

5^{for} ISAF 2025

INTERNATIONAL SYMPOSIUM
AGRICULTURE AND FOOD

8–10 October 2025

Book of Abstracts



Organized by:
Faculty of Agricultural Sciences and Food - Skopje,
Ss. Cyril and Methodius University in Skopje





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The Faculty of Agricultural Sciences and Food-Skopje is organizing the **5th International Symposium for Agriculture and Food (ISAF-2025)**, which offers a possibility for presenting novel and fundamental advances in the field of sustainable agriculture and food production. ISAF 2025 will bring together and foster the communication among leading researchers, engineers and practitioners with an aim to share their scientific ideas and experiences with all actors in the agricultural sector. Since 2012, the International Symposium for Agriculture and Food is integrating the previous organized events: Faculty-Economy Meeting, Symposium of Viticulture and Wine Production, Symposium for Vegetable and Flower Production and International Conference of the Association of Agricultural Economists of the Republic of North Macedonia.

EVENTS WITHIN ISAF 2025

- 41st Faculty-Economy Meeting
- 14th International Conference of the Association of Agricultural Economists of the Republic of North Macedonia (AAEM)
- Meeting of the Association of Faculties of Agricultural Sciences of South Eastern Europe
- 10th Balkan Animal Sciences Conference BALNIMALCON 2025
- General Assembly of Agro-Well – Horizon Europe Project
- Beyond the leaf: Innovation, Research & Regulation - Philip Morris Panel Discussion
- Biobased Technologies for Climate-Resilient Farming: The DIVAGRI Project Approach
- AgriFood Business x EDIH: Innovate, Connect, Transform

SCIENTIFIC AREAS OF ISAF 2025

The topics of ISAF 2025 are divided into the following scientific sections:

- Animal Biotechnology & BALNIMALCON 2025
- Agricultural Economics
- Agricultural Machinery and Sustainable Agriculture
- Apiculture
- Phytomedicine - Plant Protection
- Food Quality and Safety
- Fruit Growing, Viticulture and Wine Production
- Vegetable, Flower and Decorative Plants Production
- Digital Agriculture & Natural Resources Management
- Field Crop Production
- Genetics, Breeding and Genetic Resources

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PLENARY SPEAKERS



Prof. Dr. Dragi Dimitrievski, Faculty of Agricultural Sciences and Food-Skopje, North Macedonia

Title: From Support to Resurgence – A Vision for the Macedonian Agri-Food Sector

Prof. Dr. Dragi Dimitrievski is a full professor at the Institute of Agricultural Economics at the Faculty of Agricultural Sciences and Food-Skopje, University Ss. Cyril and Methodius in Skopje, and a former Vice-dean for sciences (2003–2005) and former Dean of the Faculty (2009–2017). His research interests and contributions include applied macro-economic analysis in the field of agriculture, with focus on agricultural and rural development policy. Dr. Dragi Dimitrievski is key national expert for agricultural policy and has been actively involved as researcher in different national and international projects related to agricultural and rural development policy analysis. For almost two decades, he is national expert within the Regional Rural Development Standing Working Group in South Eastern Europe (SWG). Dr. Dragi Dimitrievski is regularly being consulted on different important issues regarding the agricultural economics, so as a leader of various national projects, he contributed to development of significant number of strategic and legal documents regarding agricultural policy and rural development. His contribution is especially evident during the food crises due to the Covid-19 and the war in Ukraine, both as support to the policy makers, but also to media to update the public with reliable and thorough information regarding food security issues. All his knowledge and experience in this field he transfers to students through courses in Agricultural Policy that he lectures at all three study cycles, as well as in the course Human Resources Development on the undergraduate studies. Dr. Dragi Dimitrievski has published more than 100 articles in academic journals and international conference proceedings, as well as chapters in different monographs and two textbooks in the field.

PLENARY SPEAKERS



Prof. Dr. Cecilia Costa, CREA, Italy

Title: The most essential of all agricultural activities: apiculture

Dr. Cecilia Costa holds a degree in Agricultural Science and a PhD in Agricultural Biotechnologies. She is a Principal Researcher at CREA, the Italian Agricultural Research Council, where she has led research for over two decades on honey bee breeding and the biodiversity of *Apis mellifera*. Her work emphasizes disease resistance, genotype–environment interactions, and colony health and welfare. Dr. Costa is an active member of the COLOSS Association for the prevention of honey bee colony losses and currently coordinates an EU Horizon project. She has authored approximately 70 scientific publications and is a frequent invited lecturer at national and international apicultural and scientific events.



Prof. Dr. Hossein Azadi, Department of Geography, Ghent University, Belgium

Title: Tipping Points and Resilient Agriculture: How Climate-Smart Agriculture Can Support Small-Scale Farmers

Prof. Dr. Hossein Azadi obtained his first PhD in agricultural economics and the second in human geography. He is currently a professor at Ghent University in Belgium. He has published about 500 journal articles with +13000 citations and h-index of 60 underscoring him as top 3% global scientist ranked by AD Scientific index. His main focus is on land governance, the impacts of climate change on small-scale farmers, and agroecology. He is a member of the editorial boards in Land Use Policy, Land Degradation & Development, Agroecology and Sustainable Food Systems, and Climatic Change. He also serves as a research project evaluator for several international councils and organizations.

PANEL DISCUSSIONS

1. The Role of Innovation and Technology in Climate Change Adaptation in Agriculture

Moderator: Prof. Dr. Vjekoslav Tanaskovikj

Prof. Dr. Zdenko Loncaric, Faculty of Agrobiotechnical Sciences, Josip Juraj Strossmayer University of Osijek, Croatia

Prof. Dr. Hossein Azadi, Department of Geography, Ghent University, Belgium

Prof. Dr. Ordan Cukaliev, Faculty of Agricultural Sciences and Food-Skopje, North Macedonia

Prof. Dr. Mirela Kajkut Zeljković, Institute of Genetic Resources of University of Banja Luka, Bosnia and Hercegovina

Mr. Boban Ilic, SWG

2. From Farm to Global Market: Rethinking Agri-Food Trade

Moderator: Neda Gruevska

Prof. Dr. Ruzica Loncaric, Faculty of Agrobiotechnical Sciences, Josip Juraj Strossmayer University of Osijek, Croatia

Prof. Dr. Vlade Zaric, Faculty of Agriculture, University in Belgrade, Serbia

Prof. Dr. Bozidar Ivanov, Institute of Agricultural Economics, Sofia, Bulgaria

Dr. Ljupco Veleski, Vitaminka AD Prilep, North Macedonia

Sinisha Stefanovski, LK Raspberry DOOEL, North Macedonia

GENERAL PROGRAMME OF ISAF 2025

Date and Time	Programme	Hall
Day 1: 8 October 2025		
09.00–17.30	Registration of participants	Lobby
09.15–15.00	General Assembly of Agro-Well – Horizon Europe Project	Banket
16.00–17.30	Meeting of the Association of Faculties of Agricultural Sciences of Southeast Europe	Banket
18.00–19.00	Opening Ceremony	Biljana
19.00–19.30	Plenary Session 1	Biljana
19.30–21.30	Welcome Reception	Lobby
Day 2: 9 October 2025		
09.00–10.00	Plenary Session 2a & 2b	Biljana
10.00–10.30	Coffee Break	Lobby
	Parallel Sections 1	Biljana, Car Samoil, Kaneo, Ohrid, Labino, Banket
10.30–12.00	Beyond the leaf: Innovation, Research & Regulation - Philip Morris Panel Discussion	Car Samoil
12.00–12.30	Coffee Break	Lobby
	Parallel Sections 2	Biljana, Car Samoil, Kaneo, Ohrid, Labino, Banket
12.30–14.00	AgriFood Business x EDIH: Innovate, Connect, Transform	Green
	Biobased Technologies for Climate-Resilient Farming: The DIVAGRI Project Approach	Banket
14.00–15.00	Lunch	
15.00–16.00	Panel Discussion 1	Biljana
16.00–16.30	Coffee Break	Lobby
16.30–18.00	Parallel Sections 3	Biljana, Car Samoil, Kaneo, Ohrid, Labino, Banket
20.00	Gala Dinner	

Date and Time	Programme	Hall
Day 3: 10 October 2025		
09.00–10.00	Panel Discussion 2	Biljana
10.00–10.30	Coffee Break	Lobby
10.30–12.00	Parallel Sections 4	Biljana, Car Samoil, Kaneo, Ohrid, Labino, Banket
12.00–12.30	Coffee Break	Lobby
12.30–13.45	Parallel Sections 5	Biljana, Car Samoil, Kaneo, Ohrid, Labino, Banket
13.45–14.00	Closing Ceremony	Biljana
14.00–15.00	Lunch	
15.00–18.00	Excursion (optional)	
15.00	Departure of participants	

BOOK OF ABSTRACTS BY THEMATIC SECTIONS

ANIMAL BIOTECHNOLOGY & BALNIMALCON 2025

ID: 115 / SES-P-ABB-04: 2

Abstract Submissions

Poster Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: cattle breeding, beef production, SEUROP classification, conformation, fat covering

BOVINE CARCASSES CLASSIFICATION AT DUAL-PURPOSE ADULT CATTLE

Nikola Stolic¹, Bratislav Pešić¹, Violeta Rakic¹, Aleksandar Klincharov², Borislav Radevski², Gjoko Bunevski²

¹Toplica Academy of Applied Studies, Department of Agriculture and Food Technology Studies Prokuplje, R. of Serbia, Serbia; ²Faculty of Agricultural Sciences and Food, Skopje, R. of N. Macedonia; nikola.stolic@gmail.com

Carcasses of adult bovine animals are classified by assessment of conformation (six classes: S, E, U, R, O and P) and fat cover (five classes: 1, 2, 3, 4, and 5). Cattle conformation is a visual assessment of the overall shape and flesh coverage of the carcasses. To be given an E and S classification, the carcasses must have excellent conformation and must have no defects of its essential parts.

According to the new Law of zootechnics and Law for quality of agricultural product in R of Serbia and R of N. Macedonia, the estimation of bovine carcasses by conformation and fat covering according SEUROP standards are made in Strumica region. According to our investigations of 38 adult bovine carcasses from dual-purpose cattle breeds, most of controlled bovine carcasses belong to R, O and P class by conformation, and between 2 and 4 class by fat covering of carcasses.

ID: 117 / SES-P-ABB-04: 13

Abstract Submissions

Poster Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: day-old chicks, selenium, egg yolk, length, growth.

THE EFFECTS OF ORGANIC SELENIUM ON THE GROWTH OF DAY-OLD CHICKS

Bratislav Pesic¹, Nikola Stolic¹, Nebojsa Zlatkovic¹, Aleksandra Jevtic¹, Gjoko Bunevski², Dragoslav Kocevski²

¹Toplica Academy Prokuplje., Serbia; ²Faculty of Agricultural Sciences and Food, Skopje, R. Of Macedonia; batta.pesic@gmail.com

The biological function of selenium, which is used in poultry nutrition, comes to the fore only when it is incorporated into selenoproteins. The microelement Selenium, which occupies an active place in glutathione peroxidase (GSH-Px), has the role of defending the cellular system from damage caused by the action of oxygen, improving the immune status of animals, and increasing the production characteristics of chickens. Here, we observe the effects of organic selenium on the presence of selenium in egg homogenate with the addition of 0.30 mg/kg of inorganic selenium, 0.03 mg/kg of organic selenium, and a mixture of organic and inorganic selenium of 0.30 mg/kg (0.15 + 0, 15) to determine the optimal concentration of selenium in eggs and its essential importance on the number of incubated eggs and the quality of hatched chicks. The study found that the presence of selenium in eggs had a positive effect on embryo growth and the length of incubated day-old chicks, which was statistically proven by measuring and comparing experimental (O1) and control group (K), and confirmed that experimental (O1) chicks were longer by 0.69 cm compared to control (K) chicks. This confirmed that the use of organic selenium was rational and had a positive effect on the quality of breeding eggs and the length of incubated day-old chicks.

ID: 138 / SES-O-ABBC-03: 2

Abstract Submissions

Oral Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: layers, pH, water holding capacity, cooking loss, tenderness

EFFECT OF THE LAYING HENS' GENOTYPE AND REARING SYSTEM ON THE SELECTED MEAT QUALITY PARAMETERS

Simeon Rakonjac¹, Snežana Bogosavljević-Bošković¹, Vladimir Dosković¹, Zdenka Škrbić², Miloš Lukić², Veselin Petričević², Milun D. Petrović¹

¹University of Kragujevac, Faculty of Agronomy in Čačak, Serbia; ²Institute for Animal Husbandry, Beograd-Zemun, Serbia; simeonr@kg.ac.rs

Laying hen meat at the end of the production cycle has low organoleptic and sensory qualities, and for that reason it is not readily consumed and is mostly used as a raw material for the meat industry. As a result, the majority of the research that is now available focuses on the quality of broiler meat, whereas the meat of laying hens has less information. This study aimed to investigate the selected breast and drumsticks meat quality parameters (pH, water holding capacity - WHC, cooking loss - CL and tenderness) of different genotypes (Isa Brown and New Hampshire) and rearing systems (organic and floor) of laying hens at the end of the production cycle. The breast meat of Isa Brown had higher pH, WHC, CL and tenderness compared to New Hampshire hens ($p \leq 0.05$), while the rearing system had no significant effect on these traits ($p \geq 0.05$). It is important to note that a significant interaction of the examined factors was recorded for the pH of breast meat ($p \leq 0.05$). There was no significant effect of any of the factors on the pH and CL of drumstick meat ($p \geq 0.05$). Drumstick meat from Isa Brown had higher WHC compared to New Hampshire hens ($p \leq 0.05$). There was also a significant interaction of the examined factors on drumstick meat tenderness ($p \leq 0.05$).

ID: 147 / SES-P-ABB-04: 15**Abstract Submissions****Poster Presentation***Topics:* Animal Biotechnology & BALNIMALCON 2025*Keywords:* Animal feed, by-product utilization, fish silage, fish waste**USING OF FISH WASTE SILAGE IN ANIMAL NUTRITION****Farahuddin Larghani, Hasan Ersin Samli**TEKİRDAĞ NAMIK KEMAL UNIVERSITY, Türkiye; esamli@nku.edu.tr

Today, only 50-60% of fish caught worldwide are used for human consumption. The annual waste produced by the global fishing industry is estimated to be around 20 million tons. These products, often referred to as waste or by-products, are raw materials with high potential for use. Due to their high protein, fat, vitamin and mineral content, they are suitable for use in various sectors such as fertilizer, animal feed, biofuel and bioactive compound production in plant production. Although fish waste is a product consisting of very different parts such as head, internal organs, skin and bones, it can be converted into value-added products through appropriate processing. The diversity of the sectors of use is particularly striking. For example, protein hydrolysates, omega-3 concentrates, collagen and gelatin are used in the food, health, cosmetics and biomedical sectors. An important area of use of these by-products is the production of fish meal and fish silage for the feed sector. Fish silage, the subject of this review, is a cost-effective feed option produced by liquefying fish parts by adding acid and then activating endogenous enzymes. Studies have shown that fish silage can be used in a variety of animal species without adversely affecting performance. Using fish waste to prepare silage can help solve the fundamental problem of both waste disposal and reducing the environmental impacts caused by them. On the other hand, as an alternative source of animal protein, it can increase overall productivity and has the potential to reduce feed costs.

ID: 148 / SES-P-ABB-04: 8

Abstract Submissions

Poster Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: Alternative feed source, insect meal, poultry nutrition

POTENTIAL USE OF INSECTS IN POULTRY NUTRITION

Farahuddin Larghani, Hasan Ersin Samli

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The production of alternative feed materials in poultry feeding is one of the issues that researchers care about. In recent years, insect-based feed sources have emerged as sustainable and nutrient-rich options. Insect-based feeds offer significant advantages due to their positive environmental effects, efficiency and nutrient content. They are especially rich in digestible protein, fatty acid profile, vitamins and minerals. Depending on the insect variety and production stages, the general nutritional profile of insects positively affects poultry performance, including growth rates, feed conversion rates and immunity. As an example of its positive environmental effects, insect farming uses less water and land. It also helps to recycle organic waste. Despite these benefits, the adoption of insect-based feeds today has restrictions regarding the current legal frameworks and consumer acceptance. In this context, although certain insect species have been approved in areas such as the European Union, broader regulations and public awareness efforts are needed for wider application.

ID: 150 / SES-P-ABB-04: 14

Abstract Submissions

Poster Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: Economy, Food Security, Kabul, Poultry, Women

THE IMPACT OF DOMESTIC CHICKEN DISTRIBUTION ON WOMEN'S ECONOMIC SITUATION IN KABUL PROVINCE OF AFGHANISTAN

Farahuddin Larghani, Eser Kemal Gurcan

TEKIRDAG NAMIK KEMAL UNIVERSITY, Turkiye; egurcan@nku.edu.tr

Afghanistan is predominantly an agricultural country, with approximately 78% of its population engaged in farming and related activities. In this context, poultry production plays a vital role not only in fulfilling nutritional requirements but also in enhancing household income, particularly for vulnerable groups. In recent years, the Ministry of Agriculture, Irrigation, and Livestock (MAIL), This has resulted in the implementation of various initiatives, including the establishment of broiler farms and standardized slaughterhouses, the development of feed distribution mechanisms, the formation of poultry cooperatives and associations, and the organization of vocational training programs for rural women. Furthermore, laying hens have been distributed to economically disadvantaged women as part of livelihood support programs. The objective of this study is to assess the economic impact of poultry distribution on rural women in selected districts of Kabul Province, specifically Karabagh, Guldara, and Paghman. The study involved both beneficiary households and a smaller sample of non-beneficiary households for comparative analysis. Findings indicate that 100% of the beneficiaries selected by community-based committees were women, including widows, female-headed households, and other marginalized groups. The average age of the beneficiaries was 44.7 years, with an average household size of 9.1 members. Most beneficiaries were married and engaged in farming activities, and 66.6% were illiterate. On average, each household produced 4,246 eggs over a 10-month period, of which approximately 70% were sold and 30% consumed. Income generated from egg sales was used to meet essential needs such as food and household goods.

ID: 151 / SES-P-ABB-04: 10

Abstract Submissions

Poster Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: Cattle, Goat, Milk, Panel Data

DETERMINATION OF RELATIONSHIPS BETWEEN GOAT, CATTLE PRESENCE AND RAW MILK AMOUNT USING PANEL DATA ANALYSIS

Ugur Berker, Eser Kemal Gurcan

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When we look at the countries of the world in general, the vast majority of the raw milk obtained is obtained from cattle and the rest from goats, sheep and camels etc. Within the scope of panel data analysis, the relationship between the presence of goats and cattle in Türkiye, America, China and Russia between the years 2001-2023 and the amount of raw milk produced was examined with the data obtained from the Food and Agriculture Organization (FAO) and the most appropriate model equation was tried to be created by evaluating the Hausman and F-test criteria in terms of panel least squares method, fixed effect and random effect models. In the context of the model created within the scope of the panel least squares method; the result we reached by adding the constant term coefficient due to the increases in our independent variables and multiplying our independent variables with their coefficients is that the total amount of raw milk in 2024 will increase by 4.8% compared to 2023, and when we look at the data of TSI, this result is seen as 4.7% including the total amount of raw milk produced from cows, sheep, goats and buffalo. As a result, it becomes clear that measures should be taken to increase the number of goats in order to ensure a higher increase rate in the total amount of raw milk produced in our country and other countries in the coming years.

ID: 152 / SES-P-ABB-04: 3**Abstract Submissions****Poster Presentation***Topics:* Animal Biotechnology & BALNIMALCON 2025*Keywords:* Anatolian Buffalo, Birth Rate, Live Weight, Milk Yield, Season**EFFECTS OF YEAR AND SEASON ON GROWTH, MILK AND REPRODUCTIVE TRAITS IN ANATOLIAN BUFFALOES****Mehmet Ihsan Soysal, Eser Kemal Gurcan, Emel Özkan Ünal**TEKIRDAG NAMIK KEMAL UNIVERSITY, Türkiye; misoysal@nku.edu.tr

Anatolian buffaloes have been raised in Türkiye for many years. Although the number of buffalo decreased at one time but in the last 15 years, the value of their products has been recognized again and their numbers have increased. In this study, the effects of year and season factors on growth, milk and reproductive traits of Anatolian buffalo raised in Istanbul were investigated. Animal data were used from between 2020-2024 in this study. Although the number of data varies depending on the feature considered and, a total of 3947 animal records were used. In the 4 years considered, the highest and lowest birth rates were found to be 43.86% in summer and 9.80% in winter, respectively ($P < 0.01$). When birth rates were examined according to months, the highest and lowest birth rates were seen in August (93.77%) and December (9.81%), respectively ($P < 0.01$). The change in the number of calves was found to be the lowest in 2020 as 727 head and the highest in 2024 as 969 head ($P < 0.01$). In terms of birth weight of the calves in summer, it was found to be 37.55 ± 0.14 kg and the calves in winter, 37.36 ± 0.29 kg ($P > 0.05$). The highest lactation milk yield of buffalos was obtained as 1660 kg in 2022. The calving interval was highest in winter as 471.18 ± 1.61 days and lowest in spring as 435.45 ± 1.61 days ($P < 0.01$). As a result, it was seen that the year and season effect were important effective environmental factors.

