fungi can colonise not only crops but also alternative hosts such as weeds (Suproniene et al., 2019). Triazole fungicides metconazole, prothioconazole, and tebuconazole are frequently used to protect crops from *Fusarium* infections (Tini et al., 2020). This study aims to investigate the sensitivity of *F. graminearum*, *F. culmorum*, and *F. sporotrichioides* isolated from crops (oilseed rape, field pea, sugar beet, and spring wheat) and weeds (scentless false mayweed, field pansy, shepherd's purse, and wild buckwheat) to varying concentrations of these fungicides. The fungicidal effects were assessed by measuring the percentage inhibition of mycelial growth *in vitro*. Metconazole was found to be the most effective fungicide against *Fusarium*. The most aggressive species, *F. graminearum* and *F. culmorum*, exhibited high resistance to triazole concentrations below 0.25 mg L^{-1}. Furthermore, *Fusarium* isolates from weeds were more sensitive to low concentrations of fungicides than those from crop plants. These findings suggest that *Fusarium* strains infecting crops may have developed some level of resistance to triazole fungicides, in contrast to strains isolated from weeds.

Keywords: *Fusarium*, disease control, triazoles, fungicide, alternative plants.

Funding. This study was supported by the long-term research programme 'Harmful Organisms in Agro and Forest Ecosystems' implemented by the Lithuanian Research Centre for Agriculture and Forestry.

2nd topic:
Biodiversity, plant and soil health in a new climate

Effect of biofertilisers on soybean growth under changing climatic conditions

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Soybean (*Glycine max* (L.) Merr.), globally known for their high protein and oil content, establish symbiosis with rhizobia bacteria in root nodules, enabling atmospheric nitrogen conversion into a plant-usable form, thus optimising growth and yield. This study aimed to select locally isolated and commercial symbiotic microorganisms and bio-stimulants to enhance nitrogen fixation in soybeans. Screening naturally occurring endophytic and exophytic bacteria in 2022 at LAMMC fields identified ten promising endophytes, notably *Arthrobacter pascens*, *Serratia inhibens*, *Bacillus velezensis*, and *Serratia plymuthica*. In 2022–2023, a greenhouse experiment assessed their effects using soil fertilised with ammonium nitrate labelled with a 95% stable $\delta^{14}N$ isotope. Results indicated significant enhancement in leaf chlorophyll content, fluorescence parameters, and net photosynthesis rates compared to control. Analyses of fresh and dry biomass revealed that these endophytes positively impacted soybean productivity, while their effect ranged from 34% to 76% of that achieved by the symbiotic nodule-forming bacteria *Bradyrhizobium japonicum*. Subsequently, a field experiment (FE1) compared the selected endophytes with commercial inoculants. Data collection included biological yield, root and shoot biomass, seed quantity and weight, and soybean nodulation. Comprehensive chemical analyses determined nitrogen, phosphorus, and potassium content with rigorous evaluation of quality parameters like 1000 kernel weight, protein, fat, moisture, and glycaemic index. Post-harvest chemical analyses were conducted on plant material and soil. Statistical analysis using SAS software, including Bartlett's test, ANOVA, and Tukey's mean separation test, confirmed the homogeneity of the data and revealed significant treatment effects. These findings provide valuable insights into improving soybean nitrogen fixation and productivity, especially in regions with challenging climatic conditions, and highlight the potential of integrating endophytes into microbial inoculation strategies to improve crop performance and sustainability.

Keywords: soybean, nitrogen fixation, endophytes, *Bradyrhizobium japonicum*, microbial inoculants.

2nd topic:
Biodiversity, plant and soil health in a new climate

The effect of fluctuating temperatures on winter wheat: from physiology to transcriptome

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Cold acclimation (CA) in winter wheat is induced by low positive temperatures up to 10°C and is required to achieve freezing tolerance (FT). However, global climate change is altering the environmental conditions, thus leading to insufficient CA and reduced FT. In addition, increasingly prevalent temperature fluctuations in winter cause deacclimation (DEA) and premature loss of FT. To avoid winterkill after subsequent drops in temperature, reacclimation (REA) will become an important trait in future climate-resilient crops. Nevertheless, these processes remain poorly understood, necessitating further research to meet the growing food production demands. This presentation will highlight the findings of our studies on winter wheat physiology, metabolome (Vaitkevičiūtė et al., 2022), and transcriptome (Vaitkevičiūtė et al., 2024) under temperature fluctuations. The prolonged higher low-temperature treatment during CA led to significantly higher shoot biomass accumulation and decreased FT in winter wheat, when compared to the constant low-temperature CA treatment. The balance between carbon and nitrogen metabolism in winter wheat crown and leaf tissues was found to play an important role in FT. Differential gene expression and gene ontology enrichment analyses of two genotypes with contrasting FT revealed significant changes throughout CA, DEA, and REA in both crown and leaf tissues. These results provide new insights into DEA and REA processes, contributing valuable knowledge for crop improvement under climate change.

Keywords: abiotic stress, deacclimation, reacclimation, *Triticum aestivum* L., winter hardiness.

2nd topic:
Biodiversity, plant and soil health in a new climate

Climate changes require adjustment of glyphosate doses to achieve the same control level of noxious weeds

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Climate change will result in an elevated CO_2 concentration (e(CO_2)), higher temperature (e(T)), and altered the amount, frequency, and intensity of precipitation. In Nordic regions, increasing temperatures due to climate change may positively affect the potential for agricultural production by extending the growing season and the latitude at which some crops might be grown. However, these changes may also benefit weeds, the primary contributors to crop yield loss. In a dose-response experiment, efficacy of glyphosate on the weeds barnyard grass (*Echinochloa crus-galli*) (C_4 plant), wild oat (*Avena fatua*) (C_3 plant), and the crop oilseed rape (*Brassica napus*) (C_3 plant) was evaluated under e(CO_2) and e(T) conditions. Oilseed rape is a crop that often occurs as a volunteer in the following crop. Plants were grown at ambient CO_2 concentration (400 ppm) at 18/12°C (day/night) in one greenhouse cell and at elevated CO_2 level (800 ppm) at 20.5/14.5°C (day/night) in another greenhouse cell. Plants were sprayed at the 3–4 leaf stage with Roundup Flex 480 (a.i. 480 g L^{-1} glyphosate). Four pots with four plants of each species were sprayed with 0, 8.75, 17.5, 35, 70, 140, 420, and 1260 g a.i. ha^{-1}, respectively. Plants were harvested two weeks after spraying, and fresh and dry weights were measured. The experiment was repeated once. During the second experiment, a dose of 2520 g a.i. ha^{-1} was added.

The results of the study indicate that adjusting the glyphosate dose is necessary to achieve the same effect under elevated CO_2 concentrations and temperatures as under current ambient conditions.

Keywords: elevated CO_2, herbicide efficacy, higher temperatures.

2nd topic:
Biodiversity, plant and soil health in a new climate

Small mammal diversity and body condition in agricultural environments

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The health of ecosystems in agricultural landscapes is influenced by the interaction of human activities and climate change. Understanding biodiversity is crucial for developing strategies that support sustainable agriculture and ecological balance. Based on small mammal trapping in 1975–2023, their diversity and body condition index (BCI) were assessed in 9 habitat types, including those of agricultural environments (crops, plantations, and commercial orchards). Sample size was over 57 thousand individuals of 20 species, sampling effort – over 500 thousand trap nights. Individual rarefaction was used to ensure that differences in trapping effort did not affect the reliability of the results. With 12 species, agricultural habitats show low alpha diversity, although the Shannon index (H = 1.83) is only significantly lower than that of meadows and commensal habitats (H = 2.03 and 1.95, respectively), comparable to wetlands (H = 1.82), and higher than in other investigated habitats. Small mammal communities in agricultural habitats were dominated by the striped field mouse, *Apodemus agrarius* (27.9%, noticeably increasing in last decade), with almost equal proportions (18.6–19.8%) of the three subdominant species, the common vole, *Microtus arvalis*, the yellow-necked mouse, *Apodemus flavicollis*, and the bank vole, *Clethrionomys glareolus*. The proportions of the first two species exceeded those expected on the basis of total catch and trapping effort, while eight species, including all shrews, *A. flavicollis*, *C. glareolus*, and other *Microtus* voles, were undercaptured. The variation in BCI among habitats was species-specific with no correlation between the proportion of species in a habitat and its BCI and with higher BCI characteristic of non-dominant species. In conclusion, agricultural habitats support a diversity of small mammals, although feeding conditions for some species, particularly insectivores, are insufficient due to management practices.

Keywords: small mammals, body condition, diversity, habitats.

2nd topic:
Biodiversity, plant and soil health in a new climate

Leaf blotch as emerging disease in faba bean sowings

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Faba bean (*Vicia faba* L.) provide protein-rich food and feed and offer ecological advantages. However, significant yield instability in faba beans, due to their sensitivity to both abiotic and biotic stress, is one of the reasons for their limited cultivation. Chocolate spot (caused by *Botrytis* spp.), leaf and pod spot (caused by *Didymella fabae*) and rust (caused by *Uromyces viciae-fabae*) are widely recognised as the most important diseases that affect faba beans. Nevertheless, recent studies have shown that the range of pathogens associated with diseases of faba bean is much wider. Recent research has demonstrated the significance of leaf blotch, caused by fungi from *Alternaria* and *Stemphylium* genera in Latvia and other regions. Large, necrotic and fused blotches on different parts of plants are typical symptoms caused by fungi from these genera, but they are indistinguishable. The disease, caused by *Alternaria* spp. and *Stemphylium* spp., was recognised as dominant three out of six years during the experiments at the Latvia University of Life Sciences and Technologies. These pathogens may attack plants simultaneously, forming a complex. Identification methods based on the morphological characteristics of isolates are often insufficient to determine the species level. Molecular analysis proved the occurrence of the genera *Stemphylium* and *Alternaria*. Isolates of *Alternaria* are diverse; they belong to different sections of this genus – *Alternaria, Infectoriae* and *Brassicicola*. Further analyses by sequencing several loci will be performed to identify the species of pathogens. Understanding the composition of species, their biological traits and pathogenicity is critical for diseases prediction and control.

Keywords: *Alternaria, Stemphylium*, identification, *Vicia fabae.*

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2nd topic:
Biodiversity, plant and soil health in a new climate

Biochar production for soil improvement from agricultural residues

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In recent years, circular economy has attracted critical attention, and strenuous efforts are in place to boost industrial symbiosis. Agricultural biomass, which is often incinerated, can be converted into valuable resources such as animal feed, biochar and heating briquettes by low-temperature slow pyrolysis offering a cost-effective and simplified disposal pathway. Converting agricultural waste into biochar could improve soil quality and create circular economy loop that promotes sustainable agriculture. The present study made use of the wheat straw, barley straw and oat husk to investigate their symbiotic opportunities in producing biochar. At the beginning of the study, the properties were investigated, such as moisture, ash, wood fibre, and lignin content, acetone-soluble extracts and cellulose, holocellulose, and hemicellulose content. The granulometric composition of raw materials was investigated, and the best mode of granulation of raw materials with peat was determined. Strong granules (pellets) containing 85% biomass, and 15% peat was obtained. The apparent density of granules was determined, and morphological studies were conducted. Thermal analysis of raw materials allowed to determine the optimal temperature regime for pyrolysis of granules. Pyrolysis was carried out at a temperature of 500°C at a heating rate of 5°C·min^{-1}. After pyrolysis, the granule strength, apparent density and moisture absorption capacity were investigated. Under laboratory conditions, the substrate was tested for the growth of lettuce plants by mixing pyrolysed granules and peat in a ratio of 1:4. A sensor was placed in the middle of the pot to monitor the soil moisture. After 9 days of evaluation, it was concluded that the best raw material for biochar production can be obtained using peat with barley straw as a binder.