ID: 159 / SES-O-ABBC-03: 3

Abstract Submissions

Oral Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: Animal resources, protection, indigenous (autochthonous or domestic) breeds of cattle

IN SITU AND EX SITU PROTECTION OF THE AUTOCHTHONOUS BOVINE BREEDS

Gjoko Bunevski¹, Vesna Gantner², Bratislav Pecis³, Andrej Merdegush⁴, Ranko Gantner², Borislav Radevski¹, Aleksandar Klincarov¹, Violeta Rakic³, Nikola Stolic³

¹FASF Skopje, North Macedonia, Republic of; ²University Josip Juraj Strossmayer in Osijek, Faculty of Agro-Biotechnics of science, Croatia; ³Toplica Academy of expert sciences Prokuplje, Serbia;

⁴University of Maribor, Faculty of Agriculture and Life Sciences in Maribor, Slovenia;

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Animal resources were improved throughout the previous century in the direction of greater production and better quality of animal products. In this way, numerous highly productive breeds were created, which could express their productive potential only in much improved conditions of nutrition, accommodation and care. All this caused the disappearance of a large number of old autochthonous, primitive, low-productive, but mostly resistant breeds and strains of autochthonous (domestic) breeds, depopulation of rural and mountainous areas, as well as the abandonment of animal production in marginal areas. Autochthonous breeds play an important place, considering natural potentials, economic and social environment, with historical and cultural heritage, which influenced on rural tradition and agro diversity that developed over the centuries. In this paper are explain the present state of domestic bovine breeds that are locally adapted on our environmental conditions. In the RN Macedonia, there are two representatives of bovine species of autochthonous breeds – Busha cattle and Domestic buffalo. At the end of 2024 there are only 331 registered Busha cattle and 12 domestic buffaloes in the program of book recording. The protection and preservation of autochthonous bovine breeds contributes to the sustainability of agrobiodiversity and rural development, through their better use in organic food production and participation in agro tourism by forcing the sustainable concept “from field till table”.

ID: 189 / SES-P-ABB-04: 9

Abstract Submissions

Poster Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: protection, white sheep brined cheese, traditional, ovchepolian pramenka

POTENTIALS FOR PROTECTION OF THE TRADITIONAL WHITE BRINE CHEESE FROM OVCHEPOLSKA PRAMENKA BREED

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The traditional Macedonian white brined sheep cheese made from the Ovchepolska Pramenka breed is a distinctive product characterized by its specific aroma, taste, and cultural heritage. These qualities are attributed to the use of raw milk from this indigenous sheep breed, combined with traditional production techniques and the presence of native microflora. This study aimed to assess the potential for legal protection of this product under the national regulatory framework in the Republic of North Macedonia.

Field research involved surveys with 25 farmers and chemical and sensory analysis of cheese from five representative farms (P1, P2, P3, P5, and P6). The results showed notable variation in fat content (ranging from 18.2% to 28.5%), fat in dry matter (47.7% to 55.8%), and salt content (4.58% to 6.3%), reflecting differences in production methods. Sensory evaluation with trained panelists indicated that cheeses from producers P2 and P5 showed very good quality, while P4 scored significantly lower across all parameters, emphasizing the need for improved hygiene and standardization.

Despite P5 achieving the highest sensory scores, its chemical composition did not meet international standards (CODEX STAN 283-1978) for brined cheeses. The findings highlight the importance of harmonizing technological procedures and developing a unified product specification. Given the documented historical continuity and regional specificity, it is recommended that this cheese be considered for protection through the Protected Geographical Indication (PGI) scheme. However, the lack of registered facilities among most producers remains a challenge requiring targeted support.

ID: 198 / SES-P-ABB-04: 1

Abstract Submissions

Poster Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: ammonia emissions; livestock production; ruminant nutrition; sustainable agriculture; nitrogen in feed

AMMONIA EMISSIONS FROM LIVESTOCK PRODUCTION: CHALLENGES, CAUSES AND MITIGATION APPROACHES

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Livestock production contributes significantly to the emission of ammonia (NH₃), a gas that negatively affects air quality, soil and water systems and contributes to environmental acidification. According to FAO data and recent research, livestock production is responsible for more than 60% of total ammonia emissions, with cattle production accounting for a significant share. The main source of ammonia is nitrogenous substances from manure, especially urea from urine, which is rapidly converted to ammonia. The level of emissions is influenced by numerous factors: diet composition, digestive efficiency, manure management, microclimatic conditions and animal husbandry. An effective emission reduction strategy includes optimizing nutrition, especially crude protein content, balancing key minerals such as calcium and phosphorus, as well as proper storage and application of fertilizers. Understanding the dynamics of nitrogen within the ruminant organism and the fertilizer system is crucial for reducing losses in the form of ammonia. In addition to conventional measures, precision livestock farming technologies are gaining increasing importance, which enable individual monitoring of production and animal health, thereby contributing to better utilization of nutrients and reducing the emission footprint. A review of current knowledge indicates the need for integrated approaches that combine feeding, manure management and monitoring technologies to achieve sustainable and environmentally friendly livestock production.

ID: 206 / SES-O-ABBC-03: 6**Abstract Submissions****Oral Presentation***Topics:* Animal Biotechnology & BALNIMALCON 2025*Keywords:* Monoplex parthenopeus, record, Gulf of Antalya**THE IMPACTS OF GLOBAL WARMING ON THE SEAS: A CASE STUDY OF MONOPLEX PARTHENOPEUS FROM THE MEDITERRANEAN COAST OF TÜRKİYE****Mehmet Gokoglu, Mesut Yılmaz**Akdeniz University, Türkiye; gokoglu@akdeniz.edu.tr

Konyaaltı Beach is one of Antalya's world-famous beaches. During scuba diving conducted on May 24, 2025, a gastropod species with hair-like structures on its shell was identified under an HDPE pipe that carries seawater from the sea to an aquarium on land. This gastropod was collected and brought to the laboratory of the Faculty of Fisheries at Akdeniz University. In the laboratory, some biometric measurements of the shell were taken, and the species was identified as *Monoplex parthenopeus* (Salis Marschlin, 1793). *Monoplex parthenopeus* had previously been reported for the first time along Türkiye's Mediterranean coast in the Gulf of Antalya, approximately 20 km from this location. With this study, the presence of the species on the Turkish Mediterranean coast is being reported for the second time. Belonging to the family Cymatiidae and known as the giant or hairy triton, *M. parthenopeus* is a gastropod species distributed in the Indo-Pacific and Atlantic Oceans. The fact that this species has now been reported in two nearby locations in the Gulf of Antalya around the same period raises the possibility that global warming may be playing a role.

ID: 224 / SES-O-ABBC-03: 1

Abstract Submissions

Oral Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: dairy cow, heat stress, THI, annual THI load

CATTLE EXPOSURE TO HIGH TEMPERATURES IN NORTH MACEDONIA'S PELAGONIA REGION

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The impact of rising temperatures on dairy cattle in North Macedonia's Pelagonia region by analyzing projected heat stress levels under various climate scenarios using the Thermal Humidity Index (THI). In the region over 20% of national dairy cows are located, where 23 points (~12×12 km) were selected, spanning from N 40.91, E 21.61 to N 41.46, E 21.28. For each point, daily minimum and maximum temperatures and precipitation were used to calculate THI across three periods: P1 (1986–2015), P2 (2016–2045), and P3 (2046–2070), under three climate scenarios: RCP 2.6, RCP 4.5, and RCP 8.5. The THI was aggregated into an annual THI load, indicating the number of days exceeding stress thresholds for more than two consecutive days. Thresholds were 74–78 (alert), 78–83 (emergency), and 83+ (dangerous). Annual THI loads were averaged across periods. Under RCP 2.6, average annual THI load above 74 would peak in P2 at 84 days, 26% and 3% higher than in P1 and P3, respectively. In RCP 4.5, the highest 74+ load would occur in P3 with 81 days (27% and 19% more than in P1 and P2). Under RCP 8.5, the 74+ load reaches 85 days in P3, with the highest 83+ load of 11 days. In P2, the dangerous (83+) THI load is projected at 8, 4, and 6 days under RCP 2.6, RCP 4.5, and RCP 8.5, respectively. Economic losses for dairy farms in Pelagonia could reach up to €150 per cow annually due to heat stress.

ID: 245 / SES-P-ABB-04: 6

Abstract Submissions

Poster Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: insects, larvae, animal feed, protein, sustainability, nutritional value

INSECT LARVAE AS A SUSTAINABLE SOURCE OF PROTEIN IN ANIMAL NUTRITION: POTENTIAL AND CHALLENGES

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The increasing demand for high-quality protein sources and the pressures on traditional sources such as soybean meal and fishmeal, are putting the feed industry under pressure to increasingly focus on alternative and sustainable solutions. One of the most promising protein alternatives is insect larvae, especially the larvae of *Hermetia illucens* (black soldier fly), *Tenebrio molitor* (yellow mealworm) and *Musca domestica* (housefly). These insects are rich in protein, fat, amino acids, fatty acids and other micronutrients, making them suitable for use in the diet of poultry, pigs, fish and ruminants. The paper analyzes the chemical composition of insects, their nutritional value, the impact on animal productivity and health, as well as the technological and regulatory aspects of their application. It also discusses the economic and environmental benefits of raising insects on organic waste in R. N. Macedonia, as well as consumer and producer acceptance. The conclusion is that insects represent an innovative and sustainable alternative, but further research and appropriate regulation are needed for their wider application in livestock production and the animal feed industry.

ID: 259 / SES-P-ABB-04: 11

Abstract Submissions

Poster Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: immunosuppressed animals, animal welfare, husbandry, experimental tools

REFINING CARE AND WELFARE FOR IMMUNODEFICIENT MICE: LESSONS FROM NSG AND NSG-MHC I/II DKO MODELS

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Immunodeficient mouse strains such as NSG (Jackson Laboratory #005557) and NSG-MHC I/II DKO (Jackson Laboratory #025216) have become foundational in translational biomedical research due to their capacity to accept xenogeneic cells and tissues. However, their extreme immunodeficiency necessities highly refined husbandry and welfare protocols to ensure viability, reproductivity and compliancy with the ethical standards. This study aims to outline the optimized care strategies implemented at the Anne McLaren Biomedical Facility at the University of Cambridge for maintaining these strains under pathogen free conditions. NSG and NSG-MHC I/II DKO mice were housed in individually ventilated cages (Technoplast Green Line) under controlled microclimate with 75 air changes per hour, sterile enrichment and strain specific accommodation. Breeding protocols are carefully designed with trios established at 7 weeks of age and limited to six months of active reproduction. Particular attention is given to supporting neonatal survival, minimizing stress and facilitating cross-fostering. Supplemental hydration (e.g. gel/mash) is routinely provided to post-operative or dehydrated animals. Environmental enrichment—including soft white nesting, chew sticks, and igloos—is systematically tailored to individual and strain-specific behavioural phenotypes. All offspring are genotyped using PCR to confirm genetic consistency and maintain colony integrity. The NSGdKO strain, lacking murine MHC class I and II, offers extended engraftment windows with reduced xenogeneic graft-versus-host disease but presents increased activity and radiosensitivity, requiring further refinements in handling and preconditioning. Both strains exhibit small litter sizes and ‘scruffy’ coats, features typical of their genotype and not indicative of poor welfare.

ID: 285 / SES-P-ABB-04: 5

Abstract Submissions

Poster Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: SREBF1 gene, Anatolian water buffalo, genetic polymorphism, SNP, lipid metabolism, DNA sequencing, genetic diversity

IDENTIFICATION OF POLYMORPHISMS IN THE SREBF1 GENE REGION OF ANATOLIAN WATER BUFFALOES

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The Sterol Regulatory Element-Binding Transcription Factor 1 (SREBF1) gene encodes a key transcription factor involved in the regulation of lipid metabolism and fatty acid synthesis. This study aimed to investigate polymorphisms within the SREBF1 gene region in Anatolian water buffalo (*Bubalus bubalis*), one of Turkey's indigenous genetic resources.

Genomic DNA samples were obtained from 20 Anatolian water buffaloes randomly selected from various regions. A 783-base pair (bp) fragment of the SREBF1 gene was amplified using polymerase chain reaction (PCR), and the resulting amplicons were subjected to DNA sequencing. The nucleotide sequences obtained were aligned and compared with reference sequences from buffalo, cattle, and sheep to assess genetic variation and infer evolutionary relationships. Sequence analysis revealed several structural variants, including single nucleotide polymorphisms (SNPs), insertions, and deletions.

Preliminary results highlight the presence of genetic variation in the SREBF1 gene among Anatolian water buffaloes. These findings suggest a potential role for SREBF1 as a candidate gene in future genetic diversity assessments and marker-assisted selection programs. Nevertheless, further studies involving larger and more diverse populations are needed to validate its utility in breeding strategies.

ID: 289 / SES-P-ABB-04: 12

Abstract Submissions

Poster Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: organic livestock breeding, sheep, goat, cattle

STATE, TRENDS AND PERSPECTIVES OF ORGANIC LIVESTOCK PRODUCTION IN THE REPUBLIC OF NORTH MACEDONIA

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This study explores the status and trends of organic livestock breeding in North Macedonia, focusing on cattle, sheep, and goats. While organic livestock breeding plays a vital role in sustainable agriculture, the cattle sector faces significant challenges, characterized by a decline of 41.12% in herd size from 2009 to 2023, primarily due to structural issues and economic pressures. Sheep breeding shows more promise, with organic sheep comprising 16.07% of the national flock, demonstrating resilience despite market challenges. Goat breeding, historically affected by governmental restrictions, has seen slow recovery, with organic goats representing 6.42% of the national herd. The research utilizes official data from relevant governmental and certification bodies to provide a comprehensive overview of the organic livestock sector. The findings highlight the need for enhanced market recognition and structural improvements to foster growth and sustainability in organic livestock breeding. As the sector continues to evolve, strategic investments in education, infrastructure, and marketing will be crucial for maximizing its potential and supporting local farmers.

ID: 290 / SES-P-ABB-04: 7

Abstract Submissions

Poster Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: Salmo ohridanus, mass composition

MASS COMPOSITION OF OHRID BELVICA (SALMO OHRIDANUS, STEINDACHNER)

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To investigate the mass composition of Ohrid belvica (*Salmo ohridanus*, Steindachner, 1892), a study was conducted on specimens collected during both the vegetative and reproductive developmental phases. Sampling was performed at three locations in Lake Ohrid, Kalishta, Kaneo, and Eleshec, at depths ranging from 45 to 70 m. The specimens had an average body mass ranging from 90 to 100 g and an average total body length between 217 and 225 mm. The results revealed statistically significant differences in the mass composition of various body parts and organs. A significant difference ($P < 0.01$) was observed in the proportion of internal organs between the two developmental phases, while a highly significant difference ($P < 0.001$) was noted in the proportion of gonads. Additionally, the proportion of the digestive tract differed significantly between phases ($P < 0.05$). No statistically significant differences were detected for the remaining parameters between the vegetative and reproductive stages. From a practical perspective, knowledge of the proportion of the edible portion in the total body mass, i.e., the dressing percentage, is essential. When the fish is served with the head, the dressing percentage was significantly higher ($P < 0.05$) during the vegetative phase (85.65%) compared to the reproductive phase (83.67%). The dressing percentage of the cleaned carcass (excluding the head, internal organs, and fins) was also significantly higher in the vegetative phase (75.34%) than in the reproductive phase ($P < 0.05$).

ID: 301 / SES-O-ABBC-03: 4

Abstract Submissions

Oral Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: pigs, selenium, biofortification, immune response, health

THE ROLE OF SELENIUM (SE) IN PIG NUTRITION

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Selenium (Se) is one of the most important micronutrients that plays a significant role in the normal growth and development of organisms, especially in newborn and weaned piglets. The bioavailability and distribution of selenium in the body of pigs is influenced by a number of factors, including the chemical form of selenium, other nutritional compounds, selenium status, physiological status and breed. Also, selenium affects the improvement of some production traits, and protects against many diseases. In boars, selenium affects improved sperm quality, and in sows, the addition of organic selenium during pregnancy affects an increase in selenium levels in serum and liver, and in lactating sows, an increase in selenium levels in colostrum and milk. The main advantage of organic selenium in piglet nutrition is related to the creation of selenium reserves in the body. Under stress conditions, when the need for antioxidants is significantly increased, but feed consumption is usually reduced, selenium reserves, accumulated in tissues, can be crucial for pigs' resistance to the harmful effects of free radicals and toxic products of their metabolism. The use of selenium in pig farming is still an area that has not been sufficiently researched, precisely because of its great influence on various properties, but also because of its interaction with other nutrients and factors. The indirect effect of the positive effect of selenium in pig production is also reflected in human health, primarily due to the significant share that pork and pork products have in the human diet.

ID: 311 / SES-P-ABB-04: 4

Abstract Submissions

Poster Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: pasture, productivity, cattle, sheep, permanent grasslands

ESTIMATION OF CATTLE AND SHEEP PRODUCTIVE POTENTIAL ON MACEDONIAN PERMANENT GRASSLANDS

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Aim of this work to estimate the livestock production potential of currently mainly abandoned meadows and pastures of North Macedonia. Estimations were based on previously published data on Macedonian pastures herbage yield and conversion ratios of consumed forage dry matter / produced livestock products (live animals and milk). The work has revealed that permanent grasslands of North Macedonia possess a considerable livestock productive potential associated with potential employment in rural areas, new ruralization and return of economic emigrants back to native country.

ID: 316 / SES-O-ABBC-03: 5

Abstract Submissions

Oral Presentation

Topics: Animal Biotechnology & BALNIMALCON 2025

Keywords: pigs, herd book, farm results, national trend, w/s/y.

PHENOTYPE TREND OF MACEDONIAN PIG HUSBANDRY FARM RESULTS

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PHENOTYPE TREND OF MACEDONIAN PIG HUSBANDRY FARM RESULTS

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The aim of the research was to analyse the key farm results of five biggest Macedonian pig farms. The phenotype trend of farm performances was followed from May 2021 till September 2025 and the annual results of these farms, from September 2024 to August 2025, were analysed using the Multi Site Monitor Sows/MyAgrovision.com. The sample contains information from 5 farms, based on the total number: of sows (n=5482), services (n=14913) and farrowing's (n=12535). The average results for analysed farms are: farrowing index of 2.50, weaning-to-insemination interval of 5.33 days, total number born per litter of 16.63, number of live-born per litter of 15.21, number of stillborn piglets of 1.42, pre-weaning piglet mortality rate of 9.30%, number of weaned per litter of 13.78, average piglet weight at weaning of 6.57 kg, number of non-productive days per litter of 17.15, sow mortality rate of 5.75%, gestation length of 116.69 days, farrowing rate of 83.71%, lactation length of 26.29 days and number of weaned piglets per sow per year of 34.43. Individual trends of the most important farm indicators in 5 years showed the significant progress. The number of weaned piglets per year annual improvement was 0,57 w/s/y.

Key words: pigs, herd book, farm results, national trend, w/s/y.

AGRICULTURAL ECONOMICS

Thursday, 09/Oct/2025 12:30pm - 1:00pm

ID: 100 / SES-P-AE-02: 1

Abstract Submissions

Poster Presentation

Topics: Agricultural Economics

Keywords: agricultural extension methods, individual agricultural holding development, improving agricultural production, extension typology, knowledge transfer in agriculture

AGRICULTURAL EXTENSION METHODS FOR ENHANCING PRODUCTION OF AGRICULTURAL HOLDINGS IN THE REPUBLIC OF NORTH MACEDONIA

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Enhancing the production of the individual agricultural holdings, as the primary goal of the agricultural extension process, implies a shift in the farmers' attitudes, perspectives, and as a result of that, a shift in their behaviors.

These changes enable the farmers to acquire new knowledge, technologies, and skills to address challenges in specific aspects of agricultural production of the individual agricultural holdings. The role of the agricultural extension officers is to facilitate this transformation.

To achieve this, agricultural extension officers use targeted extension methods as a central mechanism for knowledge transfer and capacity building.

This paper analyzes data from the work of agricultural extension officers at the National Extension Agency for Agriculture (NEA) in the Republic of North Macedonia, with its headquarters in Bitola. Data were collected using an extension typology framework during the period from June 2022 to July 2023.

The objective of this paper is to emphasize the importance of complementarily applying core agricultural extension methods.

Thursday, 09/Oct/2025 1:30pm - 2:00pm

ID: 106 / SES-P-AE-02: 3

Abstract Submissions

Poster Presentation

Topics: Agricultural Economics

Keywords: data, fertilizers, FADN, FSDN, pesticide, transformation

TOWARDS THE TRANSITION FROM FADN TO FSDN: FARM-LEVEL ANALYSIS OF FERTILIZER AND PESTICIDE USE IN SERBIA

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This paper analyzes the transition from the Farm Accountancy Data Network (FADN) to the Farm Sustainability Data Network (FSDN) within the framework of the European Union's Green Deal and Common Agricultural Policy (CAP), focusing on Serbia's agricultural sector. The FSDN represents a shift toward comprehensive sustainability monitoring by incorporating economic, environmental, and social indicators. It introduces a harmonized benchmarking system based on scientifically sound, dynamically developed methodologies. The study outlines the regulatory, institutional, and methodological changes that Serbia, a candidate country for EU membership, must undertake to implement FSDN, emphasizing the necessity of harmonizing national data systems with EU standards. Key components of the FSDN system—economic, ecological, and social indicators are discussed, along with their role in shaping evidence-based agricultural policy, benchmarking farm performance, and enhancing sustainability reporting. Special attention is given to analyzing fertilizer and pesticide use at the farm level, using FADN data to assess input costs, nutrient application rates (N-P-K), and environmental pressures. Comparative insights between Serbia and EU member states reveal significant variations in usage intensity and cost structure, highlighting the importance of accurate, disaggregated data for policy targeting and resource efficiency. The findings suggest that Serbia's current FADN system provides a solid foundation for the shift to FSDN and highlight the need for increased capacity building, farmer engagement, and digital infrastructure to ensure successful implementation. The results underline the strategic importance of this transition for improving farm-level sustainability, promoting policy transparency, and achieving long-term environmental goals.

ID: 154 / SES-P-AE-01: 2

Abstract Submissions

Poster Presentation

Topics: Agricultural Economics

Keywords: tobacco production, strategy, sustainable development, world trends, economic indicators

THE PLACE AND SIGNIFICANCE OF TOBACCO IN MACEDONIA – FROM THE PAST TO THE PRESENT

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The introductory part of the paper entitled " The place and significance of tobacco in Macedonia – from the past to the present ", is focused on the fact that tobacco occupies a special place in the structure of agriculture with enormous socio-economic significance for our country and in the past decades, the production of tobacco, and especially oriental tobacco in Macedonia, is characterized by enviable quality and world reputation.

Taking into account the importance of tobacco, its production should be directed towards obtaining higher income per unit area and of course higher quality raw material. The agricultural sector in Macedonia is of great importance for the development and advancement of the economy and, together with forestry and fisheries, is the third largest sector (after services and industry) in the country.

The starting point for constructing the theoretical part of the paper will be the reports from the Ministry of Agriculture, Forestry and Water Management of the Republic of Macedonia, the State Statistical Office, data from the World Bank database, etc.

In the empirical part, the scientific method will be used - statistical analysis conducted on data obtained from survey questionnaires, whereby the data analysis will be carried out with the method of descriptive explanation of the results obtained from the research, with the mandatory application of the comparative method, the X2 test and the contingency coefficient.

In the concluding observations, the socio-economic importance of tobacco for the country, the importance of good organization, planned production and the strategic management approach are highlighted.

ID: 158 / SES-O-AE-01: 3

Abstract Submissions

Oral Presentation

Topics: Agricultural Economics

Keywords: farm structure, land consolidation, mixed-methods evaluation, North Macedonia, rural development

MEASURING THE MULTI-DIMENSIONAL IMPACTS OF LAND CONSOLIDATION: EVIDENCE FROM A MIXED-METHODS STUDY IN EGRI

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This paper evaluates the economic, social, and environmental impacts of the Land Consolidation Project in Egri, a rural village in North Macedonia, with the aim of deriving lessons for future consolidation efforts nationally and regionally. Employing a mixed-methods approach, the research combined quantitative survey of 42 farmers in Egri (about 70% of the total estimated number of farmers in the village), with a control group of 39 farmers from neighboring villages. Additional in-depth interviews and focus group discussions with resident and absentee landowners were conducted alongside the farmers' survey. The methodology included statistical hypothesis testing, farm budget assessments, and key performance indicators across multiple dimensions. Findings show that land consolidation significantly improved farm structure and efficiency in Egri. Average parcel numbers per farm declined from 11.1 to 2.4, cultivated land area increased by 17.3%, and transport time to fields decreased by 70%. These results, statistically significant compared to control villages, translated into better farm income and operational efficiency. Farmers reported enhanced productivity, reduced labor, improved working conditions, and a stronger willingness to invest in mechanization and irrigation. Socially, land consolidation fostered better community relations and fewer land disputes. The paper concludes with policy recommendations, including standardized monitoring frameworks, support for youth and women in farming, improved outreach to absentee landowners, and integration of environmental impact assessments. Egri's case illustrates how targeted land consolidation can enhance rural sustainability, agricultural productivity, and social cohesion.

ID: 162 / SES-P-AE-01: 1

Abstract Submissions

Poster Presentation

Topics: Agricultural Economics

Keywords: economic analysis, production, grapes, profitability

ECONOMIC ANALYSIS OF GRAPE PRODUCTION IN MACEDONIA: THE CASE OF THE SMEDEREVKA VARIETY

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In the Republic of North Macedonia are 1,265 thousand hectares of agricultural land, of which about 520 thousand hectares are arable land. Of the total arable land, arable land and gardens account for 80%, meadows for 12%, vineyards for 5% and orchards for 3%. In the area under vineyards, wine varieties account for 70%, of which white varieties account for 40% and red varieties for 60% (State Statistical Office, 2025). The most common white varieties are: Smederevka, Chardonnay, Riesling and Sauvignon, and the most common red varieties are: Vranec, Kratošija, Cabernet Sauvignon and Merlot. The subject of research in this paper is the production of grapes, the Smederevka variety. The aim of the research is to analyze the results and economic justification of the production of the mentioned grape variety. Data were collected through a survey of 30 grape producers from the Vardar region. The results of the analysis indicate that the average yield of the Smederevka variety is 18,833 kg/ha, and the average total income is 293,937 denars. In the total income, income from the sale of grapes accounts for 73%, subsidies per area account for 14%, and subsidies per delivered quantities of grapes account for 13%. The average yield rate is 45%, and the average yield threshold is 17,055 kg/ha. The cost price of grapes is the lowest among producers with larger plantings, and they also achieve better operational results. Smaller producers should focus on association, consolidation, and modernization of their capacities, along with continuous education.

Thursday, 09/Oct/2025 1:00pm - 1:30pm

ID: 183 / SES-P-AE-02: 2

Abstract Submissions

Poster Presentation

Topics: Agricultural Economics

Keywords: cooperative model, economic indicators, regional development, social impact

THE BUSINESS MODEL IN BULGARIAN AGRICULTURAL COOPERATIVES: REGIONAL DIFFERENCES AND SOCIAL IMPACT

Angel Sarov

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Over the past decade, interest in sustainable and flexible business models has been increasing, including their impact on regional policy and development. A main argument for this is that regional differences in Bulgaria are increasingly deepening and expanding, which leads more and more research to focus on research on business models, often built around values and social impact. Cooperatives, together with other actors in the social economy, are attracting more attention than usual. To respond to this challenge, we draw attention to the activities of agricultural cooperatives and focus on their business model.

The aim of this paper is to analyze the business model in Bulgarian agricultural cooperatives and to highlight some regional differences. The analysis was developed in accordance with the implementation of the work programme on the project „Cooperative models for doing business in Bulgaria and their potential for implementing innovative management solutions“, financed by the „Scientific Research Fund“, „Fundamental Scientific Research-2022“.

The analysis covers 863 agricultural cooperatives, distributed in 28 statistical planning regions, which are at NUTS-3 level, according to the classification of territorial units and correspond to the districts in Bulgaria. The cooperatives are specialized in growing cereals (excluding rice), legumes and oilseeds. Official data from the Agrostistics Department of the MAF, and Ciela INFO for the period 2007-2021 were used.

Preliminary results show regional differences in terms of selected economic indicators such as: income, costs, profit, labor productivity and profitability. At the same time, the efficiency ratio of costs and revenues is similar.

ID: 186 / SES-O-AE-01: 2

Abstract Submissions

Oral Presentation

Topics: Agricultural Economics

Keywords: agriculture and rural development policy, budgetary transfers, North Macedonia, strategic objectives

FROM STRATEGIC OBJECTIVES TO ACTUAL IMPLEMENTATION: ASSESSING NORTH MACEDONIA AGRICULTURAL AND RURAL DEVELOPMENT POLICY

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Strategic objectives play a central role in shaping agricultural and rural development policies by providing a clear direction for the allocation of public resources. Meeting strategic objectives is essential to ensure that budgetary interventions are proactive and generate meaningful and measurable progress toward national priorities. It enhances the effectiveness, accountability, and long-term impact of policies by aligning resources with clearly defined outcomes. This paper provides a mid-term assessment of budgetary transfers to agriculture and rural development in the Republic of North Macedonia for the period 2021–2024, through the lens of its strategic objectives aligned with the EU Common Agricultural Policy (CAP). Utilizing the Agricultural Policy Measures Classification (APMC) database, the analysis examines the allocation of public expenditure across the ten EU CAP strategic objectives. The findings reveal a strong predominance of the support towards providing fair income, competitiveness, and protecting food and health quality, whereas limited funding is directed to the remaining objectives, particularly those related to environmental sustainability, generational renewal, rural vitality, and innovation. The observed imbalance calls into question the coherence between stated strategic objectives and the distribution of public funds. The paper offers policy recommendations to enhance alignment in the upcoming programming period and serves as a valuable input for redesign of national agricultural and rural development policy toward a more balanced and strategic use of public funds.

ID: 192 / SES-O-AE-02: 4

Abstract Submissions

Oral Presentation

Topics: Agricultural Economics

Keywords: Rural youth agency, institutional trust, governance quality, migration decision-making, rural development

POLITICAL INSUFFICIENCIES AND RURAL YOUTH BEHAVIOR IN THE WESTERN BALKANS

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Rural youth in the Western Balkans (Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, Serbia) face multifaceted challenges that influence their decisions to remain in or leave their rural homeplaces. Prior studies have highlighted structural barriers, such as inadequate infrastructure, limited job opportunities, and lower quality of life, as key drivers of youth outmigration from rural areas. However, the role of political insufficiencies, such as lack of youth representation, distrust in governance, and ineffective rural policies, remains underexplored in the Western Balkan context. This study addresses this gap by examining how political factors shape rural youth behavior and their intentions to stay in their homeplaces, using a comprehensive dataset stratified by country, age, religion, and sex. The research draws on survey data from 2,158 rural youth across the six Western Balkan countries. Drawing on Social Identity Theory (Tajfel and Turner, 1979) and Intersectionality (Crenshaw, 1989), this study posits that political insufficiencies, such as distrust in institutions or perceived exclusion from policy-making, disproportionately affect rural youth's behaviors and migration intentions, with variations across country, age, religion, and sex. By examining how political insufficiencies shape behaviors and intentions to stay, this study contributes to academic and policy discussions on rural development and youth retention in the Western Balkans.

ID: 202 / SES-O-AE-02: 3

Abstract Submissions

Oral Presentation

Topics: Agricultural Economics

Keywords: migration, rural youth, Western Balkans, youth unemployment, rural development

MIGRATION AND THE FUTURE OF RURAL YOUTH IN THE WESTERN BALKANS: CHALLENGES AND PROSPECTS

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Rural areas throughout the Western Balkans are undergoing a profound demographic and socio-economic transformation, largely driven by persistent youth migration. Limited economic opportunities, high unemployment rates, underdeveloped infrastructure, and weak public services - particularly in education and healthcare - contribute to the marginalization of rural youth. Faced with few prospects, many young people are leaving their communities for urban centers or migrating abroad in search of better livelihoods. This exodus not only exacerbates rural depopulation and accelerates demographic decline, but also results in a significant brain drain and gender imbalance.

Rural youth often encounter systemic barriers to education and employment, with many discouraged from pursuing agriculture-related careers due to poor working conditions, social stigma, and limited support. The paper explores these migration trends across six Western Balkan countries—Albania, Bosnia and Herzegovina, Kosovo*, Montenegro, North Macedonia, and Serbia—examining the root causes and socio-economic impacts of rural youth migration. Based on the findings, it provides evidence-based policy recommendations aimed at revitalizing rural areas. Key proposals include diversifying employment opportunities, investing in rural infrastructure and services, strengthening educational systems, and promoting youth engagement in decision-making.

The research is grounded in a mixed-methods approach, including desk research, stakeholder interviews, focus group discussions, and a regional survey of 2,158 rural youth. Although data limitations persist, particularly in terms of comparability and coverage, the study offers a nuanced and representative understanding of the challenges rural youth face and highlights the urgent need for targeted rural development policies across the region.

ID: 246 / SES-O-AE-02: 5

Abstract Submissions

Oral Presentation

Topics: Agricultural Economics

Keywords: Key words: Financial Literacy, Rural Development, Smallholder Farmers, Financial Inclusion, Southeast Europe

BRIDGING THE GAP: FINANCIAL LITERACY AS A PATHWAY TO FINANCIAL INCLUSION FOR SMALL FARMERS IN SOUTHEAST EUROPE

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Rural populations and smallholder farmers in Southeast Europe face systemic barriers to financial inclusion, including limited access to financial products and low levels of financial literacy. This study, conducted across Albania, Bosnia-Herzegovina, Kosovo, North Macedonia, and Moldova, investigates the financial capabilities and behaviors of 386 individuals from rural communities, with a focus on record-keeping, investment literacy, and financial product awareness. Findings reveal that while 84% of respondents reported keeping financial records, most rely on informal methods (notebooks), with only 25% using digital tools or professional accounting support. Investment decisions are heavily based on personal savings (60%), with minimal engagement in formal credit mechanisms, as only 14% of current investments come from bank or microfinance loans. Knowledge of essential financial concepts, such as inflation, interest rates, and operational planning, remains low, directly impacting the ability of small farmers to make informed financial decisions. Despite these challenges, the study finds promising potential: half of the population is aged 18–50, with youth showing involvement in family farming activities, indicating a target group for tailored financial education. Respondents express strong interest in training in economic decision-making and access to business support programs. The study concludes that enhancing financial literacy, particularly in record keeping, investment planning, and loan management, can serve as a foundational step toward broader financial inclusion. Targeted, context-specific education initiatives are urgently needed to empower rural populations, improve their resilience, and enable sustainable economic participation in competitive markets.

ID: 291 / SES-O-AE-01: 4

Abstract Submissions

Oral Presentation

Topics: Agricultural Economics

Keywords: biomass, carbon, emission, measure, multi-factor, nitrogen

POTENTIAL AND PROBLEMS OF GRASSLANDS AS EXPLICIT POLICY INSTRUMENTS TO REALIZE GREEN TRANSITION

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The green transition of agriculture is challenged by the lack of targeted and effective policy instruments. This paper shows how grasslands could be integrated as policy instrument to reduce GHGs from agriculture with points of caution and typified by Denmark. Grassland measures were defined with estimated 1) soil carbon (C) storage, emissions of 2) nitrous oxide (N₂O) from fertilizers, crop residues, and indirectly, and 3) carbon dioxide (CO₂) from liming, all summed to annual net effect and relative to a “reference” crop rotation dominant in the region with soil C storage set to zero and quantified N₂O and CO₂ emissions by ample data. Grassland measures where soil C storage prevailed the annual net effect were grass for seed (0.79 Mg CO₂-eq ha⁻¹), intermediate crops (0.45 Mg CO₂-eq ha⁻¹), catch crops (0.95 Mg CO₂-eq ha⁻¹) and perennial grasses (miscanthus) and woods (willow/poplar; ca. 1 Mg CO₂-eq ha⁻¹) also due to their low fertilization, similar to fallow (1 Mg CO₂-eq ha⁻¹) where the effect was due to absence of fertilization and liming. These effects require refinement and show that knowledge integration and static nature of the method require continuous validation to reduce greenwashing of the net effect, whereas transfer to other regions requires incorporation of local empirical data.

ID: 297 / SES-O-AE-02: 2

Abstract Submissions

Oral Presentation

Topics: Agricultural Economics

Keywords: competitiveness, sheep and goat meat, production, value, consumption

COMPARATIVE COMPETITIVENESS OF SHEEP AND GOAT MEAT INDUSTRY IN THE COUNTRIES OF BALKAN REGION

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The sheep and goat meat production is a very important sector of livestock industry in the countries on Balkans. The total world production of sheep and goat meat in recent years accounts for 11,5 Mtons, whereas the 7 main country producers from the Balkan region possess a share of 6,5%. The average worldwide consumption per capita of such meat reaches up to 1,4 kg while in the covered countries, the average consumption is about 3,5 kg. The goal of the paper is to conduct comparative analysis of competitiveness of this sector in each one of those countries envisaged as an index comprised of production. The analysis will allow to trace up not only the time dynamic of each of the selected countries as well as to compare those countries one to another. The competitiveness assessment is run on the understanding of the competitiveness as a result (maintaining and enhancing market and value share in the world scale) thus it might be presented as an index ranges within 0 to 1, where both of two extremes implies lack of production (0) and that concrete state is the single producer globally (1). The results show that during the last years, the highest competitiveness is estimated in Turkish sheep and goat meat industry, following by strong performance by sectors in Greece and Albania while North Macedonia and the EU member states (Bulgaria and Romania) are losing positions and are in decline trend.

ID: 321 / SES-O-AE-01: 1

Abstract Submissions

Oral Presentation

Topics: Agricultural Economics

Keywords: agricultural policy, choice experiment, farmers' preferences, EU alignment, North Macedonia

ELICITING FARMERS' PREFERENCES FOR AGRICULTURAL POLICY REFORM

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This study examines farmers' preferences for alternative agricultural support programs in North Macedonia (NM) using a discrete choice experiment (DCE). NM provides a unique setting for such research as its agricultural policy is in transition, balancing traditional direct payments with EU-alignment requirements. The prevalence of small farms, strong reliance on subsidies, and debates over shifting resources toward rural development make understanding farmers' views crucial for designing effective and sustainable policies. Although direct payments remain the main policy tool, pressures for reform highlight the need for evidence on how farmers evaluate potential alternatives. The DCE will be conducted with a sample of active farmers and includes 15 choice tasks. In each task, respondents will select one option among two hypothetical new programs and the current national scheme. The new programs vary systematically across six attributes: budget allocation to rural development, type of direct payments, reliability and administrative burden, level and scope of investment aid, environmental conditionality, and percentage change in annual financial support relative to the status quo. The current policy is always included as the reference option.

To capture preference heterogeneity, the survey will also collect detailed socio-demographic and farm-level data, alongside attitudinal measures of policy performance, fairness, and institutional trust. This design enables the estimation of trade-offs farmers are willing to make between financial incentives, administrative simplicity, and environmental requirements. Findings will provide insights into how farmers balance continuity with reform, supporting evidence-based policymaking and the development of agricultural support programs that are both effective and acceptable to beneficiaries.

ID: 324 / SES-O-AE-02: 1

Abstract Submissions

Oral Presentation

Topics: Agricultural Economics

Keywords: Open Balkan Initiative; Regional integration; Agricultural trade; Fruits and vegetables; Western Balkans

OPEN BALKAN INITIATIVE AND IMPACT ON THE TRADE OF FRUIT AND VEGETABLE

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The Open Balkan Initiative (OBI), established in 2020 by Albania, North Macedonia, and Serbia, aims to enable the free movement of goods, people, capital, and services, fostering stronger regional economic integration in the Western Balkans. This study examines its effects on trade flows in the fruit and vegetable sectors across the three participating countries for the period 2018–2024. Using trade balance and export-import dynamics, the analysis highlights significant trends in regional agrifood exchange. Albania experienced notable growth in the export of tomatoes, cucumbers, cabbages, and strawberries, reflecting improved market access. North Macedonia's gains are visible in increased exports of tomatoes, peppers, and apples, suggesting enhanced competitiveness and reduced trade barriers. Serbia demonstrated strong export performance in carrots, onions, frozen vegetables, and apples, with visible benefits from simplified customs procedures and reduced sampling rates for imported goods. The results underscore that OBI contributed to more efficient cross-border trade and increased specialization within the fruit and vegetable industries. However, the initiative still faces open challenges regarding the inclusion of all Western Balkan economies and the full realization of the four fundamental freedoms. Overall, the Open Balkan Initiative shows promising progress toward building a more integrated and competitive regional agrifood market.