Keywords: biomass, agricultural residues, granulation, pyrolysis, biochar, soil quality.

2nd topic:
Biodiversity, plant and soil health in a new climate

The effect of conservation agriculture practices on soil microbial functional diversity and metabolic activity in *Endocalcaric-Epigleyic Cambisol*

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Microbial activity acts as a reliable indication of soil health, as soil microbes have a crucial function in breaking down organic matter and facilitating biogeochemical cycles that impact soil fertility. Promoting conservation agriculture management practices, including minimal soil disturbance and increased plant diversity, greatly improves the soil microbial community. Thus, this study aimed to evaluate the effects of conservation tillage practices and the use of cover crops on the functional diversity and metabolic activity of the microbial community. At the experimental site, located in central Lithuania at the Lithuanian Research Centre for Agriculture and Forestry (LAMMC) (55°23′50″N, 23°51′40″E), was used a split-plot design with three treatments: no-tillage (NT), no-tillage combined with cover crops (Persian clover) (NTC), and conventional tillage (CT). To determine the Microbial Community Level Physiological Profiles (CLPP), Biolog EcoPlates (Biolog Inc., USA) containing 31 different carbon sources were used. The average well-colour development (AWCD), substrate richness, and Shannon diversity index (H′) were measured to evaluate the metabolic capabilities and functional diversity of the microbial community. After 48 hours of incubating the EcoPlates, significant differences ($P \leq 0.05$) were found between the treatments in terms of total AWCD and the Shannon diversity index (H′) with NTC displaying the highest values for both indices. However, after 96 hours of incubation, no significant differences were found between the different treated soils, although the NTC treatment still exhibited trend with a relatively higher AWCD and H′ index values. Pearson's correlation analysis revealed moderate, significant positive correlations between microbial biomass carbon (MBC) and AWCD ($r = 0.630$, $p = 0.028$) as well as the Shannon index (H') ($r = 0.576$, $p = 0.050$). Overall, the findings suggest that the NTC treatment showed relatively higher microbial functional diversity and increased metabolic activity compared to NT and CT practices alone.

Keywords: conservation agriculture, tillage, cover crop, microbial activity.

2nd topic:
Biodiversity, plant and soil health in a new climate

Does inoculation help to fix atmospheric nitrogen in soybean growing in a cold climate?

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Soybean (*Glycine max* (L.) Merr.) is a leguminous crop valued for its high protein content, ability to fix atmospheric nitrogen, and extensive use in food, feed and industrial products, making it integral to global agriculture and sustainability efforts. In the Nordic and Baltic regions, there is an increasing focus on enhancing local protein production and decreasing dependence on imports with soybean cultivation emerging as a promising option. However, effectively managing soybean cultivation in areas lacking *Bradyrhizobium* strains in the soil, which are crucial for biological nitrogen fixation (BNF), requires further understanding. The study explored soybean N_2-fixation potential using inoculants containing *Bradyrhizobium japonicum* strains. The aim was to enhance BNF through seed inoculation (the standard method) as an alternative to mineral nitrogen fertilisers. Field experiment was carried out in Lithuanian Research Centre for Agriculture and Forestry in Akademija (55°24′ N, 23°51′ E), Kėdainiai district. Different microorganisms have been studied to increase nitrogen availability in soybeans and enhance protein accumulation in their seeds. Two soybean cultivars 'Laulema' and 'Merlin' exhibited significantly different nitrogen utilisation patterns. Strains of *B. japonicum* used in the commercial biostimulants Bactolife and Rhizofix 10 were identified as having the highest nitrogen fixation efficiency. Overall, this study improves soybean cultivation practices for sustainable nitrogen management in Lithuania, emphasising the importance of *Bradyrhizobium* inoculation strategies to replace N-fertiliser inputs. Field experiments are ongoing to gather more data to complement primary findings and support conclusions. Further research in this area could significantly improve agricultural sustainability.

Keywords: soybean, inoculation, nitrogen fixation.

Funding. This work was a part of postdoctoral research supported by the Research Council of Lithuania No. S-PD-24-45.

2nd topic:
Biodiversity, plant and soil health in a new climate

Wheat yield and its quality in a changing climate

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The global population is continually growing leading to an increased demand for food, while the coming decades are expected to bring more extreme weather conditions. These challenges, especially unpredictable weather patterns and prolonged droughts, pose a significant threat to agricultural productivity. The aim of the study was to analyse the impact of climatic conditions on wheat yield and quality. The experiment was conducted at the Agriculture Institute, Skrīveri, Latvia. The study was two-factorial, where factor A was wheat cultivation system (traditional/organic), and factor B was moisture supply (open field/under shelter). During the experiment, soil surface, air temperature (°C) and soil moisture content (%) were measured. At the end of experiment, grain yield and its structural components – plant height, spike count, and the number of productive spikes – as well as crop quality indicators, including protein, gluten, and starch content (%), Zeleny index (ZI), and thousand grain weight (TGW) (g) were recorded. The results demonstrated that wheat growth, development, and yield formation were influenced by both the cultivation system and moisture supply. A significant influence of moisture supply on wheat yield, TGW, protein and gluten content and ZI was determined. Similarly, the cultivation system significantly affected the number of stems, plant height, yield, TGW, protein content and ZI. However, none of the factors had a significant effect on the number of productive shoots and starch content of wheat grains. The study also found that conventionally grown wheat with higher vegetative mass maintained lower soil temperatures at a depth of 6 cm in the top layer and 15 cm above the soil surface in both open fields and under shelters. In contrast, organically grown wheat was less capable of maintaining lower temperatures and was more susceptible to heat stress, particularly under controlled conditions. The findings indicate that both moisture supply and cultivation system play a critical role in determining wheat yield and crop quality.

Keywords: *Triticum aestivum*, drought, temperature, gluten, starch.

Funding. The research has received funding from the EU Horizon 2020 Research and Innovation programme under the grant agreement No. 101000371.

2nd topic:
Biodiversity, plant and soil health in a new climate

Resilient crop diversification through millets diversity in the Baltic Sea Neighbourhoods

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The Baltic Sea is located among the countries with high population density and intensive agricultural practice. Therefore, these areas have experienced significant environmental pressure, especially increased stresses on their marine ecosystems due to the overflow of nutrients from urban areas and agricultural activities. Eutrophication in the Baltic Sea Neighbourhood is a pressing issue driven by intensive farming practices. This phenomenon is exacerbated by the extensive use of synthetic fertilisers such as nitrogen and phosphorus in the Baltic Sea Neighbourhood's agricultural landscapes, which are dominated by monoculture cropping systems. Eutrophication has been documented over a large area of the Baltic Sea, encompassing 97% of its area, primarily due to the historical and continuing influx of excessive quantities of nitrogen and phosphorus. Hence, it is evident that eutrophication in the Baltic Sea basins has resulted in significant algal proliferation and oxygen depletion at the seafloor, giving rise to extensive regions characterized by anoxic or hypoxic conditions and causing adverse consequences for the entire marine ecosystem. The research focuses on a Nature-Based Solution that integrates climate-resilient millet cultivation in the Baltic Sea Neighbourhood, aiming to reduce environmental impacts while enhancing ecosystem services and natural capital. The promotion of millet crops in the Baltic Sea Neighbourhood and the numerous benefits of their cultivation will be discussed.

Keywords: crop diversification, crop rotation, climate change, drought resilience.

2nd topic:
Biodiversity, plant and soil health in a new climate

Legume-rich leys enhance agronomic benefits and other ecosystem services into agroecosystems

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The legume-rich swards provide not only high-protein feed and more efficient use of resources, but also encourage improvements in biodiversity contributing to soil health, offering other ecosystem services and climate-related benefits. Many studies have shown the extent to which the provision of such ecosystem services depends on plant diversity. The leys containing forage legumes enhance these benefits by supplying nitrogen and replacing of mineral N fertiliser use. Many environmental and ecological benefits result from the interactions between the plant species and the soil in relation to other environmental and climatic conditions. The experiment was conducted at the Institute of Agriculture, Lithuanian Research Centre for Agriculture and Forestry with multi-species swards, including grasses and legumes, with annual fertilisation rates of N150 and N0 kg ha^{-1}. This experiment demonstrated that forage legumes improved the quality indicators of forage and contribute to maintaining a more stable overall forage yield over seasons. This short-term study showed that after three years of using perennial grasses and forage legumes in the swards, the amount of organic carbon in the soil did not change significantly compared to the beginning of the experiment. The several experiments have been conducted for assessment of the use of forage legumes and the impacts of the legume-based organic fertilisers for the maintenance of soil fertility and subsequent crops productivity. The results show that forage legumes have a positive effect on agroecosystems and could be used in different ways, although sometimes with some inconsistencies.

As the climate continues to become warmer, there is an increasing need to study a wide range of plant species and different cultivars suitable for local growing conditions. Legume-rich leys have the potential increase sustainability of agriculture, but more efforts are needed to convince politicians and farmers to have more confidence in these agricultural tools.

Keywords: nitrogen, soil organic carbon, forage yield.

2nd topic:
Biodiversity, plant and soil health in a new climate

InNoBaHort – Nordic-Baltic horticulture: innovative and sustainable

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The horticultural sector is a small but important part of local agriculture in the Nordic and Baltic countries. However, it faces major challenges in achieving the goals of the European Green Deal, which includes a reduction of hazardous pesticides by 50% and fertilisers by 20% by 2030, in addition, increasing organic horticulture by at least 25%. The InNoBaHort project, a collaborative effort with R&D institutions of multiple Nordic and Baltic countries, is dedicated to these goals and aims to decrease the burden of the horticultural production on the environment by reducing the input of mineral fertilisers and synthetic pesticides and by selecting cultivars with a higher level of resistance to one of the complex diseases.

The project consists of 5 work packages (WP). In WP 1, research in Estonia and Finland aims to reduce the use of mineral fertilisers by applying a new method for rapid and reliable leaf analysis, thus assessing plant nutrient needs more precisely. In WP 2, researchers in Norway and Finland will develop disease forecasting models for European canker in apples and Mycosphaerella leaf spot in black currants. WP 3 evaluates the fungicidal effect of new plant extracts against grey mould in strawberries, and the study is led by Lithuanian scientists in close collaboration with Estonian researchers. WP 4 investigates the resistance of Swedish and Estonian apple cultivars to European canker. The research is led by Sweden researchers in close collaboration with Estonian and Norwegian scientists. WP 5 focuses on the dissemination of project results, including knowledge transfer to fruit and berry growers and advisors.