AGRICULTURAL MACHINERY AND SUSTAINABLE AGRICULTURE

ID: 125 / SES-O-AMSA-03: 2

Abstract Submissions

Oral Presentation

Topics: Agricultural Machinery and Sustainable Agriculture

Keywords: Crop productivity, Sustainable land management, Runoff and sediment loss, Soil structural stability

CONSERVATION AND CONVENTIONAL TILLAGE MANAGEMENT IMPACT ON SOIL PHYSICAL PROPERTIES AND EROSION IN CENTRAL CROATIA

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A field experiment was established in Marija Magdalena, Croatia, to assess the impact of conservation tillage (CT) versus conventional tillage (CVT) on soil physical properties, erosion indicators, and crop performance. The trial was implemented in a young plum orchard re-cultivated in 2022, with maize sown in spring 2024. Both treatments were arranged in three replications using a randomized design on uniform slope plots (20 m²) equipped with runoff collectors. Key parameters measured included bulk density (BD), soil water content (SWC), water holding capacity (WHC), penetration resistance (PR), water-stable aggregates (WSA), surface runoff, soil loss, and maize yield. Soil sampling was conducted in the spring and autumn. Five erosion events were recorded during the growing season. Results indicated that CT improved soil structure, reflected in higher WSA and WHC and reduced PR compared to CVT. BD and SWC values suggested better porosity and water availability under CT. Conservation tillage effectively conserved studied soil and significantly reduced runoff and soil loss. Maize yields were comparable between treatments, with a slight advantage under CT, indicating no yield penalty from reduced tillage intensity. Initial data support the benefits of conservation tillage in preserving soil health and minimizing erosion without compromising crop productivity under moderate slope conditions. Continued monitoring is planned to assess long-term impacts and seasonal variability.

Acknowledgements: This work was supported by the Croatian Science Foundation through the project "Forming Climate Smart Soils: Mitigation of Soil Erosion and Degradation Processes in Croatian Agricultural Systems" (IP-2022-10-5692) (FORMclimaSOIL).

ID: 163 / SES-O-AMSA-03: 5

Abstract Submissions

Oral Presentation

Topics: Agricultural Machinery and Sustainable Agriculture

Keywords: waste, vines, fruit, calorimetric

ENERGY POTENTIAL OF PLANT RESIDUES FROM VINES AND FRUIT PLANTS

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The rapid expansion of developing countries economic is increasing the need for energy in both industrial production and daily life. This situation makes it necessary to look for new sustainable energy sources (solar energy, agricultural waste, etc.). To enable fossil fuel prices and dependence to be stabilized in world market in the long term. The amount of plant waste in agricultural production represents a huge potential for energy production (briquettes, pellets, biogas, etc.), particularly from viticulture and fruit growing. The plant residues and the vine-growing system, are approximately 300 to 900 kg/ha, while fruit plantations are between 400 to 900 kg/ha. A sustainable potential for energy sources can be obtained by multiplying this amount of plant residues by the area planted with these crops. The research examines the results of the energy potential of different ratios of plant residues as different variants with the participation of certain plant residues in the briquettes, namely briquettes containing 100% plant residues from grapevines, 100% plant residues from peaches, 100% sawdust, 80-20 ratio vine/peach, as well as 70/30 ratio peach/sawdust. With help of calorimetric tool, the amount of released potential energy in the variants was determined, with the greatest significance in relation to the control variant (100% sawdust) shown by the variant with a ratio of 70% vine and 30% sawdust.

ID: 164 / SES-O-AMSA-03: 4

Abstract Submissions

Oral Presentation

Topics: Agricultural Machinery and Sustainable Agriculture

Keywords: biomass, machines, pellets, briquettes

EXPLOITATION TESTS ON A LINE OF MACHINES FOR THE PRODUCTION OF BIOMASS PRODUCTS

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Manufacturers of a line of machines for producing briquettes have different variants, with different capacities and applications in industrial production, but also a line of machines for producing briquettes with a smaller capacity. About 1% of different biomass is used in the Republic of Macedonia, and the interest in briquettes and pellets is increasing from year to year, and pellets and briquettes are imported from abroad in larger quantities annually. At state level, it is estimated that we have approximately 800,000 m³ of unused biomass, which is used for forestry, viticulture, fruit production and other agricultural crops. The unused plant mass will contribute significantly to the domestic production of alternative energy and thus will directly affect the reduction in the import of briquettes and pellets, which will cover the needs with our own production. The study is intended to analyze the operational characteristics of a line of machines for producing briquettes and pellets at different capacities, their productivity, quality of work and production costs. In order to assess the economic efficiency and total costs of the processing of biomass intended for briquettes and pellets, special emphasis is placed on the monitoring of the energy consumption of the line of machines.

ID: 169 / SES-O-AMSA-03: 6

Abstract Submissions

Oral Presentation

Topics: Agricultural Machinery and Sustainable Agriculture

Keywords: colored shade nets, tomatoes, irradiation, micromoles, watt, chlorophyll

IMPACT OF LIGHT IRRADIATION ON YIELD OF TOMATOES PRODUCED UNDER COLORED SHADE NETS

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Research and use of light radiation in agricultural production have an impact on its diversity and sustainability. In this direction, in order to achieve this objective, an experiment has been carried out in the Skopje region in 2014 and 2015 to determine the impact of colored shade nets with 40 percent shading on the yield of two tomato hybrids. According to the measurements of the amount of light irradiation, the highest average values of 1207.5 $\mu\text{mol}/\text{m}^2$, as well as 127.7 Wm^2 were determined in the control variant (open field) and 1145.8 $\mu\text{mol}/\text{m}^2$ or 120 Wm^2 in Variant I - red nets, significant differences compared to Variant II and Variant III (white and green nets). The results for fruit temperature show the highest significant value of 27.5 C obtained in red nets as well as in the open field (26.4 C) compared to the other variants. Measuring the amount of chlorophyll, as an indicator of plant condition, showed significant differences between the control variant and Variant I (red nets) in relation to Variant II and Variant III. The highest yield was determined in Variant I - red nets 72817.0 kg/ha with a high percentage difference compared to the control and the other variants, which refers to the height of the light irradiation, temperature of the fruit and the achieved amount of chlorophyll.

ID: 170 / SES-O-AMSA-03: 7

Abstract Submissions

Oral Presentation

Topics: Agricultural Machinery and Sustainable Agriculture

Keywords: colored shade nets, tomatoes, water, ash, dry matter, vitamin C

ASSESSMENT OF SEVERAL COMPOSITIONAL AND QUALITY CHARACTERISTIC OF TOMATOES GROWN UNDER COLORED SHADE NETS

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Colored shade nets as a way of light management, promote efficient and sustainable methods of growing and exploiting the potential of tomato hybrids. To achieve this objective, an experiment was conducted in the Skopje area in 2014 and 2015 to assess several composition and quality characteristics and to determine the yield of two tomato hybrids. In addition to the effects of nets with a 40 percent shading under field conditions, which were confirmed by high yields, particularly for the red coloured net, several composition and quality parameters were also confirmed by laboratory tests. During the two years of research, laboratory tests were carried out to measure the percentage of water, dry matter, ash and vitamin C in tomato fruit. Initial results of fruit water percentage showed significant differences between the variants and treatments with red and shade nets (95.7%, 95.5%) compared to the open field (control) and the variant with white shade nets. Based on the results for the percentage of water, the highest results (5.1%) for the percentage of dry matter were found for the white nets variant, as compared with the other variants. The percentage of ash is significantly different in the fruits of the variant with green shade nets (3.99%) compared to the variants with red netting and the control variant. Vitamin C determination results showed differences between variant I (red nets) at 46.2 mg/100 and variant II (white nets) at 46.3 mg/per 100 in relation to control and Variant III (green nets).

ID: 223 / SES-O-AMSA-03: 3

Abstract Submissions

Oral Presentation

Topics: Agricultural Machinery and Sustainable Agriculture

Keywords: Locally fabricated biochar kiln, Biochar production efficiency, Farm residue, Climate change mitigation.

PERFORMANCE AND ECONOMIC EVALUATION OF A LOCAL BIOCHAR KILN USING AGRICULTURAL RESIDUES IN GHANA.

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Biochar has gained attention due to its potential to improve soil carbon storage and mitigate climate change. However, to encourage widespread adoption, biochar production must be cost-efficient and easily accessible, particularly from farm residues. The present study evaluates the performance of a self-energy-recirculating, locally fabricated biochar kiln using five feedstocks: maize cob, rice husk, coconut shell, and flamboyant pods. The specialized kiln can char all organic-based feedstocks, regardless of the particle size. The focus was on energy use efficiency, biochar yield, and the quality of the produced biochar. The study used a slow pyrolysis ranging from 300 °C to 500 °C. Results showed that biochar quality varied across feedstocks, with coconut shells and rice husks requiring more energy but yielding higher amounts of biochar than flamboyant pods, maize cob, and maize stover. Economic analysis indicated that coconut shells and maize cob were the most profitable feedstocks, with profit margins of 57.05% and 76.96%. Shells and maize cob were the most profitable feedstocks, with profit margins of 57.05% and 76.96% and internal rates of return of 3.75 and 1.84, respectively. This suggests that while some feedstocks are more energy-intensive, they offer higher financial returns. Further studies on the environmental benefits of these biochar's, both short term and long-term, are necessary. The findings of this study provide a basis for the development of kilns suited to local conditions, promoting the economical production of biochar from agricultural residues.

ID: 292 / SES-O-AMSA-03: 1

Abstract Submissions

Oral Presentation

Topics: Agricultural Machinery and Sustainable Agriculture

Keywords: agroforestry, carbon cycle, fertilization, training, nitrogen, soil

TRANSFORMING GRASSLAND SCIENCE FOR CLIMATE ACTION: DESIGN OF CARBON FARMING CURRICULUM

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Carbon farming promotes climate-smart practices that enhance carbon sequestration and reduce soil-based GHG emissions. Grasslands play a pivotal role due to their botanical, physiological, and agronomic traits, contributing significantly to soil carbon storage. To leverage this potential, the agricultural workforce must be equipped with tailored knowledge and skills. This work suggests the first in Europe professional curriculum on carbon farming, developed in response to European sectoral needs, addressing an urgent training gap in the EU agriculture. The curriculum emphasizes grasslands and aligns climate, ecological, and economic goals. Being the first of its kind and structured around the carbon cycle, it integrates scientific understanding, practical training, and business models to support rural entrepreneurs and green innovators in certifying carbon removals.

APICULTURE

ID: 131 / SES-P-API-01: 10

Abstract Submissions

Poster Presentation

Topics: Apiculture

Keywords: Chalkbrood, *Ascosphaera apis*, *Paenibacillus polymyxa*, biological control

EXPLORING COMPOST-ASSOCIATED BACTERIA FOR ECO-FRIENDLY SUPPRESSION OF A FUNGAL PATHOGEN IN BEEKEEPING

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Chalkbrood is a widespread mycotic disease of honeybee brood, caused by the spore-forming fungus *Ascosphaera apis*. The disease compromises the integrity of brood development and colony health and is an enormous risk to global apiculture. As pressure mounts for more ecologically friendly alternatives to synthetic antifungals, this study aimed to determine the prospects of compost-isolated bacteria as antifungal control agents against *A. apis*. Samples of compost were collected and processed for microbial isolation, yielding eight various bacterial strains, which were taxonomically identified as *Bacillus velezensis*, *Paenibacillus alvei*, *Paenibacillus polymyxa*, and another *Bacillus* spp.

The antifungal activity was tested through agar well diffusion assays against active growth cultures of *A. apis*. Of the isolates screened, the strongest antifungal activity was exhibited by strain AA/15, which was identified as *Paenibacillus polymyxa*, with big zones of inhibition that reflect strong antagonistic potential.

The results recognize the promise of *P. polymyxa* AA/15 as a prospective biocontrol agent in apiculture, providing a green and natural solution to counter the effects of chalkbrood disease. The future research priorities are the extraction and characterization of its bioactive molecules, determination of antifungal activities, genomic investigations on biosynthetic gene clusters, and in vivo efficacy testing under practical conditions. They could result in the development of a biologically derived, residue-free treatment product, promoting healthier colonies of bees and enhancing sustainability in beekeeping.

ID: 161 / SES-P-API-01: 6**Abstract Submissions****Poster Presentation***Topics:* Apiculture*Keywords:* genetic diversity, selective breeding, disease resistance, conservation, sustainability**SELECTION AND GENETIC RESOURCES OF THE EUROPEAN HONEYBEE (APIS MELLIFERA): TOWARD SUSTAINABLE APICULTURE****Sladjan Rasic¹, Mića Mladenović²**¹UNIVERSITY EDUCONS, Faculty of ecological agriculture, Sremska Kamenica, Serbia; ²University of Belgrade, Faculty of agriculture, Belgrade, Serbia; rasic.sladjan@gmail.com

The European honeybee (*Apis mellifera*) is a vital pollinator and a key contributor to agricultural productivity and biodiversity. Across Europe, several native subspecies—such as *A. m. mellifera*, *A. m. carnica*, and *A. m. ligustica*—demonstrate rich genetic diversity and local adaptation. This review summarizes the current state of genetic resources and breeding strategies in European apiculture. It addresses traditional selection criteria such as honey yield, docility, overwintering performance, and resistance to diseases like *Varroa destructor*. Emphasis is placed on challenges like genetic erosion from commercial queen importation, hybridization, and loss of native populations. The paper further outlines conservation initiatives and breeding programs aimed at preserving regional diversity while improving performance traits. Advances in molecular genetics and genomic tools are also discussed as a foundation for sustainable breeding practices. Ultimately, the integration of conservation and innovation is essential for resilient beekeeping under increasing environmental and economic pressures.

ID: 165 / SES-O-API-01: 3

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: biosecurity, colony collapse, invasive species, *Tropilaelaps mercedesae*

TROPILAELOPSIS, A NEW THREAT TO EUROPEAN APICULTURE

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Tropilaelaps mercedesae poses an emerging threat to European apiculture. Originally native to Asia, these mites are now advancing westward, with documented occurrences in Central Asia, southwestern Russia, and Georgia, indicating a continuous overland movement toward Europe. This westward spread is alarming for the continent, particularly due to the proximity of infested regions and the elevated risk associated with intensive beekeeping, illegal trade, and climate change, which may facilitate the geographic migration of the mites. Milder winters and extended brood-rearing periods resulting from climate change further increase the likelihood of their establishment in temperate regions, such as the Western Balkans and the Mediterranean. Given the mites' rapid reproductive cycle and the severe parasitic impacts they cause, their establishment in new areas could lead to significant colony collapse rates and economic losses, potentially exceeding those caused by *Varroa*. However, the mites' life cycle, which strongly depends on the presence of honey bee brood, presents a promising opportunity for developing chemical-free control strategies, particularly through methods aimed at interrupting brood rearing. Effective management of this emerging threat will require enhanced surveillance, improved detection protocols, stricter border controls, rapid response strategies, and research into integrated control methods. Proactive preparation is vital to protect European apiculture from the threats posed by *Tropilaelaps*, especially given the high risk of introduction.

ID: 166 / SES-P-API-01: 3

Abstract Submissions

Poster Presentation

Topics: Apiculture

Keywords: element, ICP-MS, nutrition, pollen, *Tenebrio molitor*

IRON COMPOSITION IN HONEY BEE WORKERS VARIES WITH AGE AND DIET

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Minerals are essential for the reproduction and development of both adult bees and larvae. Some elements, such as Na, K, Ca, Mg, and P, are beneficial, while others, including Al, Pb, Cd, and Ba, may be toxic. Honey bees acquire these elements through nectar, pollen, and water. Once ingested, minerals pass through the digestive tract, where only bioavailable forms are absorbed; non-bioavailable forms, such as those embedded in pollen walls, are excreted. To better understand the physiological role of individual elements, this study examined age- and diet-related changes in mineral composition of worker bees. Four experimental colonies were established using bees from five different source colonies. Colonies were fed sugar patties supplemented with either yeast (Y), pollen (P), yellow mealworm flour (T), or sugar only (S). After seven days of feeding, 150 paint-marked bees were introduced into each colony. Marked bees were sampled at 7, 14, 21, and 28 days post-introduction. Prior to analysis, the midgut and hindgut were removed, and the remaining body tissues were analysed for the concentrations of 29 elements using inductively coupled plasma mass spectrometry (ICP-MS). In this abstract, we present results for iron (Fe), selected as a representative element due to its biological relevance and known role in magnetoreception. Fe concentrations were significantly higher on days 21 and 28 compared to days 7 and 14 across all dietary groups. This pattern corresponds with the typical onset of foraging behaviour in worker bees, which begins between 14 and 21 days of age.

ID: 167 / SES-P-API-01: 7

Abstract Submissions

Poster Presentation

Topics: Apiculture

Keywords: bioavailability, body without gut, element, gut, ICP-MS

SODIUM DISTRIBUTION IN HONEY BEE WORKERS, LARVAE, AND BEE BREAD

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Sodium (Na) is an essential element with known physiological roles in insects, yet its dynamics and bioavailability in honey bee (*Apis mellifera* L.) nutrition remain insufficiently understood. This study aimed to investigate Na distribution in workers (W), worker bodies without guts (B), guts (G), larvae (L), and perga (P). A large-scale analysis was conducted at two apiaries in Austria during different time points. Using inductively coupled plasma mass spectrometry (ICP-MS), concentrations of 26 elements were determined, with sodium selected as a representative element due to its physiological importance.

Results showed that, unlike most tested elements which were most concentrated in the gut, Na levels were relatively uniform across tissues. Specifically, there was no significant difference in Na concentration between W, B, G and L. However, P had significantly lower Na levels compared to all other groups. This suggests that pollen alone may not supply sufficient Na to meet the nutritional needs of bees.

It is known that bees exhibit a strong preference for Na-rich water sources, especially in environments where pollen is Na-deficient. Previous studies have shown that sodium stimulates water foraging and improves colony-level performance. Our findings are consistent with earlier reports showing that among macronutrients (K, Ca, Mg and Na), Na is present at the lowest levels in pollen. The comparable Na concentrations in B, G, and L also suggest efficient transfer of bioavailable Na through brood food. These results underscore the importance of supplemental sodium sources in managed colonies, especially during periods of restricted access to water.

ID: 179 / SES-O-API-01: 4

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: Apis mellifera, Tropilaelaps, survival transmission, substrate dependent viability.

AN IN-VITRO ASSESSMENT OF TROPILAELOPS MERCEDESAR SURVIVAL ACROSS A RANGE OF SUBSTRATES.

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Tropilaelaps spp. are parasitic mites that feed and reproduce within honey bee brood (*Apis* spp.), causing significant damage to *Apis mellifera* colonies. While traditionally believed to be incapable of surviving without live brood, recent findings suggest *T. mercedesae* may persist during broodless periods. This study aimed to investigate the survival potential of *T. mercedesae* on various substrates in the absence of live brood, with a focus on understanding possible mechanisms supporting its persistence and spread. An in vitro survival experiment was conducted using *T. mercedesae* mites placed on three types of substrates: live adult bees (*A. dorsata* / *A. mellifera*), decomposing pupae, and decomposing adults (*A. mellifera*). Mite survival was monitored over time under controlled conditions. Survival duration was recorded and analysed using Log Rank tests and visualized with Kaplan Meier survival curves to identify differences in survival across substrates. Mites survived for over 96 hours on live adult *A. mellifera*, over 144 hours on decomposing pupae, and up to 168 hours on decomposing adults. These findings demonstrate the mite's ability to survive for extended periods without access to live brood, challenging existing assumptions about its biology and survival limits. This study highlights a potential survival mechanism of *T. mercedesae* outside brood environments, which may contribute to its spread through previously considered low-risk pathways, such as queen/package bee trade and used beekeeping equipment. These findings underscore the need for updated biosecurity protocols and further research into transmission dynamics and control strategies.

ID: 180 / SES-O-API-01: 2

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: Apis mellifera, Varroa destructor, biotechnical methods, infestation, honey production

EFFECT OF BROOD INTERRUPTION METHODS ON INFESTATION OF HONEY BEE (APIS MELLIFERA L.) COLONIES WITH VARROA DESTRUCTOR

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This study evaluated the effectiveness of three methods for controlling the ectoparasitic mite Varroa destructor: brood interruption by queen caging (QC), queen confinement on a single isolator frame (ISO), and extended oxalic acid release via glycerol strips (GLX). These were compared to a control group treated with CheckMite+ (C group). Monitored parameters included colony strength, brood area, honey yield during sunflower flow, mite infestation, and virus presence.

At the start (July 5, 2023), colonies had an average of 23.672 bees and 22.865 brood cells, with no significant differences among groups ($p > 0.05$). By the end (October 13), colony size had decreased to an average of 11.880 bees and 11.076 brood cells, again without significant differences. Initial mite infestation averaged 1.71%, lowest in GLX (1.26%) and highest in ISO (2.01%), though differences were not significant. However, by October 13, infestation levels differed significantly ($F(3,23) = 6.267$, $p = 0.004$), with ISO (2.27%) and QC (2.41%) groups showing significantly lower mite levels than GLX (4.84%) and control (6.04%). No significant differences were found in DWV-A or DWV-B virus presence among groups. Average honey yield was 18.03 kg per colony, with no significant group differences.

Results indicate that brood interruption methods during the summer nectar flow do not impair colony development or honey production but significantly reduce V. destructor infestation compared to glycerol and control treatments.

ID: 200 / SES-P-API-01: 11

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: Tropilaelaps, infestation, algorithm, computer vision, automated detection

COMPUTER VISION TECHNIQUES FOR AUTOMATIC DETECTION OF TROPILAEALAPS MITES IN HONEY BEE COLONIES (APIS MELLIFERA)

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Tropilaelaps mercedesae poses a significant threat to Apis mellifera colonies due to its rapid reproductive cycle and destructive impact. Building on previous work introducing the Rapid Brood Decapping (RBD) method as a fast, non-destructive means of revealing mite presence, this study automates the technique by integrating video and image analysis to detect mites. Following the RBD protocol, sealed brood cells were decapped using wax strips, and short video sequences were recorded immediately after uncapping. These videos were then processed using computer vision techniques to automatically detect mite presence and track its movement. The algorithm processes each video frame to detect Tropilaelaps mites by identifying and tracking small moving objects using background subtraction, morphological filtering, and blob analysis, with automatic bounding and merging of nearby detections to improve accuracy. This novel approach allows for fast and scalable detection of Tropilaelaps mites, overcoming the limitations of manual observation, which is often slow, error-prone, and challenged by the mites' small size and fast movement. The preliminary results show high detection accuracy and potential for real-time hive monitoring, making this automated extension of the RBD method a step toward integrating mite detection into digital honey bee health surveillance systems.

ID: 207 / SES-P-API-01: 1

Abstract Submissions

Poster Presentation

Topics: Apiculture

Keywords: drone larvae, physicochemical parameters, microbial contamination, nutrition

APILARNIL FROM THE SOUTHERN ROMANIAN REGION - CHEMICAL CHARACTERIZATION AND MICROBIOLOGICAL INDICATORS FOR FOOD SAFETY

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The newest bee product used in nutrition as a valuable food source and for its potential health benefits, Apilarnil is a very promising natural bee product obtained by collecting and homogenizing of bee drone larvae aged 3-7 days.

Having been discovered for less than half a century, apilarnil is used in some cultures in food and more often in therapy and cosmetic applications.

The aim of this study was to perform both physicochemical and spectral characterization of apilarnil from the southern area of Romania. By these methods were identified the main groups of nutritional components. Additionally, by microbiological assays we evaluated the safety of using the bee drone larvae in food industry in terms of the risk of microbial contamination.

Due to these factors, application of bee drone larvae in nutrition increased over the years, but still remains very low. To overcome this situation, more research is needed to optimize the production and find new ways to reveal the newest bee product used in food, therapeutic and cosmetic practices.

ID: 213 / SES-P-API-01: 8

Abstract Submissions

Poster Presentation

Topics: Apiculture

Keywords: Honey bee colonies, colony density, production, environment, consequences

THE CURIOUS CASE OF THE NUMBER OF HONEY BEE COLONIES IN MACEDONIA. WHY DO THE NUMBERS MATTER?

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An increasing number of scientific studies challenge the orthodox paradigm of viewing honey bees solely in a positive light, particularly regarding their environmental impact. The primary concerns relate to resource competition between managed honey bees and other pollinators, the risk of pathogen spillover among these groups, and the sustainability of current beekeeping models. Nowadays, urban beekeeping, as a small-scale operation, is gaining significant interest. Still, the demand for honey bee products promotes commercially oriented beekeeping concepts, such as large-scale production capacities associated with managing an extensive number of honey bee colonies per unit. The number of honey bee colonies in the EU has recorded a positive trend over the last decade, from 16 million (2016) to more than 20 million (2023) colonies. In Macedonia, according to www.makstat.stat.gov.mk, this tendency is significantly more pronounced, with an increase from 80,000 honey bee colonies registered in 2016 to over 300,000 in 2023. Nonetheless, the total honey production in the country does not follow the same positive trend. The "phenomenon" was reported by Dimitrov, Simonovska, and Uzunov (2022), who identified anomalies and discrepancies in the number of honey bee colonies from a spatial and diachronic perspective, as well as from a methodological standpoint. We will further discuss the rationale, impact, and significance for the environment, beekeeping, and agricultural policy.

ID: 217 / SES-O-API-03: 2

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: Women beekeepers drivers for positive change

EMPOWERED BEEKEEPING FAMILIES IN THE FIELD OF BEEKEEPING WITH AN EMPHASIS ON THE INVOLVEMENT OF WOMEN AND YOUNG

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A three-year development project "Women beekeepers as drivers of positive change" with the emphasis on training woman beekeepers has been designed and initiated in Macedonia. The project was supported by the Ministry of Foreign and European Affairs of the Republic of Slovenia. In total 50 women from the Macedonian Vardar and North-East regions were trained for practicing organic beekeeping. In addition, the project supported setting up and equip 25 apiaries. The training program, implemented from 2023 to 2025, enclosed sessions on honey bee biology, beekeeping equipment, colony management, production of honey bee products, bee colonies health management, marketing and management. In cooperation with the Faculty of Agricultural Sciences and Food in Skopje, a Bee Park was built and equipped. The park is for the benefit of students from the faculty, but also for all interested citizens who want to learn more about the biology of the honey bees, as well as all other pollinators, about honey plants, beekeeping and bee products. The cooperation with the faculty was also extended to the Laboratory for honey bee biology and selection, for whose needs an apiary was built and equipped through the project, the main purpose of which is the education of students, experienced beekeepers and beginners in beekeeping, but also for the realization of certain scientific research.

keywords: positive, change, Bee Park

ID: 220 / SES-P-API-01: 5

Abstract Submissions

Poster Presentation

Topics: Apiculture

Keywords: Apis mellifera, queen bee, brood break, Varroa destructor, ringing

QUEEN RINGING AS A METHOD TO INDUCE WINTER BROOD BREAK IN HONEY BEE COLONIES

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Warmer winters in temperate regions are shortening or eliminating natural brood breaks in honey bee colonies, enabling the continuous reproduction of Varroa destructor. Queen ringing is a novel method that physically prevents ovipositioning while allowing the queen to move freely within the cluster, potentially making it suitable for winter brood interruption. This study was conducted in continental Croatia from autumn 2023 to spring 2024 to evaluate the effects of queen ringing on colony strength, Varroa infestation and honey consumption. Thirty-two colonies were divided into two groups: ringing (R) and control (C). At the start of the study, the R group had significantly fewer adult bees (9859 vs. 11562), while brood and food stores were similar. By spring, the number of adult bees was comparable, but the C group had significantly more brood. Initial, Varroa infestation levels were similar in both groups. However, after one month, infestation in the C group rose to 2.42%, compared to 0.62% in the R group, which was significantly higher. Additionally, winter honey consumption was significantly lower in the R group (4.15 kg) in comparison to the C group (5.35 kg). These findings suggest that queen ringing can effectively induce brood interruption during winter, reducing Varroa pressure and food consumption without compromising colony strength. As a minimally invasive method that avoids full confinement of the queen, it shows potential for integration into sustainable beekeeping practices. Further research is needed to evaluate long-term effects on queen performance and colony productivity.

ID: 225 / SES-O-API-03: 3

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: Honey bee health, Pollen contamination, Chronic toxicity, Vitellogenin, Gut microbiota

UNEXPECTED RISKS FROM NUTRITIONAL AND BOTANICAL TRAITS OF POLLEN

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The western honey bee (*Apis mellifera* L.) is increasingly exposed to pesticide-contaminated pollen within intensive agroecosystems, raising concerns about chronic sublethal effects on bee health. This study aimed to assess how pollen contaminated with realistic pesticide levels influences survival, nutrition, and physiological responses in honey bees. Monofloral pollens from *Malus domestica*, *Phacelia tanacetifolia*, and *Taraxacum officinale*, sourced from agricultural areas with varying contamination profiles, were tested alongside an uncontaminated control and a commercial protein supplement. Field and laboratory feeding trials over 31 days revealed that pesticide load alone did not predict toxicity: while highly contaminated pollen supported moderate survival, uncontaminated pollen from a high-altitude site led to unexpected high mortality. Vitellogenin accumulation, a key health biomarker, was significantly elevated in bees consuming natural pollen diets, particularly apple pollen, but remained low in bees exposed to pesticides or artificial supplements. Gut microbiota analyses indicated that pollen-fed bees showed increased abundance of core bacterial taxa; however, some diets, notably those based on dandelion and phacelia, also promoted the proliferation of pathogens such as *Nosema ceranae* and *Serratia marcescens*. These findings highlight the complex dual role of pollen as both a nutritional resource and a vehicle for contaminants, revealing unexpected risks even from pollens considered “clean.” The results call for more ecologically grounded risk assessments that consider botanical origin, nutritional profiles, and microbial interactions, rather than focusing solely on pesticide residues.

ID: 226 / SES-O-API-02: 5

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: *Apis mellifera ruttneri*, gut microbiota, environmental exposure, local adaptation, pollinator conservation

MALTA'S LANDSCAPE SHAPES THE GUT MICROBIOTA OF ITS ENDEMIC HONEY BEE SUBSPECIES, *APIS MELLIFERA RUTTNERI*

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The gut microbiota plays a crucial role in honey bee health, immunity and environmental adaptation, yet the balance between host genetics and environmental exposure in shaping it remains unclear. *Apis mellifera ruttneri*, the endemic Maltese honey bee subspecies, has been reported to harbour a higher proportion of environmental bacteria than other subspecies, such as *A. m. ligustica* and *A. m. carnica*.

To disentangle genetic and landscape effects, we co-located colonies of *A. m. ruttneri* and *A. m. ligustica* in experimental apiaries in Malta (Mediterranean) and northern Italy (continental) for 13 months. Monthly worker bee guts and stored pollen were profiled by 16S rRNA amplicon sequencing. Across both sites, the two subspecies shared the similar core gut taxa, however their relative abundances differed sharply. *A. m. ruttneri* consistently carried higher levels of soil- and plant-associated bacteria (Bartonellaceae, Apilactobacillus, Pseudomonas), whereas *A. m. ligustica* was dominated by host-adapted Lactobacillus and Bombilactobacillus. This pattern points to a strong environmental influence on the gut microbiota of the Maltese honey bee.

Collectively, our results show that *A. m. ruttneri* hosts a microbiota shaped by long-term exposure to the ecological conditions of the Maltese landscape, revealing a previously overlooked microbial facet of local adaptation. By demonstrating the microbial distinctiveness of local subspecies, we highlight the need to consider microbial ecology in pollinator conservation strategies, especially in the face of accelerating climate and land-use change.

Research carried out as part of BeeSustain (Research Excellence Fund, Xjenza Malta) and supported by TESS (Tertiary Education Scholarship Scheme, MEYR).

ID: 227 / SES-O-API-03: 4

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: PGPB, VOCs, SWEET transporters, Nectar, Pollinator interaction

SOIL MICROBIOTA INFLUENCE FLORAL SIGNALS AND POLLINATOR ATTRACTION IN SUNFLOWERS

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Sunflowers (*Helianthus annuus*) are a key floral resource for pollinators due to their abundant nectar and pollen. Nonetheless, a marked decline in nectar production has been observed in various regions worldwide, often linked to drought stress. In parallel, reductions in soil microbial diversity within agroecosystems may also impair plant-microbe interactions critical for optimal floral development. Beneficial soil microorganisms are known to facilitate nutrient availability and modulate plant signalling pathways, potentially influencing both nectar secretion and the emission of volatile organic compounds (VOCs), which play a role in attracting pollinators. Plant Growth-Promoting Bacteria (PGPB), including strains of *Bacillus*, *Pseudomonas*, and *Lactobacillaceae*, are commonly used to enhance crop performance, but their impact on floral traits relevant to pollination remains poorly understood. To explore this, we conducted a field experiment in Italy using both hybrid and open-pollinated sunflower varieties grown in soils inoculated with different PGPB. Floral VOCs were analysed using SPME-GC, and expression of SWEET sugar transporter genes was assessed via RT-qPCR. Root-associated microbial communities were characterised through Illumina HiSeq sequencing. The rhizosphere microbiota composition was found to be primarily influenced by sunflower genotype rather than microbial inoculation. In contrast, PGPB treatments, particularly *Pseudomonas*, significantly modulated VOC profiles and enhanced pollinator visitation. Moreover, PGPB-induced changes in SWEET gene expression suggest a microbial role in shaping nectar secretion. These findings provide new insights into how soil microbiota influence floral traits and pollinator interactions in sunflowers.

ID: 228 / SES-O-API-02: 2

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: marking, queen identification, queen ringing, RFID tag, weight of tags

EXAMINATION OF THE MASS AND DIMENSIONS OF ADDED ELEMENTS ATTACHED TO HONEY BEE QUEENS

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Queen bees are marked with various visual and functional elements for identification and apitechnical purposes. To facilitate their detection, colored and numbered tags are commonly used. Additionally, electronic markers such as RFID tags are applied for tracking and data collection. In addition, one apitechnical method, queen ringing, is used to temporarily prevent egg laying. However, the mass and dimensions of these elements vary significantly depending on the model and manufacturer.

Based on preliminary data, we analyzed the masses of commonly used elements relative to the average body weight of a queen bee. All values represent the average of five measurements. The standard plastic numbered tag weighs 2.28 mg (Ø 2.2mm). Colored decorative zircons used for improved visibility weigh 3.5 mg (Ø 1.1-2.5 mm). Newer magnetized metal tags weigh 9.12 mg (Ø2.5 mm), while electronic tags (RFID/UHF) typically weigh 5.3 mg (up to Ø 2.5 mm). Glue used for tags contributes 1.2–2.0 mg, shrinking by 10–60% depending on type. The ring, for queen ringing, weighs 55.2 mg, with a length of 7.5 mm and diameter of 6 mm.

Assuming an average queen bee weight of 200 mg, the following weight percentages were observed (including ~1 mg of dried glue): plastic tag 1.64%, zircon 2.25%, metal tag 5.06%, RFID tag 3.15%, and ring 27.6% of her total body weight. In our trial of eleven queens ringing, no mortality or abnormal behavior was recorded, suggesting that the masses of all other elements do not significantly impair the queen's normal function.

ID: 229 / SES-O-API-04: 5

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: honey bee, genetic resources, subspecies, breeding

EXPLORATION OF HONEY BEE GENETIC DIVERSITY IN CHINA AND ITS BREEDING PERSPECTIVES

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Animal genetic resources, including honey bees, are vital for adapting to future challenges, making their protection and exploration key for sustainable apiculture. China, with its large land and complex landscapes, holds great potential for honey bee genetic diversity, requiring exploration of understudied regions and understanding of population evolution. We discovered a new subspecies of the Western honey bee, *Apis mellifera sinisxinyuan* (Xinyuan bees) in eastern Tian Shan Mountains, China. Initially, morphometrical analyses grouped them with the European dark bees, but genome-wide markers revealed they form a distinct group in M-lineage, with subspecies-level genetic differentiation from the European dark bees. For Eastern honey bees (*Apis cerana*), genomic studies showed high mountainous (e.g., Qinghai-Tibet Plateau) and island populations have high differentiation, with some potential subspecies. In the mountainous area, we found Batang population as a new genetic resource in China. Breeding strategies differ for the two species: *A. cerana* requires protection of local resources with genetic improvement for conservation; *A. mellifera* focuses on commercial breeding and crossbreeding.

ID: 230 / SES-O-API-04: 4

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: Honeybee, Microbiome, Nucleotide excision repair, Ultraviolet radiation, Environmental adaptation

MECHANISM OF MICROBIAL-MEDIATED DNA DAMAGE AND REPAIR IN APIS MELLIFERA UNDER ULTRAVIOLET RADIATION.

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Research has demonstrated that environmental change serves as a critical driver behind the decline in bee populations. A major manifestation of these environmental changes is the increasing intensity of ultraviolet (UV) radiation due to global ozone layer depletion. The increased UV exposure that bees encounter during their frequent outdoor activities poses a serious threat to their survival and health. However, the mechanisms by which *Apis mellifera* responds to UV radiation is still unknown. Previous studies have shown that UV radiation stress results in DNA damage, reduced survivability, and alterations the microbial community structure of *Apis mellifera*. Notably, germ-free bees exhibited increased mortality and diminished DNA damage repair ability under UV exposure. It is suggested that microbiota participate in host adaptation to UV radiation by mediating DNA damage repair. This project intends to identify specific bacterial involved in host response to UV radiation stress through in vitro culture and microbiota transplantation. Additionally, genome and metabolome will be elucidate the molecular mechanism of microbial regulation of host adaptation to UV radiation stress. In summary, this project provides crucial scientific evidence and novel insights for exploring beekeeping and conservation techniques in high-altitude regions with intense UV radiation, and provides a theoretical basis for improving the adaptability of beneficial insects to environmental stress, maintaining population health and ensuring agricultural production by regulating symbiotic microbiome.

ID: 234 / SES-P-API-01: 4

Abstract Submissions

Poster Presentation

Topics: Apiculture

Keywords: Apis mellifera, honey bee, sustainable management, threshold

PRECISE ESTIMATION OF VARROA INFESTATION LEVELS AS A TOOL FOR PRECISION BEEKEEPING

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As in other agricultural sectors, precision beekeeping should not rely on scheduled chemical treatments, but rather apply them only when disease pressure exceeds specific thresholds. Currently, the Varroa mite represents the most significant threats to honey bee (*Apis mellifera*) health, compelling beekeepers to treat hives multiple times per year to control both the parasite itself and the various diseases it transmits. Repeated treatments have negative side-effects, thus sustainable apiculture aims to reduce chemical treatments by using threshold-based treatments, biotechnical methods and breeding bees for resistance to Varroa. To apply these approaches, accurate estimation of Varroa infestation levels is required, for which several methods are available: natural mite fall counts, assessments of adult bee infestation, brood infestation evaluations, and colony strength measurements. Each method has its own advantages and limitations.

In this work, we present and discuss how these methods interact, drawing on two years of data from an experimental apiary in Bologna (central Italy) comprising over thirty hives. We evaluate the practicality of each method, required equipment, and impact on colony health, considering perspectives relevant to both research and to professional and hobbyist beekeeping. We show that the washing method yields a higher infestation, that the strength of the colony and time of the season influence correlation between results of different methods and that several methods should be used at the same time to ensure safe decision making.

ID: 236 / SES-O-API-04: 1

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: physico-chemical characteristics, polyfloral honey, honeydew, chestnut honey

DIFFERENCES BETWEEN DIFFERENT TYPES OF HONEY IN NORTH MACEDONIA

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The objective of the paper is to present the differences in the organoleptic and physico-chemical characteristics of various types of honey from North Macedonia.

With melissopalynology analysis of 180 honey samples from North Macedonia, 148 samples of polyfloral honey, 3 monofloral chestnut honey, 29 honeydew samples were identified.

Based on the provisions of the European Honey Directive 2001/110, EU Directive 2014/63, AOAC Official Methods of the International Honey Commission were used to analyze parameters which characterize the physico-chemical characteristics of honey: electrical conductivity, reducing sugars-fructose and glucose, saccharose, water content, acidity, HMF, mineral content and content of insoluble substances.

Based on the analysis of variance, statistically significant differences have been identified in the electric conductivity, content of saccharose, water content, HMF and mineral content between honey of different botanical origin.

With a Tukey HSD Post-hoc-Test statistically significant difference (0,000) was identified in the electric conductivity between polyfloral honey and honeydew.

Statistically significant difference was identified also in the saccharose content between polyfloral honey and honeydew, as well as between honeydew and monofloral chestnut honey.

There is a statistically significant difference in the content of minerals between polyfloral and chestnut honey, as well as polyfloral honey and honeydew.

ID: 237 / SES-O-API-03: 5**Abstract Submissions****Oral Presentation***Topics:* Apiculture*Keywords:* bee products, pollen, perga, food safety, apiculture**MICROBIOLOGICAL APPROACH TO USE BEE POLLEN AND PERGA FOR THEIR BIOAVAILABILITY AS THE SUPPLEMENT FOODS****Asli Ozkirim**Hacettepe University, Türkiye; asli.ozkirim@gmail.com

In recent years, bee products have become increasingly important in health protection and supplementary food. Bee pollen and perga, among these bee products, are preferred nutritional supplements due to their protein, carbohydrate, and fat content, as well as their richness in vitamins and minerals. However, when compared to pollen and perga with each other, many studies have shown that bee bread is preferred in terms of bioavailability due to both the probiotic microorganisms it contains and the pollen extract released due to the metabolism of the pollen's exine layer by microorganisms. This study compared the microorganism content and biochemical properties of pollen and bee samples collected from 25 different locations to determine the probiotic microorganism content and quantity that make bee bread superior to pollen. Unlike other studies, fungal activity in bee bread was observed to be greater than bacterial activity. Accordingly, bacteria and yeasts play the most active role in fermentation. The results of the study showed that bee bread contains significantly more probiotic microorganisms than pollen, but metabolizing the exine layer and using pollen as a substrate significantly reduces its phenolic content. Phenolic compounds, which confer antioxidant and antimicrobial properties to pollen, are present in lower amounts in bee bread, while probiotic microorganisms and postbiotic compounds are present in higher amounts in bee bread. However, the survival rate and type of microorganisms vary depending on storage conditions. Therefore, the choice of pollen or bee bread should be based on the food's characteristics and intended use.