Keywords: *Botrytis cinerea*, fertilisers, *Mycosphaerella ribis*, *Neonectria ditissima*.

2nd topic:
Biodiversity, plant and soil health in a new climate

Alternative plant protection strategy for strawberry quality improvement

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It is necessary to promote alternative plant protection methods to reduce the risks and consequences of the use of chemical pesticides, while ensuring environmental safety and human health. The EU action plan encourages reducing the use of chemical pesticides and promotes alternative plant protection. This study aimed to evaluate alternative protection of strawberry plants to improve their yield and quality. The experiments were conducted in the greenhouse tunnel, cultivar 'Elsanta'. Treatments: chemical, bacterial, thyme, and control. The first application was at 10% flowering (BBCH 61–65) and was repeated every 7–10 days (four times). Evaluated: yield, fruit size, weight, ascorbic acid, dry matter, fruit firmness, soluble solids and resistance to *Botrytis cinerea*. The bacterial treatment led to a weight increase in the first harvest. Moreover, bacteria-treated strawberries were firmer and more considerable in first yield but reduced the amount of soluble solids. Thyme had the highest amount of ascorbic acid with a concentration of 45.06%. The results of the study showed that it is possible to obtain high-quality strawberries by integrating alternative plant protection while reducing the use of chemical fungicides. Based on the primary results, it can be concluded that *Bacillus velezencis*, *B. halotolerans* and thyme can potentially serve as alternative plant protection products. However, further investigations are needed.

Keywords: first harvest, fruit weight, fruit size, essential oils, bacteria.

Funding. This project has received funding from the Research Council of Lithuania (LMTLT), agreement No. S-NORDFORSK-23-6.

3rd topic:
Sustainability and animal production

Plant nutrient recovery from secondary raw materials: applications and risk assessment

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As global agricultural demands increase and natural resources become strained, the recovery of plant nutrients from secondary raw materials offers a sustainable and innovative solution. This presentation reveals the potential of biofuel ash and organic waste as sources for nutrient recovery, highlighting their applications in modern agriculture and the associated risk assessments. Biofuel ash, a byproduct of biomass combustion, is rich in essential nutrients such as potassium, calcium, and phosphorus. Similarly, organic waste, including food scraps and agricultural residues, provides a valuable source of organic matter, macro- and micronutrients. Both materials are promising alternatives to traditional fertilisers that meet the principles of circular economy and waste reduction.

This presentation will analyse the plant nutrient profiles of biofuel ash and organic waste and heir extraction technologies. Moreover, case studies demonstrating the effectiveness of these recovered nutrients in improving soil fertility, crop yield, and overall plant health will be presented during the conference. Comprehensive evaluation of potential risks, mainly due to including heavy metal contamination and environmental impact, was assessed. Strategies and prospectives for mitigating these risks aim to ensure the safe and sustainable use of secondary raw materials in agriculture. By integrating scientific research with practical applications and laboratory testing, this presentation aims to provide a comprehensive understanding of the benefits and challenges of plant nutrient recovery from biofuel ash and organic waste.

Keywords: plant nutrients, biofuel ash, organic waste, risk index.

3rd topic:
Sustainability and animal production

How dairy production adapts to warmer conditions: making the future more tangible through climate change adaptation-stories

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Climate change is rapidly transforming agroecosystems and agricultural practices worldwide, with significant impacts for dairy production. With rising global temperatures, dairy systems must be adapted to ensure the sustainability, productivity and health of livestock production. Despite increasing concern about the impacts of climate change, it can be challenging for stakeholders to take decisive action. The issues are complex and uncertain, and the amount of information on the topic can be overwhelming and confusing. In addition to reliable information, practical examples are needed to demonstrate the practical measures available. It is important to raise awareness through emotionally appealing messages that encourage active participation and commitment to climate change adaptation. Examples of regional "adaptation-stories", which are fictional but science-based accounts set in the 2050s, are presented. The stories describe conditions in the future climate through the varied perspectives of different dairy farmers and dairy buyers, who have implemented adaptation measures in their unique local cultural and societal context. A qualitative interview study was conducted in the North Karelia region of Eastern Finland to identify experiences and perspectives of dairy farmers and buyers concerning notable impacts of climate change on dairy production, factors driving the impacts and current and future adaptation options. It is presented: 1) how the stories were co-created with the key stakeholders, 2) excerpts from the adaptation-stories, and 3) the views of those listening to the stories on their benefits and weaknesses in terms of climate change communication. Adaptation-stories are imagined futures that can help people make sense of existing information, promote learning, and improve the effectiveness of communication. They can also promote engagement in climate change adaptation actions.

Keywords: adaptation, stories, climate change, dairy production, future.

3rd topic:
Sustainability and animal production

Dairy farmers' perceptions on nutritional measures reducing greenhouse gas emissions in Finnish milk production

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The aim of the study was to investigate the perception of Finnish dairy farmers towards greenhouse gas (GHG) reduction measures and in particular the use of feed additives such as 3-NOPs (marketed as Bovaer®) that reduce methane emissions. Barriers to the application of these methods need to be highlighted. The data includes survey responses from 239 Finnish dairy farmers in spring 2023. The results of the study show that most farmers recognise the importance of climate issues, but only a small number of them believe that mitigation is the responsibility of the producer only. Moreover, farmers prefer to decide themselves how to reduce emissions, indicating that there may be resistance to externally directed measures. The barriers to the adoption of methane-reducing feed additives such as 3-NOP and other sustainable agricultural practices are multiple and complex. It is a major barrier if economic viability is poor, because farmers are concerned that the cost of additives may increase production costs, leading consumers to switch to cheaper foreign products. The lack of clear economic benefits further hinders uptake, especially as there are concerns about the high market power of additive manufacturers. Practical challenges, such as the difficulties of using Bovaer with young animals and the potential negative effects on animal productivity, add to the hesitation. The current perceived complex and inconsistent policy creates further uncertainty, and farmers are calling for more consistent and long-term regulations that meet the practical needs of farming. Resource constraints are another barrier with many farmers feeling that they lack the support and training needed to effectively implement climate-friendly practices. Knowledge is also essential for adoption, as better-educated farmers are more willing to adopt lower-emission practices. However, gender dynamics may be different for chemical feed additives. Women, who are typically more environmentally sensitive, may have a more negative attitude towards these additives and thus influence uptake than men. While market-based solutions such as emissions trading are attractive, they are associated with risks and uncertainties, highlighting the need for a balanced approach combining government support and market mechanisms.

Keywords: GHG, mitigation, adoption, obstacles.

4th topic:
Economics, social impacts and lifecycle sustainability assessments

Life cycle assessment of fish by-products processing and utilisation

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This study evaluated the possibility of recovery of high-quality valuable fish oil and proteins from fish processing co-streams by traditional way or a combination of several technologies. This study aims to determine energy efficiency and life cycle assessment of different salmon by-products processing and utilisation scenarios. Concepts studied are examples of zero-waste processing of bioproducts and illustrate the possibilities and benefits of fully utilising the fish by-products to energy and fertilisers. If such streams are available this concept utilises the organic fraction of residue for energy production and recycles the inorganic components as fertilisers and reduces the energy need and amount of purchased mineral fertiliser in farms.

Funding. This study is part of the ENOUGH project, which has received funding from the European Union's Horizon 2020 Research and Innovation programme under grant agreement No. 101036588.

Keywords: fish by-products, biogas, energy, biofertlisers.

4th topic:
Economics, social impacts and lifecycle sustainability assessments

The role of entrepreneurial risk taking in farm profitability and growth: the influence of farm and farmer characteristics

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The economic dimension of sustainable agriculture implies succeeding profitability and achieving growth. Profitability is essential for assessing the success of the farm and its survival and growth (Kahan, 2013). Successful farm entrepreneurship requires the involvement of dynamic processes, including propensity to take risks (Hardaker et al., 1997). However, farms and farmers are heterogeneous. The impact of risk taking on success of profitability and growth varies based on the heterogeneities. Research on farm entrepreneurship supports the need to account the consideration of heterogeneity in research on farm success (McElwee, 2006). This study analyses the impact of risk-taking propensities of farmers on the success in profitability and growth. The novel analysis system of this study reflects the heterogeneity of farms. The data were collected through an electronic questionnaire responded by 1709 farmers in Finland. Success in profitability and growth were constructed as perceptions (Reijonen, Komppula, 2007), and risk-taking as an element of entrepreneurial orientation (Covin, Slevin, 1989). The characteristics of the farm, farmer and household were employed. Confirmatory Factor Analysis and Structural Equation Modelling were applied. All factor loadings are found to be significant. Conceptual model represents good fit. Preliminary results from the structural model show the significance of the effect of risk-taking on profitability and growth. The intermediation effect of external labour differs among family farms but not among solo farms. The mediation effects of farm size, forest size and life cycle differ for both family and solo farms. The overall contribution of this study is the implications for farmers and insights for the sustainable farm entrepreneurship literature on how different characteristics influence the relationship between risk-taking, profitability and growth.

Keywords: farm entrepreneurship, risk-taking propensity, profitability, growth, success.

4th topic:
Economics, social impacts and lifecycle sustainability assessments

Career planning among the students in the Baltic and the Nordic countries

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This study presents the results of questioning on the career planning among the students in the Baltic and the Nordic countries and their entrepreneurial intention. Data on students' career vision were obtained from 4042 respondents studying in Estonia, Lithuania, Finland and Sweden by implementing Global University Entrepreneurial Spirit Students' Survey (GUESSS) in 2021. Data analysis was performed using statistical data analysis methods and the modified Krueger's (2009) entrepreneurial intention model based on the Theory of Planned Behaviour (TPB). The analysis of the answers was performed at several levels using the data obtained from all respondents and from individual sub-samples, divided by gender, level of study, field of study, and country of residence. The analysis of the results clarified the preferences of the students for career planning immediately after graduation and five years after graduation of studies, cross-countries comparison showed similarities and differences in vision to the own career in different countries, revealed weakness of universities impact on orientation toward students' entrepreneurship. Five hypotheses were tested to identify the factors most influencing an entrepreneurial intention among students in the involved countries. A positive relationship with students' entrepreneurial intentions was clarified and the selected hypotheses were proved by analysing almost all variables of all sub-samples. Due to insufficient level of statistical significance, only two hypotheses were not proved in the case of Lithuania and one in the case of Sweden and Finland.

Keywords: students, career planning, entrepreneurial intentions, cross-countries comparison.