ID: 248 / SES-O-API-01: 5

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: breeding, DPC, mating, selection, Varroa

INNOVATIVE BREEDING STRATEGIES FOR RESILIENT BEEKEEPING WITHIN THE FRAMEWORK OF THE BEEGUARDS PROJECT IN MACEDONIA

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The main objective of the study, as part of WP2 – Innovative Breeding Strategies in BeeGuards project, is to validate the reproductive fitness of Varroa-challenged drone-producing colonies (DPC) in comparison to DPCs managed by conventional Varroa control practices. An additional goal is to test the possibility of shortening and accelerating the standard breeding cycle to enable rapid data collection, breeding value estimation, and selection. The research is implemented in four countries: Macedonia (WP2 leader), Italy, Poland and Germany. In Macedonia, near Skopje, two apiaries with a total of n=42 honey bee colonies were set apart 700 meters from each other. Each apiary consists N=21 colonies from N=3 different queen sister groups from *Apis mellifera macedonica*. The first apiary, called conventional, is managed by a local beekeeping practice for Varroa control, amitraz for summer, and oxalic acid trickling as winter treatment. The second, so-called innovative, is managed by applying a bio-technical method with chemical treatment (queen caging for 21 days with oxalic acid trickling as a single annual treatment). Data and samples are collected at different periods and frequencies for assessing total of 17 parameters. Prior to the mating season, daughters (n=42) are produced from the queens of each colony, and the same colonies are used as DPCs. During the mating season, a single location, Toranica (1537m), is used as an isolated mating station for both apiaries at different periods of the season. The experience and the preliminary results of the first seasons will be presented and further discussed.

ID: 249 / SES-P-API-01: 9

Abstract Submissions

Poster Presentation

Topics: Apiculture

Keywords: Apis mellifera ligustica, Apis mellifera siciliana, performance testing, morphometry, BLUP Animal Model

THE ITALIAN NATIONAL REGISTRY FOR BEE BREEDERS: SAFEGUARDING LOCAL HONEY BEE SUBSPECIES

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Established in 1997 by the Italian Ministry of Agriculture, the National Registry for Italian Queen Breeders aims to protect and improve the native honey bee subspecies *Apis mellifera ligustica* and *Apis mellifera siciliana*. Participation is voluntary but requires breeders to meet criteria, including managing ≥ 100 colonies, adequate facilities, and ≥ 3 years of queen production experience. Enrollment is decided after field inspections and morphometric analyses to confirm conformity with subspecies standards.

Registered breeders periodically submit samples to monitor subspecies standards. Performance testing is conducted annually on sister queens from selected breeding lines, which are anonymized and distributed to testing centers across Italy. Testing criteria include honey production, swarming tendency, defensive behavior, and disease resistance traits such as hygienic behavior and *Varroa* infestation levels.

Data from breeders and testing centers are centralized and processed with the BLUP Animal Model adapted for honey bees, producing breeding values that incorporate family performance, testing environment, and genetic background. These values are published online (www.beebreed.eu), supporting selection decisions and transparency.

Studies on Registry population confirm that Italian honey bees maintain unique genetic traits and show genotype–environment interactions, underscoring the value of local breeding efforts. Through coordinated genetic monitoring, standardized performance testing, and open data sharing, the Registry helps conserve the diversity and productivity of Italian honey bees while supporting both professional and semi-professional breeders.

The Registry is coordinated by CREA, which also manages at least one performance testing station annually, collaborating with breeders, beekeeper associations, and other scientific institutions.

ID: 250 / SES-O-API-04: 6

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: Native honey bee, Varroa resistance, colony survival, Mediterranean, *Apis mellifera ruttneri*

PERFORMANCE OF NATIVE APIS MELLIFERA RUTTNERI VERSUS INTRODUCED A. M. LIGUSTICA UNDER MALTESE CONDITIONS

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The endemic Maltese honey bee (*Apis mellifera ruttneri*) is increasingly threatened by imports of the commercially popular Italian subspecies (*A. m. ligustica*). To quantify the adaptive value of the native subspecies, we monitored 15 colonies of *A. m. ruttneri* and 18 of *A. m. ligustica* from June 2017 to March 2020 in two Maltese apiaries.

Assessments documented survival, population dynamics, honey yield, hygienic behaviour and parasite/pathogen loads were taken every two months. Untreated *A. m. ruttneri* colonies outlived *A. m. ligustica* by over a year: mean survival 25.4 ± 2.7 months versus 11.3 ± 0.9 months, with 53% of *A. m. ruttneri* still alive after 32 months and no *A. m. ligustica* surviving beyond 17 months ($p < 0.01$). At the spring peak, *A. m. ruttneri* produced significantly larger adult bee and brood populations ($p < 0.01$) and yielded 1.3 fold more honey under identical management. Social immunity tests showed *A. m. ruttneri* to be 14% more hygienic ($p < 0.01$) and to maintain Varroa loads below 22 mites per 10g bees, whereas *A. m. ligustica* peaked at 57 mites and collapsed within a year. Virus incidence and Nosema prevalence remained low and did not account for colony losses. These results highlight the inherent resilience of *A. m. ruttneri* and support its conservation and deployment in treatment-reduced, sustainable Mediterranean apiculture.

These findings confirm that *A. m. ruttneri* is well adapted to Malta's environmental conditions and harbours inherent resistance traits that can underpin sustainable beekeeping.

ID: 251 / SES-O-API-04: 3

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: Oriental hornet, honey bee health, environmental transmission, diet effects, gut microbiome

GUT MICROBIOME OF THE ORIENTAL HORNET (*VESPA ORIENTALIS*) AND ITS ROLE IN HONEY BEE PATHOGEN DYNAMICS

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Vespa orientalis (the Oriental hornet) is increasingly recognised as an emerging invasive threat, with populations spreading well beyond its native range into Europe, South America, and other regions. Although the species is indigenous to Malta, recent population surges and the mounting pressure on local beekeeping mirror the dynamics of a biological invasion. Yet, *V. orientalis*'s microbial ecology and potential contribution to pathogen circulation remain poorly understood. To address this gap, we characterised the gut microbiota of 70 adult workers collected from urban and rural Maltese sites where hornets were either preying on *Apis mellifera* or scavenging cat food.

16S rRNA gene sequencing, quantitative PCR and genome based functional predictions were integrated with a three year beekeeper survey. A conserved core community dominated by *Spiroplasma*, *Arsenophonus* and *Rosenbergiella* was identified, with site- and diet-linked enrichment of *Arsenophonus* in bee-predating hornets and *Enterobacter* and *Serratia* in cat food scavengers. Predicted functions were largely stable across sites, highlighting robust amino acid biosynthesis, protein turnover and xenobiotic resistance. Pathogen screening revealed high prevalence of *Nosema ceranae* (97%) and *Crithidia bombi* (63%) regardless of predation behaviour, suggesting environmental acquisition and a carrier role for *V. orientalis*. Survey data corroborated escalating hornet pressure on Maltese apiaries.

Our results show that the hornet's gut microbiome is both diet-flexible and metabolically robust. Because this adaptable microbial community can influence the spread of pathogens important to apiculture, these insights are vital for developing evidence based control measures as the *V. orientalis* continues its regional advance.

ID: 254 / SES-O-API-04: 2

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: Varroa destructor; propolis; GC-MS; glycerol residue; beekeeping treatments

CHEMICAL ANALYSIS OF PROPOLIS POST-TREATMENT WITH ANTI-VARROA APPLICATIONS

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Varroa destructor remains one of the most serious threats to apiculture worldwide. In Greece, beekeepers apply a variety of control methods, including amitraz strips, oxalic or formic acid strips impregnated with glycerol, as well as oxalic acid via sublimation or instillation. Despite the fact that these treatments are widely used to manage Varroa infestations, little is known about their impact on the quality of propolis, a valuable hive product with antimicrobial properties. The objective of this study was to examine the effects of each different anti-Varroa treatment on propolis chemical composition over a 65-day period, with a particular focus on residual glycerol levels. To this end, propolis samples were collected from 5 beehives in Chalkidiki (North Greece), on days 7, 21 and 65 post-treatment, extracted with ethanol/water (70:30), silylated and then analyzed using GC-MS. The results indicated that the use of oxalic acid strips impregnated with glycerol significantly deteriorates propolis quality, resulting in elevated and persistent glycerol residues. In contrast, treatments such as amitraz and oxalic acid sublimation showed reduced or minimal glycerol presence over time. Among all methods tested, sublimation of oxalic acid is the most effective in controlling Varroa, while preserving the chemical integrity of propolis. These findings highlight the importance of applying treatment methods that minimize contamination of hive products. We recommend avoiding the use of glycerol-impregnated strips in future Varroa management strategies, so as to maintain the quality and commercial value of propolis.

ID: 261 / SES-O-API-02: 4

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: RF-EMF, exposure, indoors, impact, honey bees, brood development

ASSESSING THE IMPACT OF INDOOR RF-EMF EXPOSURE AT 3.6 GHZ ON THE DEVELOPMENT OF HONEY BEES

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Newly introduced telecommunication technology results in changes in exposure patterns of radiofrequency electromagnetic fields (RF-EMFs) that can be absorbed in organisms which have unclear biological consequences. The current study aims at investigating the effects of RF-EMFs at 3.6 GHz on honeybee brood development under controlled conditions (ETAIN- HORIZON project). To achieve this objective, three colonies were exposed to RF-EMF signal at 3.6 GHz with an incident rms-power density of 1W/m², while three parallel control colonies were not. The two groups of colonies were kept in separate rooms electromagnetically shielded from each other. The colonies were placed on digital scales and equipped with sensors continuously measuring RF electric field strengths, temperature, humidity, and CO₂. The development of the eggs, larvae and pupae was monitored continuously, as well as the state of the queens. The first results showed that there was no significant difference between the treated and control colonies in terms of the eggs and larvae removed. However, we observed a one-day delay in hatching for 23% and 8% of eggs in exposed and control groups, respectively (significant difference), and one day delay in the emergence of adult bees for 19% and 4% of larvae, in exposed and control bees, respectively (n.s. difference). Total emergence percentage was not different between the exposed and the control group (ca. 100%). The results of the study enhance the knowledge and understanding of the behavior of bees under these exposure patterns, the biological significance and may contribute to the prevention of any negative impacts.

ID: 262 / SES-O-API-02: 3

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: sulfoxaflo, imidacloprid, sub-lethal effects, laboratory, field, protection

CHRONIC EXPOSURE EFFECTS OF SUFLOXAFLOR AND IMIDACLOPRID UNDER LABORATORY AND FIELD CONDITIONS

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Sulfoxaflo and imidacloprid are two of the most used pesticides affecting honey bees. We contacted several laboratory and field experiments where sulfoxaflo and imidacloprid were administered via the food. Sulfoxaflo was fed to the bees at a concentration of 5µg/kg in sugar solution and 50 µg/kg in pollen. Imidacloprid was fed to bees at a concentration of 2 µg/kg sugar solution and 3 µg/kg in pollen paste during one month. For the laboratory experiment, bee survival, rate of mortality, amount of food consumed, the size of the HPGs and the amount of fat body was accessed. For the field experiment, colony population, amount of brood and dead bees in front of the colonies was accessed.

For sulfoxaflo, the preliminary results have shown no difference in any variable between treated and control bees in the laboratory, but a significant most of treated colonies did not manage to overwinter successfully. Control bees also had a significantly higher dry weight of abdomens. For imidacloprid the results showed that the observed changes were influenced by the mode of intoxication (chronic or acute), meaning that the chronic exposure had a higher impact on HPGs, colony strength and alterations in the expression profile of the isoenzymes of GST group.

Further experiments need to be contacted especially for ssulfoxaflo. Action needs to be taken to protect all types of bees.

ID: 263 / SES-O-API-02: 1

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: *Apis mellifera*, queen bee, quality, reproductive parameters.

THE QUALITY OF HONEY BEE (*APIS MELLIFERA*) QUEENS IN MONTENEGRO

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The quality of honey bee queens is a critical factor influencing colony health, productivity and survival. Montenegro is a country with diverse ecological conditions and a rich beekeeping tradition. This study evaluates the morphological and reproductive traits of honey bee (*Apis mellifera carnica*) queens reared by 8 commercial producers of bee queens in different parts of Montenegro. Total of 48 bee queen samples were analyzed (6 per producer). Parameters assessed include queen weight, head width, thorax width, abdomen length and width, sperm viability and number of ovarioles in right ovary. Results reveal variation in queen quality between producers, influenced by local environmental conditions and breeding practices. The average head width was 3,75 mm (min. 3.41 – max. 3.96), thorax width 4,72 mm (min. 4.31 – max. 5.08), abdomen width 4,67 mm (min. 4.10 – max. 5.18), abdomen length 10,86 mm (min. 9.51 – max. 12.11) and body weight was 0,2002 g (min. 0.1539 – max. 0.2385). Number of the ovarioles was 134 (min. 105 – max. 169) on average. Number of spermatozoa in spermatheca was 3 710 000 (min. 1 540 000 – max. 6 140 000) and sperm viability was 73.22% (min. 3 – max 95). The findings underscore the need for standardized queen-rearing protocols and selective breeding programs to enhance queen performance and colony resilience in Montenegro. This research provides a foundation for improving national queen production standards and supporting the long-term development of the apiculture sector.

ID: 264 / SES-O-API-03: 1

Abstract Submissions

Oral Presentation

Topics: Apiculture

Keywords: urban beekeeping, pollinators, sustainability, conservationism, environment

PROS & CONS OF URBAN BEEKEEPING

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Urban beekeeping is an activity, flourishing with the popularization of the beekeeping in general. In some world capitals, it has experienced rapid growth over the last decade, reminding us of the importance of living in healthy environments, green cities and the strategic significance of food self-sufficiency.

It can be used for different educational activities, have a positive social impact and low carbon footprint. However, recent evidence shows that increasing honeybee colony density does not only have positive effects. The carrying capacity of space is limited and as the number of hives has increased, honey yields have started to decline (partly due to climate changes). An increasing number of scientific papers claim that too many honeybees mean a lack of forage not only for them but also for other, equally important pollinators - and colony density also helps spread different pathogens faster. A "heretical" idea emerged in the scientific circles that popularization of the honeybees might even harm biodiversity and that limitless expansion of beekeeping is not always the best thing we can do for nature conservation.

As beekeepers, we should therefore behave responsibly and think about the number of colonies we care for and the wider impact we have on the environment. We cannot overcome biology with our ideology. Thus, urban beekeeping should be approached in a more holistic way. If we're serious about sustainability, we should consider it from several perspectives.

ID: 279 / SES-P-API-01: 2

Abstract Submissions

Poster Presentation

Topics: Apiculture

Keywords: Propolis; GC-MS; Poplar type; European type; Aspen-type

EXPLORING THE CHEMICAL DIVERSITY OF PROPOLIS IN LATVIA: A REGIONAL PERSPECTIVE**Freideriki Papakosta¹, Konstantia Graikou¹, Leonidas Charistos², Valters Brusbardis³, Josef van der Steen⁴, Ivo Roessink⁵, Bas Buddendorf⁵, Fani Hatjina², Ioanna Chinou¹**¹Laboratory of Pharmacognosy and Chemistry of Natural Products, Faculty of Pharmacy, National and Kapodistrian University of Athens, Panepistimiopolis, Zografou, 15771, Athens, Greece;²Department of Apiculture, Hellenic Agricultural Organisation 'DIMITRA', Nea Moudania, 63 200, Greece;³Latvian Beekeepers Association, Rīgas iela 22, LV-3004 Jelgava Latvia;⁴Alveus AB Consultancy, Kerkstraat 96, 5061 EL Oisterwijk, The Netherlands;⁵Wageningen Environmental Research, Droevendaalsesteeg 3, PO Box 47, 6700 AA, Wageningen; faye.d.papakosta@gmail.com

Propolis, a valuable biological mixture produced by European honey bees (*Apis mellifera* L.) using beeswax and plant resins. Its chemical composition is significantly influenced by geographical origin, seasonal variation and available botanical sources. The present study aimed to investigate ten propolis samples collected from ten districts of Latvia in July 2022 to determine their chemical constituents. Propolis samples were extracted with ethanol/water (70:30), silylated and then analyzed using GC-MS. The results revealed that Latvian propolis is primarily composed of phenolic acids, their esters and flavonoids, consistent with the typical chemical profile of European propolis. Samples from eight regions were classified as aspen-type, while the remaining were identified as poplar-type. The GC-MS analysis has enabled the identification of 49 distinct compounds, among which the presence of 2',4',6'-trihydroxy-4-methoxy dihydrochalcone, 2',6',4'-trihydroxy-4'-methoxy dihydrochalcone, 2',6'-dihydroxy-4,4'-dimethoxy dihydrochalcone, 2',6'-dihydroxy-4'-methoxy dihydrochalcone and 2',4',6'-trihydroxydihydrochalcone, as well as palmitic acid, benzyl benzoate, cinnamyl cinnamate, pinostrobin, pinostrobin chalcone, pinocembrin and pinobanksin, was confirmed through isolation procedures. Given the limited studies on the chemical profile of Latvian propolis, these findings contribute towards interesting insights into the phytochemical diversity of propolis within this geographic area. This study contributes to a deeper understanding of the chemical composition of Latvian propolis and supports future research into its bioactive properties, therapeutic potential and possible applications in pharmacology, biotechnology and natural health product development.

ID: 284 / SES-O-API-01: 1**Abstract Submissions****Oral Presentation***Topics:* Apiculture*Keywords:* varroa diagnosis, varroa control, acaricides, oxalic acid, sustainable apiculture**VARROA (VARROA DESTRUCTOR) CONTROL FOR SUSTAINABLE APICULTURE****Ales Gregorc**University of Maribor, Faculty of Agriculture and Life Sciences, Slovenia; ales.gregorc@um.si

Drone and worker brood examination, counting natural varroa mortality, powdered sugar test and alcohol wash are the main diagnostic methods to establish varroa (*Varroa destructor*) infestation level in honey bee colonies. In order to keep the varroa population under threshold levels, laboratory and field experiments were conducted using a variety of varroa control measures. Positive correlations were found between the relative number of infested bees detected by powdered sugar shake and washing bees with alcohol plus soapy water ($r = 0.90$ and $r = 0.62$). We observed significant varroa mortality after total brood removal, or caging the queens and OA applications in broodless colonies. Four consecutive OA applications by trickling onto adult bees between combs 'in situ' during in climatic conditions where colonies containing capped brood, ensured a cumulative efficacy of 98%. Tests were conducted to establish the efficacy of various acaricides on varroa mortality in laboratory caged bees and in queen-right colonies. The acaricides tested (coumaphos, tau-fluvalinate, amitraz, thymol, and natural plant compounds (hop acids)) significantly increased the overall varroa mortality in the laboratory experiments. In the colonies, a higher varroa mortality was recorded in all treatments, compared to the natural varroa mortality. The acaricide toxicity to the varroa mites was consistent in both the caged bees and in the colonies. We recommend effective varroa diagnosis, combining OA applications with artificial broodless colony conditions achieved either by brood removal or queen caging as an effective management strategy for varroa in sustainable apiculture.

PHYTOMEDICINE-PLANT PROTECTION

ID: 121 / SES-P-PHPP-04: 5

Abstract Submissions

Poster Presentation

Topics: Phytomedicine - Plant Protection

Keywords: fruit rot, watermelon, identification

IDENTIFICATION OF FUSARIUM SPECIES CAUSING WATERMELON FRUIT ROT

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Watermelon (*Citrullus lanatus*) is one of the most significant economic fruits among the family Cucurbitaceae, growing in the Republic of Serbia. However, fruit rot caused by fungal and bacterial pathogens poses a significant threat to watermelon production globally, resulting in substantial economic losses. In July 2024, fruit rot was observed in watermelons in the AP Vojvodina (Despotovo, Serbia), with disease incidence ranging from 5-10%. Symptoms included water-soaked brown lesions on the fruit's surface, which eventually expanded and led to internal decay. From the collected samples, ten fungal isolates belonging to the genus *Fusarium* were obtained on PDA medium. These isolates exhibited white to light red mycelia and produced microconidia, macroconidia and chlamydospores. Morphological analysis identified all watermelon monoconidial isolates as *F. oxysporum*. Pathogenicity was confirmed on cucumber and squash fruits. Based on the results and host specificity the findings of this study suggest that *F. oxysporum* f. sp. *niveum* (FON) is responsible for the fruit rot disease in watermelons. This fungus can be transmitted through seeds and can survive in the soil for long periods; chlamydospores can remain viable for over a decade without a host, making contaminated soil a continual source of infection. FON can affect cucurbits at any growth stage, leading to symptoms such as seedling damping-off, plant stunting, death, and fruit rot. To manage FON, several strategies have been implemented, such as utilizing resistant cultivars, practicing crop rotation, applying chemical treatments, and grafting. However, an effective control measure for FON in cucurbits production is still lacking.

ID: 130 / SES-P-PHPP-04: 7

Abstract Submissions

Poster Presentation

Topics: Phytomedicine - Plant Protection

Keywords: Pythium spp., biocontrol, sustainable agriculture, antagonistic bacteria

HARNESSING NATIVE MICROBIAL ANTAGONISTS FOR ECO-FRIENDLY SUPPRESSION OF SOILBORNE PATHOGENS IN TOBACCO

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Pythium spp., a pathogenic oomycete, is a significant causal organism of tobacco root rot (*Nicotiana tabacum*), resulting in considerable economic losses during tobacco cultivation. Owing to the increased focus on sustainable and environmentally friendly agriculture, the present study examines the antagonistic role of naturally occurring microorganisms, i.e., bacteria from the genera *Bacillus*, *Paenibacillus*, and *Pseudomonas*, in their interactions with *Pythium* spp.

Through the utilization of developed techniques for the isolation of microorganisms and screening for biocontrol activity and in vitro assays such as diffusion and antibiosis tests, a number of bacterial strains were found to effectively suppress the growth of *Pythium* spp. *Paenibacillus polymyxa* showed the greatest degree of antagonistic activity through the synthesis of secondary metabolites with antimicrobial activity, with excellent inhibitory effects on the growth and pathogenicity of the pathogen.

The results of this study highlight the potential of sporogenic bacteria as biocontrol agents against fungal pathogens within the framework of tobacco cultivation. The use of environmentally friendly approaches not only provides a promising alternative to chemical fungicides but also assists in maintaining the integrity of the ecosystem and fostering ecologically sound agricultural practices. This research emphasizes the need to exploit natural microbial antagonism to achieve effective disease management, thereby guaranteeing the evolution of new alternatives to sustainable agriculture.

ID: 141 / SES-P-PHPP-04: 1

Abstract Submissions

Poster Presentation

Topics: Phytomedicine - Plant Protection

Keywords: L. amplexicaule, bio-ecology, competitiveness, control

BIO-ECOLOGY, COMPETITIVENESS AND CONTROL OF LAMIAM AMPLEXICAULE L. (HENBIT DEADNETTLE)

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L. amplexicaule is a widespread cool season, annual, facultative biennial, herbaceous, fast-growing, broadleaved weed spreading and branching at the base and grows 10–40 cm tall. It is reproducing by seed, which germinates between late summer and early spring, but typically emerge in late autumn, between mid–October through mid–December at the minimal temperature of 4–6°C. L. amplexicaule is weed that is among the first plants to flower in the spring, usually in March in temperate zones. Flowering and seed set begin in early spring in the northern hemisphere, especially in April. Plants complete their life cycles in hot, dry late–May and June. L. amplexicaule is the most widely distributed weed and can be found in cultivated fields, fallow fields, gardens, turf, roadsides, pastures, and waste areas, mainly across the temperate regions of the world. It can be very competitive with crops and other plants, particularly in winter cereal crops. Crop yield loss associated with L. amplexicaule interference ranged from 0.3 to 48% based on weed density. Yield reduction is not the only way that this weed can impact crops. L. amplexicaule is a host for a number of insect and disease pests. Numerous herbicides are highly effective in controlling L. amplexicaule. Generally, an autumn herbicide application has provided satisfactory weed control and can be beneficial compared to an early spring application, because of younger weed growth stages and during the wet years.

ID: 143 / SES-O-PHPP-04: 1

Abstract Submissions

Oral Presentation

Topics: Phytomedicine - Plant Protection

Keywords: Flight period, *G. molesta*, number of generations per year, seasonal dynamics, stone fruits.

BIOLOGICAL DEVELOPMENT OF *GRAPHOLITA MOLESTA* BUSCK, 1916 (LEPIDOPTERA: TORTRICIDAE) IN NORTH MACEDONIA

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Three-year study, 2021-2023, was conducted for the *Grapholita molesta* Busck 1916, (Lepidoptera: Tortricidae), as an economically significant pest on stone fruit in North Macedonia. The objectives were to find out its flight period, seasonal dynamics and number of generations in mixed plantations of stone fruits located in Chelopek (North-East region) and Sirkovo (Vardar region). The pest was monitored using pheromone traps. With a total of 3.518 individuals captured, the obtained data gives new insights for biological development of *G. molesta* in the specific climatic and geographical conditions. During 2021, *G. molesta* had total flight period of 178 days (9.4-3.10.2021) in Chelopek versus 222 days (29.3-5.11.2021) in Sirkovo. In 2022 *G. molesta* had total flight period of 201 days (20.3-7.10.2022) in Chelopek versus 258 days (2.3-14.11.2022) in Sirkovo. In the last year of the study (2023) *G. molesta* had total flight period of 204 days (20.3-10.10.2023) in Chelopek versus 228 days (20.3-3.11.2023) in Sirkovo. The dynamics of the population of *G. molesta*, revealed that the pest is active from March to November and it has the potential to develop more than 3 generations per year, depending on the locality. The locality indicates statistically significant differences for *G. molesta* ($p < .01$). These results will help in development of Integral Pest Management (IPM) strategies in stone fruit orchards in order to improve food safety standards and to reduce environment pollution with insecticide use.

ID: 188 / SES-P-PHPP-04: 6

Abstract Submissions

Poster Presentation

Topics: Phytomedicine - Plant Protection

Keywords: leaf rust, pathotypes, Lr genes, efficiency, Black Sea Coast

RACE DIVERSITY IN THE POPULATIONS OF PUCCINIA TRITICINA IN THE AREAS OF THE BULGARIAN BLACK SEA COAST

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Leaf rust caused by *Puccinia triticina* is one of the main fungal pathogens of wheat in Bulgaria and in years with suitable climatic conditions and the presence of susceptible varieties, significant yield reductions can be observed. Sometimes in the warmer, wetter and coastal areas, pathotypes are found that can be more aggressive and wheat production can also be compromised. In this regard, this study presents data on the most common pathotypes of *Puccinia triticina* along the Bulgarian Black Sea Coast for the growing seasons 2022/23 and 2024/25. Thirteen phenotypically different pathotypes were identified. The pathotypes PKTTR (20.8%) and TKTTR (12.8%) were identified with the highest frequency of occurrence in these areas. The current study also presents data on the efficiency of the Lr genes. The genes Lr 2b, Lr 9, Lr 19, Lr 22b, Lr 41, Lr 43 and Lr 47 were found to be absolutely effective. The genes Lr 20, Lr 40 and Lr 48 showed high effectiveness. The genes Lr 25, Lr 29, Lr 39 and Lr 42 showed good effectiveness, while the genes Lr 2c, Lr 24 and Lr 51 showed satisfactory effectiveness. All other genes tested were either weakly effective or completely ineffective. Monitoring studies are crucial for the early detection of new virulent races with the potential to cause devastating epidemics. The presented data may help to develop effective control strategies, including selection of varieties possessing a combination of several resistance genes to protect the crop from the earliest stages until its harvest.

ID: 193 / SES-P-PHPP-04: 2

Abstract Submissions

Poster Presentation

Topics: Phytomedicine - Plant Protection

Keywords: Trichoderma asperellum, Botrytis cinerea, tomato, biofungicide, biological control

BIOCONTROL ACTIVITY OF TRICHODERMA ASPERELLUM AGAINST BOTRYTIS CINEREA ON TOMATO: IN VIVO ASSESSMENT

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Botrytis cinerea, the causal agent of gray mold disease, is one of the most destructive pathogens affecting tomato production worldwide. In this study, the efficacy of the biofungicide Trifender WP, based on Trichoderma asperellum, was evaluated in vivo under controlled laboratory conditions. Tomato plants grown in pots (30–40 cm height, with 3–5 open flower buds) were subjected to different treatment variants: (1) preventive application of Trifender WP - 24 hours before artificial inoculation with B. cinerea spores, (2) curative application - 24 hours after inoculation and (3) untreated, inoculated control.

Results showed that in the control variant, B. cinerea caused widespread infection across all plant organs, with disease incidence of 100% in flowers, 71.1% in leaves, and 15% in stems. In contrast, Trifender WP significantly reduced diseased incidence levels. In the preventive treatment, disease incidence was limited to 6.33%, while in the curative treatment it reached 10.33%. No infections were observed in flowers or stems in either treatment. Biofungicide efficacy exceeded 85% on leaves and reached 100% on flowers and stems.

These findings highlight the strong protective and therapeutic potential of T. asperellum in managing gray mold in tomato, especially at the flowering stage. Preventive application proved slightly more effective than curative use, reinforcing the importance of early biocontrol interventions.

ID: 232 / SES-P-PHPP-04: 3

Abstract Submissions

Poster Presentation

Topics: Phytomedicine - Plant Protection

Keywords: chemical control, Pyrenophora teres, Zantara

EVALUATION OF BIXAFEN IN THE CONTROL OF NET BLOTCH DISEASE IN BARLEY

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Net blotch is a major foliar disease of barley in many countries throughout the world. Caused by *Pyrenophora teres*, this disease causes significant grain yield loss and reduces grain quality. In our experiment conducted during 2023 in two production regions in Republic of North Macedonia, Sveti Nikole and Gradsko, we have studied the efficacy of the novel active ingredient bixafen in combination with tebuconazol (Zantara) in controlling of net blotch disease. In optimal environmental conditions, net blotch develops quickly, causing destructive damage in barley production. This was the case in the region of Sveti Nikole, where a very high level of disease severity (53.9%) was observed. In these devastating conditions, the tested novel fungicide Zantara demonstrated high level of efficacy, above 92%. In the region of Gradsko, considerably lower level of disease severity was observed in the untreated variant (14.9%), with Zantara providing a maximum efficacy of 100%. Chemical control is still the most effective way in controlling net blotch disease in barley and other cereals, highlighting the necessity of broadening the range of registered fungicides.

ID: 306 / SES-P-PHPP-04: 4

Abstract Submissions

Poster Presentation

Topics: Phytomedicine - Plant Protection

Keywords: Key words: Cotton mealybug *Phenacoccus solenopsis*, Host preference and spatial distribution

HOST PREFERENCE AND SPATIAL DISTRIBUTION OF COTTON MEALYBUGS, PHENACOCCLUS SOLENOPSIS (TINSLEY, 1898), (HEMIPTERA: PSEUDOCOCCIDAE)

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Phenacoccus solenopsis is one of the most important plant pests. Field survey was conducted during 2022-2023 in fields in Baghdad Governorate. The study included host preference, spatial distribution, and infestation severity on 21 types of plants

P. solenopsis, prefers *Hibiscus rosa-sinensis* in the first degree, followed by *Lantana camara*, then *Tecoma stans* to a moderate degree, with the least being *Jasminum sambac*, *Chrysanthemum* (Arula), and *Portulacaria afra*, while we did not notice the presence of this pest on the other types of plants that were studied in terms of home garden plants. As for vegetable and fruit crop plants, tomato *Solanum lycopersicum* was the most preferred, followed by eggplant *Solanum melongena* and okra *Abelmoschus esculentus* then cotton *Gossypium herbaceum*.

As for spatial distribution of the insect on plant parts, the results indicated that this pest mainly prefers the ends or tip of young branches and is less present in the middle of the branch, while this insect does not prefer the bottom or bases of the plant branches. The average number of insects was: 18 - 2, 133 - 66, 351 - 121 nymphs - adults / 5 cm at the bottom, middle, branch tips, respectively, in *H. rosa-sinensis* compared to 7 - 3, 88 - 24, 125 - 78 nymphs - adults / 5 cm at the bottom, Middle and branch tips respectively in the cotton plant *G. herbaceum*. These results of this study can serve in the management of this pest when identifying the families most affected and when implementing integrated control programs.

ID: 319 / SES-O-PHPP-04: 2

Abstract Submissions

Oral Presentation

Topics: Phytomedicine - Plant Protection

Keywords: Soil, bioremediation, pesticides, microorganisms

BIOREMEDIATION OF PESTICIDE-CONTAMINATED SOIL USING MICROORGANISMS FROM PETROLEUM-IMPACTED ENVIRONMENTS

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Bioremediation is an environmentally friendly method of changing toxic pollutants to innocuous substances by the catabolic metabolism of living organisms, specifically microorganisms. Isolation of bacterial strains from petroleum hydrocarbon-consistently polluted soils was done with a view of discovering potential candidates for pesticide degradation. Owing to their continued exposure to intricate hydrocarbons, the native microorganisms were hypothesized to have high catabolic potential.

Following initial isolation, the most promising strains were selected based on growth performance and viability. Their degradation potential was assessed in two cultivation systems: aerobic (with agitation) and microaerophilic (static), using chemical oxygen demand (COD), total nitrogen (TN), and biomass production as indicators of microbial activity and contaminant transformation.

The effects of environmental parameters pH, temperature, as well as medium composition, upon microorganisms' growth and their efficiency in degradation were systematically examined under controlled lab conditions. The results indicated that while diverse isolates expressed enhanced degradation efficiency within purely aerobic environments, a significant percentage possessed high remaining activity within microaerophilic atmospheres that are very close to natural soil environments.

Most of the isolates also had optimal growth at neutral pH and mesophilic temperatures typical of natural soil environments. Our data place petroleum-adapted bacteria as potential bioremediating agents of pesticide-contaminated soils effective within limited-oxygen environments. Our study is a step towards the development of environmentally sustainable, microbially influenced technologies of environmental rehabilitation.

FOOD QUALITY AND SAFETY

ID: 109 / SES-O-FQS-04: 1

Abstract Submissions

Oral Presentation

Topics: Food Quality and Safety

Keywords: soil microorganisms, antimicrobial activity, acid and bile tolerance, in vitro tests

INVESTIGATING THE PROBIOTIC ROLE OF ENVIRONMENTAL LYSINIBACILLUS SPHAERICUS STRAINS

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Soil-derived microorganisms contribute significantly to biogeochemical processes and microbial community dynamics in terrestrial ecosystems. Among them, *Lysinibacillus sphaericus* remains largely uncharacterized in terms of its functional traits relevant to probiotic applications. Characterization of isolated bacterial culture was identified by morphological and MALDI-TOF MS identification. To test the probiotic properties of *Lysinibacillus sphaericus*, hemolysis test, salt tolerance, arginine hydrolysis, acid and bile tolerance, catalase activity, antibiotic sensitivity testing and antibacterial activity were applied. The results showed that *Lysinibacillus sphaericus* has the highest inhibitory effect against *Salmonella enterica* ATCC 10708, *Escherichia coli* ATCC 8739, *Listeria monocytogenes* ATCC 13393 and *Staphylococcus aureus* ATCC 25922 at 16.15 mm, 12.06 mm, 13.48 mm and 21.85 mm, respectively. The isolate was resistant to ampicillin, cefotaxime, mupirocin and penicillin and sensitive to other antibiotics among the 24 antibiotics tested and showed β -hemolysis. The isolate was rod-shaped, Gram-positive, catalase positive and produced ammonia from arginine hydrolysis. The optimal growth temperature was 44°C, the optimal pH was 7.0. Furthermore, the isolate could grow at NaCl concentration of 6.5%, in the presence of bile salt and at pH value of 3.0. In summary, this study isolated *Lysinibacillus sphaericus* from soil, established its safety through in vitro testing and helped to provide an understanding of the interconnections between environmental microorganisms and their probiotic potential.

ID: 110 / SES-P-FQS-05: 9**Abstract Submissions****Poster Presentation***Topics:* Food Quality and Safety*Keywords:* food safety, preservation, spontaneous fermentation, antimicrobial**HARNESSING PROBIOTICS FROM CABBAGE: A NATURAL DEFENSE AGAINST
FOODBORNE PATHOGENS****Irina Gjorgievska-Pejovska, Mila Nikoloska, Sofija Kostandinovska, Dzoko Kungulovski,
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The use of probiotics as natural inhibitors of foodborne pathogens has gained significant attention in food safety and preservation. This study explores the inhibitory effects of probiotics isolated from spontaneously fermented cabbage against common food pathogens. Spontaneously fermented cabbage, a traditional and widely consumed product in our country, serves as a rich source of beneficial lactic acid bacteria with potential antimicrobial properties. In this research, probiotic strains were identified and characterized for their antimicrobial activity against different pathogenic microorganisms. The filtered sterile supernatant of the bacterial cultures was tested with an agar well diffusion assay; the growth medium had been previously inoculated with different pathogen strains (*Escherichia coli* ATCC 8739, *Listeria monocytogenes* ATCC 13393, *Salmonella enterica* ATCC 10708 and *Staphylococcus aureus* ATCC 25922). Laboratory assays demonstrated that these probiotic strains produce bioactive compounds, including organic acids and bacteriocins, which effectively inhibit the growth of foodborne pathogens. Furthermore, the analysis highlighted the stability and potency of these probiotics under various stress conditions, like different concentration of NaCl, low pH, and emphasizing their applicability in enhancing food safety. The findings suggest that cabbage-derived probiotics represent a promising, natural approach to mitigating risks associated with foodborne illnesses and reducing reliance on synthetic preservatives. This study contributes to the growing body of research on probiotics and their role in sustainable food systems, providing valuable insights into their practical applications in food safety and public health.

ID: 113 / SES-P-FQS-05: 14

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: polyphenolic components, antioxidants, UV/VIS spectrophotometry

TOTAL MONOMERIC ANTHOCYANIN CONTENT AND ANTIOXIDANT ACTIVITY IN FRUITS OF BILBERRY (*VACCINIUM MYRTILLUS* L.)

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Bilberry (*Vaccinium myrtillus* L.) is one of the richest natural sources of anthocyanins. Moreover, in bilberries, anthocyanins have been estimated to represent nearly 90% of the total phenolics. These polyphenolic components give bilberry its blue/black color and high antioxidant content. Due to their high levels of phenolics, bilberries have been reported to have multiple biological effects, including anticarcinogenic, anti-inflammatory and antimicrobial activities and lipid-lowering effects. Beneficial effects have also been established in cardiovascular diseases and diabetes, as well as in improved vision and neurodegenerative functions. The aim of this study was to investigate the antioxidant properties, content of total monomeric anthocyanins, indices for pigment degradation, polymeric color and browning index of a bilberry and bilberry extract. The antioxidant activity was assessed using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical. Quantification was performed on the basis of a standard curve and result was expressed as Trolox equivalents per 100 g of fresh bilberries (mmol TE/100g). Antioxidant activity was 0.34 ± 0.01 mmol TE/100g bilberries. The content of total monomeric anthocyanins was investigated spectrophotometrically by the pH-differential method. Data were quantified as mg of standard cyanidin3-glucoside equivalents (C3GE equivalent) per 100 g of fresh bilberries. The total monomeric anthocyanins content was 403.70 ± 3.97 mg CGE/100 g FW of bilberries and 1821.39 ± 17.89 mg CGE/L of extract. Indices for pigment degradation, polymeric color, and browning were assayed spectrophotometrically. Percent of polymeric color was 23.66%, and browning index was 0.93. Antioxidant activity of bilberries was significant. The high antioxidant activity matched well with the high anthocyanin content in bilberries.

ID: 124 / SES-O-FQS-04: 2

Abstract Submissions

Oral Presentation

Topics: Food Quality and Safety

Keywords: Byproduct, oleic acid, *Prunus domestica*, unsaturated fatty acids, vitamin E

PLUM KERNEL OIL AS A NUTRIENT-RICH BYPRODUCT: INSIGHTS INTO FATTY ACIDS AND TOCOPHEROL COMPOSITION

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The study aimed to determine some physicochemical and bioactive properties of plum (*P. domestica* L.) kernel oil, a byproduct of industrial processing of this fruit species, primarily into brandy and juice, with significant potential for use in the food industry as an alternative to conventional edible oils. The study included six cultivars from organic production at two locations in Norway. The oil was extracted using cold solvent extraction, and its fatty acid and tocopherol profiles were analyzed using gas chromatography and HPLC, respectively. The obtained yield varied significantly, ranging from 12.76% ('Opal', Ullensvang) to 29.60% ('Mallard', Ullensvang). Oleic acid was the dominant component in the oil of all examined cultivars, with an average value of 58.93%, followed by linoleic (34.13%) and palmitic acid (5.23%). Additionally, tocopherols (vitamin E), which are a key group of bioactive compounds in plant oils, were present in high concentrations in these oils. The average tocopherol content among all the analyzed samples was 39.98 mg/100g, with γ -tocopherol being the most abundant (36.18 mg/100g), while α - and δ -tocopherol levels were negligible, at 1.25 mg/100g and 1.55 mg/100g, respectively. Based on these findings, it can be concluded that plum kernel oil is nutritionally highly favorable, characterized by a predominant concentration of unsaturated oleic acid and a high tocopherol content, making it a promising candidate for use as an alternative to conventional edible oils. Additionally, utilizing this byproduct reduces the amount of organic waste generated during fruit processing and contributes to a more sustainable, circular economy.

ID: 126 / SES-O-FQS-04: 3

Abstract Submissions

Oral Presentation

Topics: Food Quality and Safety

Keywords: Donkey milk, lactic acid bacteria, probiotic potential, antimicrobial activity

ISOLATION AND FUNCTIONAL ASSESSMENT OF BENEFICIAL MICROBIOTA FROM AN UNCONVENTIONAL MAMMALIAN DAIRY SOURCE

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Donkey milk has gained interest in health benefits mainly concerning bioactive compounds and lactic acid bacteria (LAB). LAB is responsible for improved digestive health and also supports immune response and antimicrobial action. Hence, donkey milk is a possible target for probiotics work. The purpose of this research was to isolate and characterize microorganisms with high probiotic activity from donkey milk to test their health effects.