4th topic:
Economics, social impacts and lifecycle sustainability assessments

An analysis of transitioning to peat-free food chain in South Ostrobothnia

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Finland has plenty of peatland, and peat is used for different purposes such as a high-quality bedding material in animal husbandry, as growing media in greenhouses and for energy production. As peat is a high carbon-intensive energy source, Finland is reducing use of peat energy substantially by 2030. However, peat for bedding and growing media are typically obtained as byproducts when harvesting peat for energy production. Therefore, discontinuing energy use is expected to reduce the availability and increase the cost of peat as bedding material and growing medium.

The aim of the study was to investigate the peat and alternatives for peat in food value chains in South Ostrobothnia region of Finland. The research is based on the PESTEL method, which analyses the businesses operational environment in terms of political, economic, social, technological and environmental aspects. The analysis produces information on the development needs and challenges related to the value chains using peat and materials substituting peat in the food chain. Several arable biomass and industrial by-products have been investigated and proposed peat substitutes. These include reed canaries, lake reeds, grasses, Osmania, hemp, curly-leaf pondweed, wood-fibrous biomass and digestates from biogas plants. Actors of peat and alternative value chains are mapped, and their structure and operating environment are studied. The use of alternative materials has not been widespread especially due to the low price of peat, the properties of alternative materials and their low availability on the market when compared to peat. In addition to the technical properties of alternative materials, the importance of stable and quantitatively adequate supply and competitive price of substitute materials will be point out. As alternative materials are often produced in small scale, there is a need to strengthen their supply chains and ensure appropriate post-harvest processing and logistics.

Keywords: peat, value chain, climate change, biomass, PESTEL-analysis.

Funding. Peat-free food chain project is co-funded by the European Union.

4th topic:
Economics, social impacts and lifecycle sustainability assessments

Challenges in social protection and farmer well-being in EU agriculture

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The Common Agricultural Policy is an essential tool for striving towards sustainability transformation, in which farmers are given a primary role. In the 2017, the European Commission Communication "The Future of Food and Farming" recognises farmers as those who guarantee food security for more than 500 million Europeans and are the primary guardians of the natural environment. According to the Communication, the role of the policy is "to highlight the best features of the European Union's (EU) agricultural sector and rural areas to support farmers in addressing future challenges and important development issues". The essential role of farmers in contributing to these challenges in the EU is emphasised in the European Green Deal's the Farm to Fork Strategy and the Biodiversity Strategy. It is stated that farmers have an important role to play in contributing to the solutions for many challenges faced by the EU. Farmers are an important part of the production of agricultural goods and contribute to the implementation of the goals of the European Green Deal. Therefore, the well-being issues of farmers are important and relevant considering physical and mental health, social protection and psychological challenges. The present research is a part of Horizon project "Strengthening Farm Health and Safety Knowledge and Innovation Systems" (SAFEHABITUS), aiming at identifying main insights about social protection of farmers/farmworkers from literature. The method of the present research is systemic literature review. The main findings of the research are: the main problems, which were risen in scientific literature were existence/not existence of insurance; living and working in the not appropriate conditions; aspects of employment on the farm. It was found that mostly social protection issues in agriculture are usually risen in research done about USA, Canada, Latin America and some Nordic countries of Europe. There is still lack of research done under European countries scope. Each European country possesses a unique history and culture regarding farming systems. Furthermore, various social systems have been implemented in each country to support farmers. These variations result in a lack of comparable data on farmers' injuries and well-being across Europe. Consequently, this disparity hinders the measurement and comparison of the effectiveness of implemented programs or systems as well as the ability to leverage and adapt best practices from other countries.

Keywords: agriculture, social protection, farm, wellbeing.

5th topic:
Modelling of agriculture, food system, environmental, climate change and European policy issues

Dynamic factor method – a tool on chemical element uptake by plants under climate change

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Climate change, which causes environmental, biological, and ecosystem-specific changes, may influence chemical elements (CEs) transfer from soils to plants. The interface between the soil and the plant, expressed in the concentration of a specific CE in the plant and its concentration in the soil, is the basis of the widely used biological absorption coefficient, also known as the transfer factor, bioaccumulation factor, mobility ratio, or plant-soil coefficient, which is expressed as the CE concentration in the plant and in the soil. However, from the biogeochemical perspective, these coefficients/factors can only provide insight into the CEs uptake by plants in a particular place (under typical environmental conditions) and at a particular time.

Climate change causing alterations in the external and internal factors of the soil–plant system affects the process changes in the CEs plant uptake, and this requires a new way of process observation and evaluation. Factors that highlight the variation in the processes, rather than the variation in the CE quantity under the conditions of the environmental variation, are required. The second-level or dynamic factors can be used for this purpose. A quantitative method is proposed, using the dynamic factors of bioaccumulation, biophilicity, translocation, bioavailability, and phytoremediation, to assess the variation in the process of the uptake of CEs by different plants, to evaluate the influence of soil modification on their participation in the plants' metabolism and to perform a quantitative assessment of the efficiency of phytoremediation over a certain period of time. Dynamic factors are used to describe the CEs' uptake by plants in various climate change-affected cases, representing aerogenic (atmogenic) and edaphic CEs' transfer, will be discussed. This method can be used as a screening method before further, more detailed analysis of the plant uptake or as an integral part of the models for climate change's effect on the CE's transfer in the soil–plant system.

Keywords: chemical elements, climate change, dynamic factor method, plant uptake.

Acknowledgements. The author is grateful to her most prominent research guides – her father, Prof. Dr habil. Pranas Baltrėnas, her BSc, MSc and PhD work supervisor – Prof. Dr habil. Donatas Butkus and her postdoctoral mentor – Prof. Dr Arvydas Lietuvninkas.

2nd / 5th topics:
Biodiversity, plant and soil health in a new climate /
Modelling of agriculture, food system, environmental, climate change and European policy issues

Inter-monthly variability of pineapple (*Ananas comosus*, MD2) plant water requirement in Ghana: implications for planting period adjustment

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CROPWAT 8.0 model was used to estimate the water requirement of pineapple for the 2021–2022 cropping period, considering all the months in the year. This was done to ascertain which months in the year have lower irrigation water requirements and where water savings can be made. For the months of December to August, irrigation requirement (mm) of 140, 145.1, 113.3, 110.8, 110.9, 145.9, 107.6, and 114, respectively, was determined at the study site. However, sucker planting in September, October and November has shown requirements (mm) of 72.8, 61.3, and 61.4, respectively, and adjusting the planting calendar to accommodate these months is recommended.

Keywords: crop water requirement, irrigation water requirement, pineapple.

5th topic:
Modelling of agriculture, food system, environmental, climate change and European policy issues

European policy issues and their influence on modernisation of Latvian agricultural sector

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Nowadays, the agricultural sector in the world and especially in European Union is facing major challenges. Farming societies are seeking an appropriate response to global emissions reducing tendences, climate change, economic and political trends in the area. The constant development of regulations creates risks in this area and are high. Therefore, new tools and mechanisms should be considered for implementation. Importance of changes in current way of farming mechanisms is becoming more and more significant.

There is crucial role of European agriculture:

- ✓ providing high-quality food and maintaining food security;
- ✓ the necessity for fair remuneration for farmers, who are often the most vulnerable in the value chain;
- ✓ the importance of sustainability, innovation, and responding to consumer preferences, such as demands for healthy and sustainable food;
- ✓ the resilience of the agri-food sector in facing recent challenges like the pandemic, energy crisis, and the effects of the Russian aggression in Ukraine.

European Funding mechanisms sharpened Latvian farming society providing different projects and programs, financing all modern technologies and machinery. Currently stakeholders in the area are forced to make new approaches, in particular make research, analyse and evaluate digital tools, machinery and technologies, available in the market, its economic effects internally and as well globally, to meet criteria of present agricultural sector developing. This presentation aims to highlight the main issues of agricultural sector, briefly describe the measures needed to correspond with the new regulations as well as gather data of the economic impact of implementing eco-friendly farming techniques for small (up to 10 ha), medium (up to 200–300 ha) and large (1000+ ha) Latvian farmers, how those innovations affect each category. In the end, major goal is to develop a long-term perspective for Latvian agriculture that ensures sustainability, leverages knowledge and technology, and enhances the competitiveness of Europe's food system in correspondence to current European policy issues.

Keywords: European police, modernisation, agriculture.

5th topic:
Modelling of agriculture, food system, environmental, climate change and European policy issues

Source apportionment of diffuse phosphorus losses to the Danish aquatic environment

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While knowledge on the overall phosphorus (P) loading to the Danish aquatic environment is relatively well confounded, much more uncertainty surrounds the individual contributions and their spatial distribution. A targeted and therefore cost-effective reduction of P losses requires knowledge on the mechanisms behind the individual sources, their location, and size to enable the use of adequate mitigation measures. This presentation reports the results of a three-year study on the mapping and quantification of sources to diffuse P losses. The study produced comprehensive new data supplementing existing data as well as developed a number of models. A series of maps have been produced indicating risk areas of P loss to surface water in Denmark. In total, diffuse sources amount to 1327 t P yr^{-1} equivalent of ca. 66% of the overall P loading to the aquatic environment (2021 t P yr^{-1}, average 2014–2018). The study demonstrated that erosion of stream banks is the most important diffuse P source (644 t P yr^{-1}), followed by leaching from cultivated organic soils (326 t P yr^{-1}), and leaching via macropores in minerogenic soils (162 t P yr^{-1}). Phosphorus losses which can be attributed to agriculture amounts to 683 t P yr^{-1}, or 34%.

Keywords: phosphorus, diffuse losses.

FLASH PRESENTATIONS

1st / 2nd topics:
Technological solutions for a cleaner agri-food system
/ Biodiversity, plant and soil health in a new climate

Physiological and genetic reactions of winter wheat to drought under the influence of probiotic microorganisms and calcium

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Climate change is a major challenge to agricultural development and ensuring enough food for a growing world population. For this reason, many models have been proposed in the past that could help plants adapt to drought caused by climate change, but none are sufficient to completely solve this worldwide growing problem. Wheat (*Triticum aestivum* L.) is one the most common and widely used crops in the world. Improving drought stress tolerance in wheat is a very challenging task and more research is necessary, as many countries of the world depend on this crop for food and feed. This work is focused on the influence of probiotic microorganisms in combination with calcium salts on the physiological and biochemical metabolic pathways used by wheat when exposed to drought stress together with the analysis of gene expression levels that contribute to drought tolerance in wheat. The research was carried out in the laboratory under controlled conditions, simulating a prolonged drought from 6 to 18 days. Seedlings were treated with different probiotics (*Bacillus subtilis*, *Lactobacillus paracasei*, and some yeast) separately and in combination with each other in 10^5 CFU ml^{-1} concentrations for seed priming and later in the same concentration for seedling spraying. 70 g m^{-2} $CaCO_3$ or 10 g m^{-2} $CaCl_2$ was added to the soil. Almost all tested compounds improved the prolonged drought tolerance of winter wheat. *Bacillus subtilis* + $CaCl_2$ had the greatest effect in maintaining the leaf relative water content (RWC) and growth parameters close to those of irrigated plants together with lower levels of drought-induced gene expression.

This study showed that using some probiotics in combination with calcium salts can activate the defence reactions of plants in response to drought.

Keywords: drought, *Triticum aestivum*, probiotic microorganisms, calcium.

1st topic:
Technological solutions for a cleaner agri-food system

Possibilities to enhance soil moisture and nutrient retention using air nanobubble-saturated water

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Water scarcity and the need for water management have driven the exploration of innovative irrigation techniques. This study investigates the role of air nanobubble-saturated water (NBSW) in improving soil moisture retention, nutrient retention, and plant growth. Three parallel experiments were conducted using two types of silty loam soils, differentiated by their clay content, and a sandy loam soil, with additional biochar amendments. The results demonstrate that air NBSW can enhance soil moisture retention in sandy loam and silty loam soils with lower clay content. However, it reduces potassium (K^+) input compared to conventional watering while maintaining similar levels of leached substances.

The study revealed that biochar amendments combined with air NBSW significantly reduce total dissolved solids (TDS) losses in silty loam with higher clay content and decrease the leaching of nitrate (NO^{3-}), calcium (Ca^{2+}), and potassium (K^+) from sandy loam soil. Furthermore, air NBSW was found to enhance stomatal conductance in California pepper plants grown in both silty loam and sandy loam soils, although no effect was observed in silty loam with higher clay content. Interestingly, the combination of biochar and air NBSW reduced chlorophyll content and stomatal conductance in a sandy loam soil.

This study highlights the potential of air NBSW to improve water and nutrient management in agriculture, especially when combined with biochar. The findings suggest that air NBSW can be a valuable tool for enhancing soil moisture retention and the integration of air NBSW with biochar amendments presents a promising approach to address water scarcity and improve crop productivity.

Keywords: air nanobubble-saturated water, soil moisture, nutrient retention, biochar amendment, water management.

1st topic:
Technological solutions for a cleaner agri-food system

Sustainable farming practices: harnessing biostimulants for enhanced crop and weed management

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Herbicides are one the most effective means for managing weed competition in agricultural crops. However, overuse of herbicides has led to increased crop productivity at the expense of negative environmental impacts. To address these issues, it is crucial to explore environmentally friendly alternatives to reduce herbicide use in agriculture. This study aims to control oilseed rape and weed growth using an integrated system combining herbicide formulation containing clopyralid and picloram with the microbial biostimulant NaturGel. The study aimed to evaluate the combined effects of the herbicide using the manufacturer's recommended rate and half of the recommended rate, the microbial biostimulant and the combination of both products on the biometrical and biochemical parameters of oilseed rape cultivar 'Visby' and the survival rate of weeds grown under controlled laboratory conditions. The microbial biostimulant had a positive effect on the growth of oilseed rape. In contrast, the recommended herbicide rate reduced the analysed parameters of the oilseed rape plants. However, the combined use of the microbial biostimulant and half the recommended rate of herbicide mitigated the negative effects on the analysed biometrical and biochemical parameters of the oilseed rape plants, demonstrating a synergistic effect. The microbial biostimulant alone had no adverse effect on weed survival, but the combined application of biostimulant and herbicide resulted in the lowest weed survival. The microbial biostimulant promotes the growth and development of the oilseed rape and allows a reduced herbicide uses. Integrating the biostimulant into agrotechnology packages promotes sustainable farming practices by reducing herbicide use, maintaining the vitality of oilseed rape plants and ensuring effective weed control. This approach contributes to environmentally friendly agriculture by increasing crop productivity and minimising adverse effects on the environment.

Keywords: herbicide, microbial biostimulants, sustainable agriculture, environmental physiology, oilseed rape.

1st topic:
Technological solutions for a cleaner agri-food system

The effect of proline, putrescine and DFMA on the response to the increasing low temperature stress in *Brassica napus*

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Rapeseed is one of the oldest and most economically valuable crops, the distribution of which is highly dependent on climatic conditions. Research has shown that the combination and duration of natural phenomena creating autumn-winter conditions are critical for the quality of winter rapeseed's overwintering. This study aimed to investigate the potential of modifying rapeseed's response to cold using growth regulators putrescine (Put), proline (Pro), and difluoromethylarginine (DFMA). In addition, it was aimed to improve the scientific understanding of plant responses to adverse environmental conditions by investigating the effects of increased low-temperature stress on the metabolism of closely related plant stress biomarkers. Winter rapeseed hybrid 'Visby' was used in the study. Acclimated (A) and non-acclimated (NA) plants were used in the study. Both A and NA plants were exposed to increasing cold conditions (IC) at −1°C on the first day and −3°C on the second day. The results showed that treatments with Pro, Put, and DFMA increased proline content under IC conditions. Pro treatment also elevated putrescine and spermidine levels under optimal conditions. Put treatment balanced putrescine levels in both A and NA plants under IC conditions. Pro and Put treatments increased spermine content in A plants. DFMA did not affect spermine or spermidine levels but increased ethylene content under optimal conditions, while Put and Pro decreased ethylene content under the same conditions.

These findings provide new insights into the stress response of plants under specific environmental conditions. Future studies on plant stress mechanisms in different plant species and environmental scenarios are expected to answer fundamental questions and suggest new strategies for crop protection against stress.

Keywords: rapeseed, growth regulators, crop protection, stress response, adverse conditions.

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1st topic:
Technological solutions for a cleaner agri-food system

Valorisation of the little-studied plant species *Desmodium canadense* by evaluating its antioxidant potential

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Botanicals are important sources of bioactives for functional foods and nutraceuticals. *Desmodium canadense* (L.) DC. (common name Canada tick-trefoil) leaves are rich in flavonoids; however, its application is limited due to the absence of more comprehensive studies focusing on plant processing. This study applied high pressure extraction techniques for the recovery of different polarity fractions from *D. canadense* leaves collected at different plant vegetation phases (intensive growing, bud formation, beginning, massive and end of flowering) and evaluating their antioxidant potential. The lipophilic compounds were recovered with supercritical carbon dioxide (SFE-CO_2), the residues were consecutively fractionated by pressurised liquid extraction (PLE) using the increasing polarity solvents, namely acetone, ethanol, and water. The antioxidant capacity of fractions and solid plant material before extraction and after each extraction step was determined by estimating total phenolic content (TPC) and $ABTS^{+\bullet}$ scavenging capacity. The yields of lipophilic fractions were from 0.9 (end of flowering) to 1.4% (massive flowering), the highest yields obtained by PLE were 3.48, 14.80, and 16.54 % with acetone, ethanol and water at intensive growing, massive flowering, and bud formation phases, respectively. Ethanol extracts were the strongest antioxidants with TPC from 16.36 (end of flowering) to 38.63 mg GAE g^{-1} DW (massive flowering) and $ABTS^{+\bullet}$ scavenging from 58.30 to 149.50 mg TE g^{-1} DW (at the same phases). TPC of acetone and water extracts were 3.28–6.32 and 11.0–22.86 mg GAE g^{-1} DW: $ABTS^{+\bullet}$ 13.5–28.4 and 39.0–111.2 TE g^{-1} DW, respectively. In general, ethanol extracts of PLE exhibited higher antioxidant capacity values, while massive flowering and bud formation were preferable phases for the recovery of antioxidants. Hence the best times to collect *D. canadense* are during massive flowering and botanisation phases. At these stages of growth, herbs may contain higher amounts of desirable compounds such as antioxidants or active ingredients, making them more suitable for various applications such as herbal medicine or natural product extraction.

Keywords: *Desmodium canadense*, antioxidant capacity, supercritical carbon dioxide extraction, pressurised-liquid extraction.

1st topic:
Technological solutions for a cleaner agri-food system

Maximum yield potential in the context of sustainability. Is it compatible?

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Farmers increasingly learn to use less and less mineral fertilisers, pesticides and reduce the number of driving through the field, etc. Is it possible to farm sustainably and get high yields? To answer this question, it needed to know the main features of sustainable farming and what determines a high yield. Firstly, the key features of sustainable farming are compliance with the norms of nutritional elements (N, P, and K). Secondly, a 50 percent reduction of the pesticides.

The key factors of high yield are: 1. Crop rotation. It should include as many plants as possible. 2. Selection of stable plant varieties. Stable varieties that have been in the market for many years and have been grown under various conditions should be selected. The selection of varieties is large; therefore, only certified seeds should be chosen. 3. Selection of effective products. Not all products provide a yield supplement. Different products should be tried and find the ones that are useful. 4. Algorithms for different crop technologies. It is very important to apply different technologies algorithms in various crops based on the needs. 5. Smart solutions in adapting to the changing nature.

Nature changes and changes the way crops are grow. Smart solutions are those that are made after evaluating a lot on information based on nature changes. Maximising yield is compatible with sustainable farming, only the main goals mentioned above need to be implemented.

Keywords: sustainability, yield, clean food.

2nd topic:
Biodiversity, plant and soil health in a new climate

Response of psammophytes *Secale sylvestre* Host and *Alyssum desertorum* Stapf to soil flooding

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Understanding the molecular bases of the range of plant resistance becomes especially relevant in connection with the forecasts of global climate changes. Psammophytes are well adapted to a lack of water, on the contrary, waterlogging is not characteristic of them. The question - whether plants of sandy habitats can survive at excessive soil moisture - remains almost unsolved. To study this, two species of annual herbaceous plants grown on sandy soils of the steppe zone of Ukraine - monocot *Secale sylvestre* Host (wild rye, Poaceae) and dicot *Alyssum desertorum* Stapf (desert beetroot, Brassicaceae) were studied. Plants grown from seeds collected in the steppe zone of the Dnipropetrovsk region were subjected to soil flooding. To analyse their systemic response to root hypoxia, plant leaves were used. Relative water content (RWC) and photosynthetic pigments as indicators of the physiological state, the electrophoretic protein spectrum as an indicator of protein homeostasis, proline and stress protein HSP70 involved in protection of cellular homeostasis, alcohol dehydrogenase (ADH) - the key enzyme of anaerobic metabolism, and emission of ethylene, a phytohormone that plays an important role in triggering the adaptive responses of plants to flooding were analysed. It was shown that the reaction of both species included short-term (several days) activation of defence systems and anaerobic metabolism against the background of preservation of the total protein spectrum. However, longer flooding led to activation of ethylene synthesis, a decrease in RWC, content of proline and photosynthetic pigments, which was accompanied by yellowing of leaves and indicates the induction of senescence. Notably, the reaction of *A. desertorum* was more significant compared to *S. sylvestre*. In general, such data suppose that psammophytes have mechanisms capable of ensuring plant survival during short periods of waterlogging.

Keywords: Psammophyte, soil flooding, tolerance limits.

2nd topic:
Biodiversity, plant and soil health in a new climate

Long-term straw management and tillage for climate resilience in agroecosystems sustainability

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The research, conducted at the Vytautas Magnus University Experimental Station since 1999, has been investigating the relationship between plant and soil using innovative nature-based solutions aimed at renewing agriculture and preserving natural resources under climate change. The focus was on two main factors: straw management (removal *vs.* chopping and spreading) and different tillage practices (conventional deep ploughing, shallow ploughing, ploughless tillage, single seedbed discing, and two no-tillage practices, one incorporating cover crops). Our findings reveal that specific combinations of residue management and tillage practices significantly enhance soil organic matter. This increase in organic matter not only improves soil resilience and crop yield but also optimises soil carbon dioxide fluxes, demonstrating potential climate change mitigation within agroecosystems. The study highlights the critical importance of integrating ecological insights into crop and soil management practices to establish sustainable agricultural benchmarks in a changing climate.

The findings of this long-term experiment highlight a significant increase in SOC stocks in all treatments over the 24-year period. Notably, the no-tillage practices, coupled with the spreading of chopped straw, demonstrated the most substantial growth in SOC levels, particularly in the top 0–10 cm soil layer. This trend highlights the effectiveness of reducing soil disturbance and incorporating organic matter in boosting SOC stocks. The different tillage systems influence CO_2 emissions from soil. Initially, direct sowing into uncultivated land, both with and without cover crops, led to a notable reduction in CO_2 emissions compared to conventional ploughing.

Our findings indicate that practices combining straw management with appropriate tillage techniques significantly enhance soil organic matter. This leads to reduced soil CO_2 emissions and improved soil resilience, which in turn contributes to higher crop yields.

These results highlight the potential of adapted agroecological practices to mitigate the negative impacts of climate change on agroecosystems. By boosting soil organic matter and resilience, these practices set a foundation for sustainable agriculture that not only addresses environmental challenges but also supports food security in the face of climatic volatility.

Keywords: soil resilience, plant-soil interactions, sustainable agriculture, climate change adaptation.

2nd topic:
Biodiversity, plant and soil health in a new climate

Green clean-up strategy for the removal of contaminants from water using bacterial isolates as biosorbent

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Water pollution is caused by industry and urbanization. Physical and chemical treatment methods for eliminating impurities from water are environmentally hazardous. Phytoremediation is an efficient method. Floating treatment wetlands (FTWs) are a low-cost phytoremediation technology that can treat wastewater. The current work aims to clean contaminated water by utilising indigenous plants and their associated plant growth-promoting rhizobacteria (PGPR). Plant samples were collected from the bank of the water channel (sub-tropical region) in village Karima, Attock of Pakistan (33°39'04.2" N and 72°42'14.6" E). Plant species such as Cocklebur (*Xanthium strumarium*), Vetiver grass (*Chrysopogon zizanioides*), Parthenium (*Parthenium hystophorous*), Bermuda grass (*Cynodon dactylon*), and Hemp (*Cannabis sativa*) were selected. The PGPR isolates showed positive results for biochemical characterization. Molecular approaches were used to identify strains of *Bacillus cereus, Bacillus altidunis, Stenotrophomonas maltophilia*, and *Acinetobacter schindleri*. Floating treatment wetlands (FTWs) were seeded with Vetiver grass and Bermuda grass. Physicochemical analysis considerably lowered the elimination of heavy metals cadmium (0.0000) > nickel (0.0016) > chromium (0.0117). Water quality metrics revealed a significant decrease in concentration. Using Vetiver grass (*Chrysopogon zizanoides*) and Bermuda grass (*Cynodon dactylon*) with their associated bacteria *Stenotrophomonas maltophilia* in an FTW may be a more viable method for contaminated water treatment.

Keywords: contamination, floating treatment wetland, indigenous plants, phytoremediation, plant growth promoting rhizobacteria.

2nd topic:
Biodiversity, plant and soil health in a new climate

Haplotype diversity and molecular phylogeny within *Alternata* and *Arborescens* lineages from tomatoes

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One of the major limiting factors of tomato (*Solanum lycopersicum* L.) production in temperate climate zone are fungal diseases, including leaf spot caused by *Alternaria* spp. This study is the first report on molecular data implementation in *Alternaria* spp. from section *Alternaria* identification on tomatoes in Northern Europe. The sampling was conducted in greenhouses and high tunnels in three countries (Latvia, Lithuania, and Estonia, respectively). Symptomatic samples were collected from the beginning of August until the end of September in 2022 and 2023, and recovered fungal strains were analysed by integrating phenotypic assays, multi-locus phylogeny, and haplotype analysis. Considerable variation in phenotypic diversity was found for tomato-associated *Alternaria* spp. strains; however, sporulation patterns and conidial morphology did not allow precise identification of all obtained strains to the species level. Small-spored *Alternaria* spp. strains were nonpathogenic to 8-week-old tomato plants and tested negative for the presence of the AAL-toxin biosynthesis gene (ALT1). Initial identification of the fungal strains based on the internal transcribed spacer regions 1 and 2 and intervening 5.8S nrDNA (ITS) confirmed the occurrence of *Alternaria* spp. from section *Alternaria* on symptomatic tomatoes. Further molecular phylogeny based on section-specific markers (ASA-10, putative F-box-domain-containing protein and ASA-19, putative histone-like transcription factor) together with the second largest subunit (rpb2) of RNA polymerase II revealed that fungal strains recovered predominantly alternata and arborescens phylogenetic lineages from the section *Alternaria*, while *A. postmessia* was also identified from symptomatic samples collected in Estonia. *Alternaria* spp. strains analysed in this study were more genetically diverse than expected for the asexual fungi, and occurrence of shared haplotypes and recombination between phylogenetic lineages in section *Alternaria* was reported.

Keywords: multi-locus phylogeny, genetic diversity, *Alternaria* leaf spot, *Solanum lycopersicum* L.

2nd topic:
Biodiversity, plant and soil health in a new climate

Evaluation of apple scab susceptibility in cultivar 'Gala' on ten different rootstocks

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Apple scab (*Venturia inaequalis*) is one of the most prevalent and destructive diseases affecting apple trees, leading to significant crop losses and reduced fruit quality. Effective management of this disease requires not only the application of fungicides but also the use of resistant cultivars and rootstocks. 'Gala' is one of the most popular and widely cultivated apple cultivars in the world. One of the main drawbacks of this cultivar is its high susceptibility to apple scab. Due to its susceptibility to diseases, the cultivar requires regular treatments with fungicides and other protective measures, which increases the costs of its cultivation. 'Gala' was grafted onto ten different rootstocks, including M9, B396, Pūre1, B9, Mark, M7, M26, MM106, B118 and 'Antonovka'. The evaluation of scab occurrence and stage of development on 'Gala' / rootstocks was assessed twice per season, starting in 2020. The degree of disease development was determined visually by assessing each tree individually and using a nine-point scale in the evaluation. Scab severity was compared between rootstock and a cultivar grafted onto the same rootstock. The results of the five-year study showed significant differences in scab resistance between rootstocks and 'Gala' on different rootstocks. The most susceptible rootstocks were B396, M26, B118, and 'Antonovka'. The highest level of infection was observed in 2020 with scores of 6.6 for B396, 3.0 for M26, 3.2 for B118, and 3.4 for 'Antonovka'. In contrast, M9, Pūre1, and B9 rootstocks showed the highest resistance with average infection scores not exceeding 1.0–1.1 in all seasons. The highest resistance of the cultivar 'Gala' was determined with the rootstocks M9 and Pūre1 with average infection scores not exceeding 1.0–1.37 in all seasons. Resistant rootstocks can significantly improve the disease resistance of 'Gala' and while reducing the need for chemical plant protection products.

Keywords: *Venturia inaequalis*, resistance, malus.

2nd topic:
Biodiversity, plant and soil health in a new climate

Predicted changes in distribution and richness of crop wild relatives under climate change scenarios in Northeast Africa

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Crop Wild Relatives (CWR) are wild plant taxa closely related to domesticated crops, playing a crucial role in crop improvement and resilience. However, the impact of climate change on the CWR in Northeast Africa, encompassing Djibouti, Eritrea, Ethiopia, Somalia, and South Sudan, remains largely unknown. This study utilised Species Distribution Modelling (SDM) to assess the potential effects of climate change on 97 priority CWR in the region. Of 4,551 occurrence records collated from global datasets like GBIF, Kew, BEIN, and IUCN, 3,094 were analysed. Predictions were made for the period 2041–2070 over three Shared Socioeconomic Pathways (SSP126, SSP370, and SSP585) using bioclimatic variables from five global circulation models as well as soil and topography. For both current and future climatic conditions, 19 bioclimatic variables were sourced from climatologies at High Resolution for the Earth's Land Surface Areas (CHELSA), 10 edaphic variables from ISRIC–World Soil, and one geophysical variable as a Digital Elevation Model (DEM). To enhance reproducibility, MaxEnt was employed and tuned using the ENMeval package in R version 4.2.3, with calibration based on the Area Under the Curve (AUC) and Continuous Boyce Index (CBI). The results show a significant decrease in habitat suitability for an average of 35 taxa in all three SSPs, including species such as *Citrullus lanatus* L., *Solanum aculeatissimum* Jacq., and *Solanum marginatum* L.f., which are projected to lose all suitable habitats. These findings highlight the great need for targeted conservation and management strategies to preserve these valuable genetic resources for future generations.

Keywords: crop wild relatives, climate change, biodiversity loss, suitable habitats.

2nd topic:
Biodiversity, plant and soil health in a new climate

Genetic diversity of *Pyrenophora tritici-repentis*

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Wheat (*Triticum aestivum*) is the most widely grown crop in Latvia. Tan spot caused by *Pyrenophora tritici-repentis* is the predominant wheat disease in Latvia. The knowledge of pathogen genetic diversity is important to improve wheat breeding programmes over the world. However, the genetic diversity of *P. tritici-repentis* is insufficiently studied in the Baltic Sea region. The aim of this study was to analyse *P. tritici repentis* genetic diversity in Latvia and compare it with populations from other world regions. In this study, 78 isolates from Latvia (n = 57), Belarus (n = 9), The Czech Republic (n = 6), USA (n = 2), Canada (n = 2), Finland (n = 1) and Lithuania (n = 1) were analysed. Sequences of translation elongation factor 1 alpha (tef-1α) gene was used to compare the isolates. Obtained sequences from 78 isolates were compared with available sequences from GeneBank using MegAlign Pro 17. Analysis of tef-1α sequences showed that isolates were mostly uniform, and 72 isolates were identical. Remaining six isolates showed some variation as single nucleotide polymorphisms (SNP) and/or three nucleotide insertions. Isolates with divergence in tef-1α were from Czech Republic (n = 2), USA (n = 2) and Latvia (n = 2). In these isolates some of the SNP's were overlapping, but not identical. Nucleotide insertions of triplet TCT were present in the same position in sequences of four isolates. These results show that there is some variation in *P. tritici-repentis* tef-1α gene.

Keywords: tan spot, tef-1α, *Triticum aestivum*.

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2nd topic:
Biodiversity, plant and soil health in a new climate

Evaluating the effect of liming and manuring on composition and stability of soil aggregates in an acidic soil over 50 years period

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Particle aggregate formation and stability play a critical role in soil health, influencing ecosystem services and sustainability. Organic matter is broken down into binding agents that bind the mineral soil particle to form stable soil aggregates. The study looked at how liming, manuring, and their combination affect soil aggregation and aggregate stability over time. This experiment was initiated in 1949 at the west part of Lithuania, where soil of the experimental site is *Retisol* (texture moraine loam). This study was comprised of four treatments: (T1) Unlimed or naturally acidic soil. (T2) Farmyard manure (FYM) 60 t ha^{-1} (T3) Liming 3.0–3.5 t ha^{-1} (T4) Liming 3.0–3.5 tha^{-1} + FYM 60 t ha^{-1} with three replications. The lime and FYM were applied every 5 years interval. Soil samples were collected from 0–20 cm depth. Soil aggregates were separated into nine fractions by dry sieving and five fractions by wet sieving, and also the mean weight diameter (MWD) of aggregate fractions were calculated. According to the agronomic standard, soil aggregates were classified into four categories using sieves of different mesh sizes: macroaggregates, mezoaggregates, microaggregates, and silt clay fraction. The results indicated that (when the soil was treated with lime in combination manure), 32.81% increase in macroaggregates, 21.47% reduction in mezoaggregates, and 34.70% reduction in microaggregates, and 33.15% reduction in silt clay fraction, respectively, compared to control. Meanwhile, water stable aggregate fraction (WSA, 0.25 mm) and MWD show the same tendency T4 showed the maximum increase in water stable aggregate and MWD (18.59% and 22.30%), which was followed by T3 (13.48% and 12.60%) and T2 (10.29% and 5.60%), respectively, compared to control. It was concluded that in a naturally acidic soils lime combined with FYM promotes the formation of macroaggregates and stable aggregates better than lime or FYM alone.

Keywords: soil aggregates fractions, organic amendments, WSA, MWD.

2nd topic:
Biodiversity, plant and soil health in a new climate

Impact of cereal / legume intercropping system on physical cereal root parameters and C sequestration

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Plant roots are central to the function of natural and agricultural ecosystems by driving plant acquisition of soil resources and promoting organic carbon inputs in the soil, which facilitates long-term C storage in agroecosystems. Root characteristics like length, diameter, and volume are critical to measure to understand plant and soil functions. Crops with optimised root traits are considered an important determinant of future food security that improves farm productivity and sustainability. The idea of this experiment is to use the stable isotope technique, which is mature-safe technology, to determine net annual C inputs in cereals/ legume intercropping system, moreover, follow their biological fate and turnover, allowing us to maximize root derived C storage, persistence in relation to specific root traits and functions. The field study experiment was conducted in the Lithuanian Research Centre for Agriculture and Forestry, Akademija, Kėdainiai district (55°23′50″ N, 23°51′40″ E) in the organically managed cropping system in 6 treatments: two monocultures (spring barley and oat) and two compositions with legume intercropping (field pea and red clover) in four replications. ^{13}C and ^{15}N production will be measured in the Isotopic Research Laboratory at the Centre for Physical Sciences and Technology. During the growing season of 2024, the specific root length of spring barley and oats in all samples ranged from 84.88 to 107.61 m g^{-1} and from 104.57 to 140.31 m g^{-1}, respectively. The root tissue density of spring barley and oats in all samples ranged from 0.396 to 0.464 g cm^{-3} and from 0.357 to 0.399 g cm^{-3}, respectively. In average, among all samples, specific root length of spring barley was 29% higher and tissue density 13% lower than oat. Significantly higher specific root length was found in the treatments with red clover intercrop.

Keywords: barley, oat, root system architecture, ^{13}C isotope.

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2nd topic:
Biodiversity, plant and soil health in a new climate

Growth and spectral response of northern and southern forage cultivars under variable temperature regimes

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Climate change is increasingly affecting agricultural systems, impacting the productivity and digestibility of forage crops that are essential for livestock feed. Understanding how forage crops respond to temperature is crucial for optimising growth and nutritional value. Remote sensing technologies are promising tools for monitoring plant health and predicting forage quality. As part of the project UPSCALE, this study investigates the growth and spectral response of Northern and Southern cultivars under different temperature regimes. Two red clover ('Gandalf' from Norway and 'Vytis' from Lithuania) and two timothy ('Noreng' from Norway and 'Jauniai' from Lithuania) cultivars were grown at controlled temperatures of 12, 15, and 18 °C. A total of 168 pots (10L, ~30 plants per pot) were maintained in climate-controlled chambers at The Climate Laboratory, UiT, Tromsø. Plant growth was monitored using the PlantEye F600, providing 3D models, biomass, height, leaf area index, and stress indices (NDVI, NPCI, PSRI). Destructive sampling was conducted at three stages: pre-flowering, post-flowering, and at the end of the experiment. Leaves were scanned using Specim FX10e (VNIR) and FX17e (SWIR) hyperspectral cameras before drying for chemical analysis. The results showed significant growth differences between the cultivars. Clovers increased in height and biomass with rising temperatures, though 'Gandalf' consistently yielded less biomass. Timothy 'Jauniai' followed a similar trend to the clovers, while cultivar 'Noreng' had optimal growth at 15°C. Spectral indices did not reveal significant contrasts; ongoing hyperspectral analysis may provide further insights. The upcoming chemical analysis will integrate with hyperspectral data to identify lignin signatures for assessing forage digestibility. These findings contribute to a deeper understanding of how forage crops respond to temperature variations, to select cultivars with optimal growth and digestibility in the face of climate change.

Keywords: climate change, remote sensing, forage crops, growth, digestibility.

2nd topic:
Biodiversity, plant and soil health in a new climate

Impact of green manure mixtures on winter wheat yield in organic farming

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Interest in green manure cultivation is steadily increasing on organic farms, as this practice not only improves soil fertility but also possibilities to improve crop yield. The study aims to determine the most suitable mixture of green manure by evaluating economic factors, green biomass yield, and its influence on winter wheat yield in organic fields in different parts of Latvia, taking into account varying meteorological conditions. Data for green manure mixtures were collected from the field experiments conducted over two years (2022–2023) in four locations - the "Geidas" farm in the Kurzeme region, the "Gaikeni" farm in the Vidzemes region, the "Mazbungas" Ltd in the Zemgales region and the "IRGK Serviss" Ltd in the Latgale region of Latvia. Three different mixtures were compared with a control (black fallow): oats-mustard-rapeseed oil-buckwheat (non-legume), oats-buckwheat-peas (legumes below 50%) and oats-lupine-vetch (legumes above 50%) in 2022 and 2023. The green manure mixtures were grown in 0.3 ha plots. The economic data of green manure mixture cultivation were collected for 2022 and 2023 to evaluate the gross margin calculation per 1 ha of each farm field trails. Data were collected on the activities performed for one green manure variant in each farm's field and the yield of the following crop winter wheat (*Triticum aestivum*). In "Mazbungas" Ltd and "IRGK Serviss" Ltd, the green biomass yield of green manure mixtures depended on the year. "Gaikeni" farm identified the most suitable mixture with a significantly ($p < 0.05$) higher green biomass yields non-legume and with legumes below 50%. "Geidas" farm had a significantly ($p < 0.05$) higher yield for the green manure mixture with legumes below 50% with an average yield of in both years. The study found tendency that mixtures with legume content above 50% were characterized by higher nitrogen levels in the aboveground biomass but significantly ($p < 0.05$) lower green biomass yield. However, these mixtures resulted in a significantly higher ($p < 0.05$) percentage increase in winter wheat yield compared to the control, consistently observed in both years and across all farms. The difference between the income and expenses for the mixtures and obtained wheat yield in each farm is significantly.

Keywords: green manure mixtures, biomass yield, wheat yield, economic factors.

Funding. The study was conducted as part of the project "Demonstration of green manure effectiveness for ensuring soil fertility in organic farming," funded by the European Agricultural Fund for Rural Development of the Ministry of Agriculture, project No. 22-00-A00102-000003.

2nd topic:
Biodiversity, plant and soil health in a new climate

Effect of soil tillage system on soil microbiological activity

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No-tillage farming is increasingly adopted across Europe and globally, as it helps reduce soil carbon emissions and supports agricultural sustainability. Sustainable agriculture hinges on practices that protect the environment, such as minimising fertiliser use. However, maintaining productivity requires careful attention to natural processes, particularly the activity of soil microorganisms, which play a crucial role in soil health. In Latvia, there is a scarcity of research on how reduced tillage intensity affects soil microbial activity. The aims to evaluate the impact of different soil tillage systems on soil biological activity. The experiment was conducted in a production field at SIA "SL Ideju darbnīca" in Vitrupe, Limbaži municipality, Viļķenes parish. A two-factor experiment was designed, with Factor A representing the tillage system and Factor B representing soil depth. Soil samples were analysed to determine soil respiration rates using titration of the released CO_2 and to estimate soil microbial biomass via the substrate-induced respiration. The activity of dehydrogenases (DH) and hydrolytic enzymes (FDA) was also measured. In addition, plant growth, weed incidence, and crop yield were compared under different soil treatments. The results revealed that soil microbial activity fluctuates throughout the growing season, influenced by external environmental factors. Significant variations in microbial biomass were observed between different tillage treatments and sampling times, with the highest biomass recorded mid-season. Notably, soil respiration rates, indicative of microbial activity, peaked in the minimum tillage system, reaching up to 5.30 mg CO_2 $100g^{-1}$ h^{-1} in the first year. Hydrolytic enzyme activity was higher under conventional tillage, particularly before harvest. These findings suggest that tillage practices significantly affect soil processes and microbial activity. However, to make more precise conclusions about the long-term effects of tillage systems on soil microorganisms, further research is needed.

Keywords: reduced tillage, conventional tillage, no-tillage, soil enzymes.

Funding. The research has received funding from the EU Horizon 2020 Research and Innovation programme under the grant agreement No. 101000371.

2nd topic:
Biodiversity, plant and soil health in a new climate

Carbon dioxide emissions with conventional nitrogen fertilisation and impact on soil fertility by burning waste in wheat production in Baja California, Mexico

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Greenhouse gas (GHG) emissions in agricultural soils are associated with soil management, plant cover, removal or burning of crop residues that reduce nutrients and organic matter, with deterioration and loss of soil fertility, in addition to fertilisation practices, which impact crop yield as well as nitrous oxide and carbon dioxide emissions. However, the magnitude and rate of these processes varies depending on the agricultural practices in each crop and region. The objective of this study was to evaluate the CO_2 emission rate and its relationship with the nitrogen (N) fertilisation dose as well as the variation in soil chemical fertility due to the effect of burning crop residue in wheat crops under conventional management in the Mexicali Valley, Baja California, Mexico. The experiment was carried out in two stages: 1) The evaluation of the CO_2 emission rate was carried out in an experimental plot cultivated with wheat (winter), with three doses (0, 200, and 400 kg ha^{-1}) of N fertilisation. Soil samples were collected from each treatment (30 cm) at each fertilisation, incubations were performed under controlled temperature and humidity conditions (30°C and humidity at field capacity). Readings were taken at 4, 22, 46 and 142 hours, the magnitude of CO_2 emission, the accumulated trend of CO_2 with respect to time were obtained and the mathematical equation with the best fit was obtained; 2) The evaluation of soil fertility by the effect of burning crop residue was carried out with soil sampling at 30 cm from 26 plots, the pH, electrical conductivity (EC), N, P, MO and CO of the soil were evaluated. The CO_2 emission was higher ($p > 0.05$) with the application of 400 kg ha^{-1} N, with a magnitude of 225 to 291 mg g^{-1}, at an emission rate of 48.464 mg CO_2 g h^{-1}. Burning wheat straw reduced the content of OM, CO and P ($p > 0.05$), which affects soil fertility and the environment.

Keywords: greenhouse gases, agricultural production, cereals, degraded soils, *Vertisol*.

2nd topic:
Biodiversity, plant and soil health in a new climate

Calcium effect on lettuce *Alternaria* spp. growth *in vitro*

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Investigations of the relationship between two important plant sciences of nutrition and pathology find a better understanding of macro-, micro-, and beneficial nutrients' role in plant diseases and activating host defence responses. The leafy vegetable growth in different nutrition conditions influences postharvest shelf-life and prolonged postharvest storage. This study aimed to identify the effect of different calcium (Ca) levels on lettuce *Alternaria* spp. pathogenicity. The lettuce was grown hydroponically with different levels of calcium nutrition at concentrations of 40, 80, and 120 ppm Ca. *Alternaria* spp. pathogenicity carried out *in vitro* on detached lettuce leaves at harvest. The *Alternaria* spp. 5 mm mycelium disk placed in the centre of detached lettuce leaves in Petri with filter paper with 5 ml ddH_2O. Incubated 22°C in darkness and assessed after 2, 4, and 7 days after artificial infection (DPI). The results revealed that *Alternaria* spp. did not grow at all nutrition levels of Ca at 2 DPI. The lowest pathogen growth was at rates 80 and 120 ppm of Ca at 4 and 7 DPI. The rate of 40 ppm Ca slightly promoted the growth of the pathogen at 4 and 7 DPI. Based on these preliminary results, it can be assumed that the Ca concentrations affect *Alternaria* spp. growth.

Keywords: lettuce, calcium, concentration, growth.

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2nd topic:
Biodiversity, plant and soil health in a new climate

Soil properties and wheat productivity in the headlands and non-compacted field in two different soil types

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The use of heavy machinery, especially when the soil is wet, often compacts the soil in headland, which can degrade soil conditions and ultimately reduce yields. Studies of compacted headlands are important not only to assess the extent of the problem, but also to find solutions for sustainable use of such areas and mitigation of soil compaction. The aim of the study was to evaluate soil parameters in compacted headland and cultivated field as well as their influence on wheat yields in two soil regions in Lithuania in 2022–2023. Experiments were conducted with winter and spring wheat in Akademija, Kėdainiai district (Central part) and with winter wheat in Vėžaičiai, Klaipėda district (Western part). According to WRB, the soil in Central Lithuania is classified as *Endocalcari-Epihypogleyic Cambisol* and in the Western Lithuania as *Bathygleyic Dystric Glossic Retisol*. Soil texture in both experiments was indicated as a loam soil. Soil texture, organic C, total N, bulk density and total porosity, were measured in 0–10, 10–20, and 20–30 cm soil layer in 2022 and throughout the whole profile down to100 cm in 2023 (every 10 cm depth), penetration resistance down to 80 cm (every 1 cm), above ground biomass, wheat grain productivity was also evaluated. All measurements were performed in 5 replications in 2022 and 3 replications in 2023 in the headland and non-compacted field area. The results obtained in both experiments and in both years showed that the values of the soil physical and chemical parameters describing the soil condition were essentially worse within the soil profile in the headland than in the mid-field. Soil bulk density in the headlands exceeded the critical limit of 1.65 Mg m^{-3} within the whole profile, while in the cultivated field it was below the limits down to 50 cm in *Cambisol* and to 40 cm in *Retisol*. Soil organic C and total N tended to decrease in headland compared to non-compacted field in both locations, while C/N in *Retisol* was significantly lower in 20–50 cm soil layer. Such conditions affected the wheat grain yield, which decreased by 9% (spring wheat) and 12% (winter wheat) in *Cambisol* and by 13% to 31% (in 2022 and 2023, respectively) in *Retisol*, when compared grain yield in compacted headland to non-compacted field.

Keywords: soil compaction, bulk density, organic C, total N, grain yield.

Funding. This study was funded by the EU Horizon 2020 Research and Development programme via the SoilCompaC project, grant No. 862695.

2nd topic:
Biodiversity, plant and soil health in a new climate

Weed control perspective in the context of sustainable agriculture

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Weed competition reduces wheat yields and profitability slows harvest and may serve as hosts for insects or diseases. With the changing climate and applied technologies, new problematic weed species appear in Lithuania, the control of which is often problematic and ineffective. With reduced tillage, big part of cereals in crop rotations annual monocotyledonous weeds and some dicotyledonous, especially *Stellaria media*, become very significant in winter cereals. Weeds are usually controlled by herbicides as the cheapest and simplest means of weed control. Due to over-reliance on this mean, herbicide resistance is a growing problem worldwide.

Without effective weed control, an even greater spread of weeds is likely, which could reduce production efficiency and lead to improper use of chemical means, which not only does not achieve the expected result, but also pollutes the environment. Crop competitiveness could be one of several measures of cultural weed control, which is very important in integrated weed control.

In 2018–2023, in the Central part of Lithuania, field experiments were conducted at the Institute of Agriculture, LAMMC to test winter wheat weed control measures: plant stand density, sowing delay and the use of herbicides. The soil of the experimental site was *Endocalcari-Endohypogleyic Cambisol*.

It could be concluded, that sowing delay may allow the use of a preplant tillage operation to control early emerging weeds and for the reducing of crop – weed competition three weeks sowing delay of winter wheat could be effective implement. In winter wheat crop with delayed sowing chemical weed control was more effective compared to early sowed crop. Winter wheat population density influenced plant competition for water and nutrients and crop shading effects on weeds. Higher crop population density was more competitive with weeds than lower.

Keywords: weed competition, herbicide resistance, reduced tillage.

2nd topic:
Biodiversity, plant and soil health in a new climate

Relationship between soil carbon pools and aggregate stability under no-till and diversified agricultural management practices

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The relationship between soil structure and the ability of soil microbiome to stabilize soil organic matter is a key element in soil carbon (C) dynamics. Water extractable organic carbon (WEOC) pool can be considered as prompt indicator of soil organic matter dynamic, as respiration substrate for soil microbial biomass. Therefore, the study aimed to validate the established correlation between the water stable aggregates (WSA, %), soil organic carbon (SOC, %), WEOC (g kg^{-1}), and soil microbial biomass C (SMBC, µg g^{-1}) in bulk soil and various soil aggregates (fine: 0.25–1 mm and coarse: >1 mm) under no-till and diversified practices under different environmental conditions at experimental sites in Italy (S1-CREA), Spain (S2-INIA-CSIC), and Lithuania (S3-LAMMC). Soil samples were collected from 3-blocks with three sub-replications in two no tillage treatments: T1 – no crop diversification (no-Div) and T2 – crop diversification (Div). At S1, Div was based on wheat + vetch cover crops in-between apricot tree rows, at S2 – on the wheat-vetch-barley rotation, and at S3 – on Persian clover cover crop grown after oilseed rape. The content of SOC was determined according to the Nikitin-modified Tyurin method, WEOC – by the IR detection method after UV-catalysed persulphate oxidation, SMBC – by the chloroform fumigation extraction method.

Positive and significant correlations were found between all variables tested. As expected, a strong correlation (r > 0.8**l) was found between SOC and WEOC in bulk soil and as well as in coarse and fine aggregates. Interestingly, SMBC strongly correlated with WSA (r = 0.87**l), SOC and WEOC in bulk soil (r = 0.67**l and r = 0.62**l, respectively). Highest WSA correlations were found with SOC in fine aggregates (r = 0.73**l) and WEOC in bulk soil (r = 0.69**l).

This study emphasises the complex relationship between soil structure, microbial biomass, and carbon cycling under different environmental conditions and agricultural practices. The strong correlations observed between SMBC, WEOC, SOC, and WSA highlight the critical importance of soil organic matter stability in regulating soil carbon processes. Integrated agricultural management strategies are essential for improving soil carbon dynamics in response to these findings.

Keywords: soil aggregate stability, soil microbial carbon, soil organic carbon, water extractable organic carbon.

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5th topic:
Modelling of agriculture, food system, environmental, climate change and European policy issues

Comprehensive analysis of the effect of renewable energy on the stability of the environment

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This work represents a review of the effect of renewable energy on the stability of the environment through generating clean energy with no greenhouse gas emissions and lowering some types of air pollution by using comprehensive analysis of the processes such as consumption and production. It aims to audit the research articles in addition to the aspects and opinions to scrutiny and handle the challenges. Besides, creating an extensive vision aimed at completing research development by analysing the published papers, patents, and industrial designs in this field. Furthermore, this present study aims to highlight on the efficient energy conversion systems, sources of greenhouse gas emissions as an attempt to reach an optimal solution to preserve the environment and climate through modern technologies. Renewable energy has unstable and indirect performance due to changing of the climate in the current era. The unstable characteristics lower the popularisation and use of renewable energy resources. According to the energy consumption analysis and studies of management system refer to the generation of photovoltaic power and wind power capacity data are predicted accurately by multiple models, which are combined with an optimal control solution equation to manage it scientifically with high efficiency. Also, the output of generating solar energy, wind power, or photovoltaic power can be flexibly selected and applied to the maximum extent. On the other hand, the energy consumption cost is minimised. So, the utilisation efficiency of renewable energy sources by electricity will be improved and will significantly contribute to improving the capacity of green energy and the reduction of environmental pollution.

Keywords: renewable energy, solar energy, optimisation of energy resources, climate change, sustainability, environmental pollution.

5th topic:
Modelling of agriculture, food system, environmental, climate change and European policy issues

A database for Nordic Baltic sustainable food systems

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In the framework of a recently launched the Nordic Joint Committee for Agricultural and Food Research (NKJ) sponsored project entitled "A Nordic Baltic framework for sustainable food systems", partners are trying to lay the basis for a theoretical framework that could help establishing the first database on sustainable food systems at Nordic and Baltic level. The sustainable food systems database will take inspiration from the FAO Food System Dashboard (FSD), which is currently used to define and describe food systems by summarizing the drivers, components, and outcomes of food systems. The FSD depicts three components of food systems: food supply chains, food environments, and individual factors, that are interrelated but lacks sustainability components. Based on this, the project partners aim to add sustainability indicators to the already existing FSD 275 indictors and create a specific model that could benefit a large audience of policy makers, practitioners and researchers. The scope of potential action to promote sustainable food systems is large. The actions represented in the Sustainable Food Systems Database are supposed to provide solutions for food system across production, supply chain, food environment and policy.

Keywords: sustainable food system, database, Nordic and Baltic countries.

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