Donkey milk samples were obtained from two farms from different regions of North Macedonia. Isolation and morphological characterization were done macroscopically and microscopically, probiotic potential was performed by physiological, biochemical, and health safety, including antimicrobial activity against pathogens.

Forty bacterial isolates were identified, consisting of 25 aerobes and 15 anaerobes, of which 85% were cocci and 15% were bacilli. Seven of the bacterial isolates demonstrated high antimicrobial activity against *Salmonella typhimurium*, *Escherichia coli*, *Staphylococcus aureus*, *Bacillus* spp., and *Pseudomonas aeruginosa*. They didn't show against *Candida albicans*. The isolates showed halotolerant (2–7% NaCl) characteristics, tolerance to low pH (up to pH 2), and bile salts (0.3–0.7%). Biochemical reactions indicated catalase- and oxidase-negative activity and fermentation of several sugars. Safety health was confirmed by γ haemolysis, demonstrating 95% resistance to a range of commonly used antibiotics.

LAB isolated from donkey milk exhibits high probiotic potential and antimicrobial activities. Studies would emphasize molecular identification, biotechnological characterization, and in vivo proof of their probiotic potential toward health-promoting applications.

ID: 127 / SES-O-FQS-04: 4**Abstract Submissions****Oral Presentation***Topics:* Food Quality and Safety*Keywords:* conservation tillage, crude protein, hardness, organic amendments, maize**PSYCHICAL-CHEMICAL PROPERTIES OF MAIZE GRAIN GROWN UNDER DIFFERENT TILLAGE SYSTEMS AND ORGANIC AMENDMENTS****Kristina Kljak, Manuel Matišić, Dora Zurak, Ivica Kisić, Igor Bogunović**University of Zagreb Faculty of Agriculture, Zagreb, Croatia; kkljak@agr.hr

Different soil managements have an impact on maize yield, but could also affect grain properties. This study, conducted in continental Croatia on Stagnosols, investigated how different tillage systems and organic soil amendments affect the physical-chemical properties of maize grains. The field trial was conducted in autumn 2020 in a split-plot design. The main factors were tillage management, which included conventional tillage (ploughing) and conservation tillage (minimal soil disturbance). Each tillage system consisted of three subtreatments: control (no input), farmyard manure (40 t/ha) and biochar (40 t/ha). The maize grain was cultivated in 2023. Physical properties included 1000 kernel weight and volume, test weight and Stenvert hardness, while chemical properties included contents of moisture, ash, crude protein (CP), crude fat (CF), neutral detergent fibre and starch. Tested soil amendments did not affect maize grain properties and the selected organic amendments were suitable for sustainability of agroecological system without negative effects on the maize grain. On the other side, conservation tillage significantly decreased 1000-kernel weight and volume (275 vs. 242 g and 389 vs. 349 mL, respectively) and lower CP and CF content (91.4 vs. 84.4 and 46.7 vs. 43.6 g/kg DM, respectively). The grain grown under conservation tillage also had lower hardness as determined by all three Stenvert hardness parameters. By affecting grain hardness and composition, the tillage system affects the nutritional value of maize, which must be considered when formulating animal diet.

ID: 142 / SES-O-FQS-04: 5

Abstract Submissions

Oral Presentation

Topics: Food Quality and Safety

Keywords: Dromedary; Ungulate; Desert; Nutraceutical; Nomads; Food Security

NATURE'S WAY TO MEET CHALLENGES OF FOOD SECURITY (CAMEL PRODUCTION)

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Implications of climate change are becoming more severe with ever growing world human population. Food security is becoming a point of concern with growing populations and challenges associated with climate change. In this perspective, arid and semi-arid lands (ASALs) are more effected by unexpected extreme weather conditions. However, nature has provided its solution in the form of unique resilient flora and fauna in ASALs. The dromedary camel (*Camelus dromedarius*) is a large even-toed ungulate which is distributed mainly in ASALs and deserts of Asia, Africa and Australia. According to FAOs live animal statistics, the worldwide camel population is ~ 35 million heads. Nature has equipped this beast with physiological and anatomical features to combat harsh weather conditions. Among other biological adaptations, their tolerance to dehydration, heat stress, feed scarcity and ability to convert scanty vegetation into milk, meat and fiber make this animal unique among the livestock species. Furthermore, food products from camels are of high nutritional and nutraceutical value. Traditionally camels are reared in the nomadic system, which is typically featured with low production while of prime importance in socio-economic status of nomads. Extensive farming systems with modern techniques are in practice mainly in Middle East where food of camel origin is very popular and expensive. In conclusion, camel has a potential to perform better in the likely events of climate change and global warming and becomes a strong candidate to play vital role in food security in future.

ID: 153 / SES-P-FQS-05: 10

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: food waste, households, CO₂-e emissions, consumer awareness, sustainability

HOUSEHOLD FOOD WASTE AND ITS ENVIRONMENTAL IMPLICATIONS

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This study explores the generation of food waste and its environmental impacts among urban households in North Macedonia. Thirty households participated in a structured seven-day survey, which included a food waste diary and a structured consumer survey. Participants measured food discarded during preparation and consumption, including both edible and inedible parts.

The analysis showed an average daily household food waste of 0.700 kg, corresponding to 2.66 kg of CO₂-e emissions per household per day. On an individual level, the average waste generation was 0.250 kg per person, linked to 0.784 kg CO₂-e. The total weekly waste across all households was 168.9 kg, with the largest share from inedible fruit and vegetable parts (66.75 kg), followed by vegetables and fruits, e.g. whole fruits, salads, etc. (32.105 kg) and cooked meals without meat (15.03 kg). Animal-based waste accounted for 59% of total emissions, while fruit and vegetable waste contributed 20%.

Survey responses indicated that 56.67% of participants did not separate food waste at home, and 36.67% often prepared more food than necessary. A notable 76.67% expressed interest in educational workshops, and 90% believed that reducing food waste is essential for environmental protection. Furthermore, 56.67% reported feeling guilty when discarding edible food.

These findings underscore the need for integrated strategies that combine awareness-raising, education, and practical tools to promote more sustainable food consumption and reduce environmental impacts at the household level.

ID: 160 / SES-O-FQS-04: 6

Abstract Submissions

Oral Presentation

Topics: Food Quality and Safety

Keywords: Nicotine pouches, nicotine, use, risks, regulation

NICOTINE POUCHES, A NEW PRODUCT ON THE MARKET OF THE REPUBLIC OF NORTH MACEDONIA

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Nicotine pouches, products intended for oral use, contain nicotine but not plant material from tobacco leaves. Mass production of this type of nicotine product by a large number of companies, including companies producing traditional products of classic tobacco products (cigarettes, cigarillos, etc.), began in 2014. According to available data, the first registered import to the market in our country was in 2022, followed by their gradual expansion. These are different brands and their variants and with different nicotine content (strength). They are present in a range of flavors, such as menthol, eucalyptus, coffee and fruit flavors. Several companies are importers, and the products are manufactured by different companies from around the world. The nicotine content in the products placed on our market varies from brand to brand and from variant to variant, i.e. from 6 mg/pouch to 17 mg/ pouch. The humidity of these nicotine products ranges from: 14.37% to 18.97%.

The degree of use among young people and adults in the Republic of North Macedonia is uncertain, because so far no comprehensive analyses have been conducted on their use. For the new product, the institutions in our country have found themselves "unprepared". Nicotine pouches are not regulated in accordance with the Law on Tobacco, Tobacco Products and Related Products. In the Republic of North Macedonia, for now, institutions, experts and the public are also divided on whether the import and trade of these products should be completely banned or they should be regulated by law.

ID: 181 / SES-P-FQS-05: 8

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: thyme, mountain tea, St. John's wort, medicinal plants, traditional knowledge

ETHNOBOTANICAL SURVEY OF THYMUS VULGARIS, HYPERICUM PERFORATUM AND ORIGANUM VULGARE IN NORTH MACEDONIA

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Medicinal and aromatic plants have a fundamental role in traditional healthcare and dietary practices across North Macedonia, where centuries of ethnobotanical knowledge have shaped both therapeutic practices and culinary heritage. This study explores the contemporary use of *Thymus vulgaris* (wild thyme), *Hypericum perforatum* (St. John's Wort) and *Origanum vulgare* (mountain tea, oregano), through an ethnobotanical survey designed to assess their medicinal and dietary applications. An anonymous, semi-structured online questionnaire gathered responses from 127 individuals across diverse demographic groups. Rural and urban populations frequently rely on wild or homegrown herbs for common health issues and local diet. Based on the respondents, 83% reside in urban areas, while 17% are from rural regions. Notably, 67% of participants reported actively collecting medicinal plants. The survey also calculated Use Value (UV) scores of 1.39 for thyme, 1.27 for mountain tea, and 1.03 for St. John's wort. The results showed that the most commonly used plant species is wild thyme (82%), followed by mountain tea (69%) and St. John's wort (43%). The Cultural Importance Index (CI) further highlights thyme's broad usage for both medicinal and culinary purposes (CI = 1.08), with mountain tea similarly valued for its dual role (CI = 1.05). St. John's wort shows a slightly lower CI of 0.96, primarily used for medicinal applications. This research underlines the significance of preserving and validating ethnobotanical knowledge not only as cultural heritage, but also as a foundation for sustainable healthcare and dietary strategies rooted in natural resources.

ID: 190 / SES-P-FQS-05: 7

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: Food composition data, North Macedonia, FCDB, Daris software, Traditional foods

ESTABLISHING A NATIONAL FOOD COMPOSITION DATABASE FOR TRADITIONAL FOODS IN NORTH MACEDONIA

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Food composition databases (FCDBs) are essential tools that support nutrition research, food policy development, dietary planning, and food industry practices. North Macedonia currently lacks a structured national FCDB, limiting the availability of reliable data on the food composition of traditional foods. This project aims to address that limitation by compiling documented and standardised data for foods typically consumed in the country.

In 2024, through a trilateral collaboration among the Faculty of Agricultural Sciences and Food, North Macedonia (UKIM), the Institute of Public Health (IPH), North Macedonia, and the National Agricultural and Food Centre – Food Research Institute (NPPC-VÚP) in Slovakia, analytical data from laboratory reports, scientific papers and thesis for 34 traditional North Macedonian foods were prioritised, collected, and documented. The Daris software, developed and provided by NPPC-VÚP, was used for this purpose. NPPC-VÚP granted a license for the use of the software and delivered initial training to national staff, along with continuous technical and methodological support. The process included categorisation, nutrient profiling, and documentation in line with EuroFIR standards.

The collected data are expressed per 100 g of edible portion. The component values cover water, protein, total fat, saturated fatty acids, total carbohydrates by difference, individual sugars, ash, salt, vitamin C, and organic acids, and the availability of components varies by product. This work contributes not only to the long-term goal of establishing national FCDB, but also strengthens institutional capacities in food data documentation and supports future activities in nutrition labelling, food quality control, and dietary monitoring.

ID: 191 / SES-O-FQS-03: 6

Abstract Submissions

Oral Presentation

Topics: Food Quality and Safety

Keywords: AlCl_3 colorimetric method, flavonoids, Folin - Ciocâlțeu assay, polyphenols, UV-Vis spectrophotometry.

SPECTROPHOTOMETRIC QUANTIFICATION OF TOTAL POLYPHENOLS AND FLAVONIDS IN VEGETABLE EXTRACTS

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Vegetables are a key component of the human diet and represent a significant natural source of biologically active compounds, with polyphenols being among the most important. Determining the content of polyphenols is essential, as they not only affect the quality of food but also possess strong antioxidant activity, which helps reduce the risk of oxidative stress and various diseases. In this study, various vegetables were analyzed (spinach, Swiss chard, spring onion (bulb, stem, and leaves), spring garlic (bulb, stem, and leaves), leek (bulb and stem), lettuce, zucchini, zucchini peel and carrot). The samples were dried in a dehydrator at 60 °C and then blended to obtain a powder with uniform particle size. Extraction was carried out at room temperature (22 °C) and in an oven (50 °C) using 70% ethanol and acidified ethanol (containing 1% citric acid), employing various techniques, including magnetic stirring, ultrasonic bath, and maceration. The total polyphenol content (TPC) was determined using the Folin - Ciocâlțeu assay, with gallic acid as the reference standard. For this purpose, absorbance was measured at 765 nm using a UV-Vis spectrophotometer. The total flavonoid content (TFC) was determined using the AlCl_3 colorimetric method, with quercetin as reference standard, at 415 nm. The obtained results revealed that spinach exhibited the highest polyphenol content (17.02 mg GAE/g dry weight), whereas carrot had the lowest (2.63 mg GAE/g). Regarding flavonoids, Swiss chard had the highest concentration (8.58 mg QE/g), while the white part of the spring garlic showed the lowest value (0.08 mg QE/g).

ID: 195 / SES-P-FQS-05: 13

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: wheat, flour, variety, mixtures, quality

QUALITY OF MIXED FLOUR DEPENDING OF WHEAT VARIETY

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The quality of flour depends of many factors, including the potential of the wheat variety. In practice, flour obtained by mixing two or more wheat varieties, can provide better baking quality than flour obtained from a single variety. Therefore, using mixed flours, results in improved quality characteristics of the dough.

The aim of the research was to examine the quality properties of flour in different combinations of five wheat varieties (Pobeda, Ingenio, Amazon 150, Podobrena Orovchanka, and Milenka). The combinations made between all varieties in ratios of 50/50, 75/25, and 25/75, resulting in 30 types of flour. The rheological characteristics of the dough were examined for each mixture.

The important parameters for flour quality, showed best protein content (14.2%) as well wet gluten (28.6%) in Ingenio variety. In the mixtured flours, the highest protein content of 14.1% was recorded in Ingenio/Milenka (75/25). Milenka showed highest quality number, and Ingenio highest softening degree. Among the combined flours, the highest quality number was obtained in Pobeda/Milenka (25/75), and softening degree with Pobeda/Podobrena Orovchanka (25/75) variant.

The Milenka is characterized by the highest values for resistance, extensibility, and energy. The highest values for all parameters were obtained in Amazon 150/Milenka mixture.

The amylographic number, for the varieties Amazon 150, Podobrena Orovchanka, and Milenka was over 1000AU, as well all mixtures involving Amazon 150, Podobrena Orovchanka, and Milenka.

Overall, the chemical characteristics of the variety affect the flour quality, but not proportionally across all parameters. Therefore, preliminary testing for each parameter individually is necessary.

ID: 196 / SES-P-FQS-05: 17

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: Keywords: chocolate, coating, dried, plums, quality

QUALITY PROPERTIES OF CHOCOLATE COVERED DRIED PLUMS

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The demand for functional confectionery products is continuously increasing due to growing consumer awareness of their health benefits. The aim of this research was to evaluate the technological, nutritional and sensory properties of dried plums coated with dark, milk and white chocolate. Stanley variety plums, harvested at technological ripeness from the Berovo region, were analyzed as fresh fruit and then processed into dried plums and chocolate covered dried products. Standard laboratory methods were used to determine moisture content, total dry matter, total acids, total sugars, L-ascorbic acid, total ash and dietary fiber. Sensory evaluation was performed by assessing appearance, taste, aroma, and texture.

Drying method significantly increased the concentration of nutritional ingredients and the shelf life of the product. Compared to fresh fruit, dried plums had higher total dry matter (73.40 %), sugars (43.35 %), total acids (1.33 %), vitamin C (20.29 mg/100 g), total ash (2.77 %) and dietary fiber (3.09 %). The average fruit mass was 28.27 g with a yield of 92.41 %. Sensory scores showed that all chocolate coated samples were well accepted, where the dark chocolate coated samples achieving the highest scores across most attributes, especially aroma, taste and texture.

The results highlight that chocolate covered dried plums, particularly those coated in dark chocolate, offer a promising direction for developing nutritionally valuable, functional desert products. This combination meets consumer demands for food products that balance health benefits with sensory appeal.

ID: 197 / SES-O-FQS-03: 1

Abstract Submissions

Oral Presentation

Topics: Food Quality and Safety

Keywords: Keywords: garlic, nutrition, oil, paste, properties.

COMPARISON OF NUTRITIONAL PROPERTIES OF DIFFERENT TYPES OF GARLIC PASTE

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Garlic pastes, comprising approximately 24 % garlic, is a widely consumed culinary product valued for its flavor and specific taste. While it can consist solely of garlic and oil, the formulation is often enhanced with spices such as parsley, red pepper, and basil, as well as some ground nuts, which contribute to both sensory appeal and nutritional value of the product.

This study aimed to evaluate and compare the quality and nutritional characteristics of garlic in its raw form and across three garlic paste variants: classic garlic paste, garlic paste with ground walnuts, and garlic paste with olive oil, in which the sunflower oil was substituted. A range of quality defining parameters was analyzed for each sample.

The results indicated that the garlic paste with olive oil contained the highest values for water (39.29 %) and ash (3.85 %), while the garlic paste with ground walnut exhibited the highest value for total dry matter (83.84 %). The results of the nutritional profiling revealed that the classic garlic paste had the greatest total fat content (72.4 %) and vitamin C concentration (25.15 mg/100 g); the garlic paste with ground walnut as a variant recorded the highest carbohydrate level (12.5 %), whereas the garlic paste with olive oil had the highest concentrations of fructose (1.26 %) and glucose (3.93 %). Energy content calculations showed that the classic garlic paste possessed the highest caloric value, amounting to 694 Kcal per 100 grams.

ID: 203 / SES-P-FQS-05: 1

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: dried meat products, semi-dried meat products, preservation, health risks

ANALYSIS OF SODIUM CHLORIDE CONTENT IN CURED MEAT PRODUCTS IN MACEDONIAN MARKET

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Table salt (sodium chloride) has been used by humans since ancient times to preserve meat, and it continues to be used in the meat industry today. Semi-dried and dried meat products contain high levels of sodium chloride, which is a potential health risk. The aim of this study was to determine the sodium chloride content in semi-dried and dried meat products available in the Macedonian market. The study was conducted on 50 samples of semi-dried meat products and 50 samples of dried meat products. The sodium chloride content in semi-dried meat products ranged from 1.87% to 3.58%. The highest average sodium chloride content was found in smoked pork ham (2.93%), while the lowest was in smoked chicken drumstick (2.56%). Smoked pork ribs had a narrow range of values (2.82% to 2.96%), compared to smoked beef, which showed significant variation in sodium chloride content (1.87% to 3.58%). Sodium chloride content in various types of dried meat products ranged from 5.12% (pancetta) to 6.78% (prosciutto). The average sodium chloride content ranged from 5.49% (pancetta) to 6.22% (dry neck). Dry pork roast had a relatively narrow sodium chloride content range from 6.00% to 6.58%, while prosciutto exhibited the largest variation (5.39% to 6.78%). Monitoring and reducing the sodium chloride content in dried meat products is necessary.

ID: 204 / SES-P-FQS-05: 4

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: tomato, drought stress, irrigation regime, polyphenols, flavonoids, antioxidant activity.

BIOCHEMICAL RESPONSES OF TOMATO GENOTYPES TO DROUGHT STRESS: POLYPHENOLIC CONTENT AND ANTIOXIDANT ACTIVITY

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Drought stress is a major abiotic factor that limits both the productivity and quality of tomato crops. To address this challenge, in this study we investigated the biochemical adaptations of several tomato genotypes exposed to two distinct irrigation regimes: one simulating drought conditions and the other maintaining optimal water supply (control). Total polyphenolic content was determined using the Folin - Ciocâlteu method, a colorimetric assay based on electron transfer that measures the overall reducing capacity of phenolic antioxidants in the sample. The results were expressed as mg GAE (gallic acid equivalents)/g dw. Total flavonoid content was quantified using the aluminum chloride colorimetric method, with quercetin as the reference standard. Results were expressed as milligrams of quercetin equivalents per gram of dry weight (mg QE/g dw). Antioxidant potential was assessed through the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging assay, which quantifies the capacity of antioxidants in the sample to reduce free radicals. The results showed that drought stress led to increased accumulation of total phenolics and flavonoids in multiple genotypes, indicating an enhanced antioxidant response as an adaptive mechanism. A strong correlation was observed between antioxidant activity and the concentrations of polyphenols and flavonoids, underscoring their contribution to improved fruit quality under stress. These findings emphasize the value of selecting genotypes with elevated antioxidant profiles for breeding programs aimed at developing drought-resilient and nutritionally enriched tomato varieties. Ongoing research involves HPLC-DAD profiling of individual polyphenolic compounds to further elucidate genotype-specific biochemical responses.

ID: 205 / SES-O-FQS-04: 7

Abstract Submissions

Oral Presentation

Topics: Food Quality and Safety

Keywords: Fish waste, biocalcium, production methods, food

PRODUCTION OF BIOCALCIUM POWDER FROM FISH BONES AND ITS USE AS A FOOD ADDITIVE

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ABSTRACT

Fish bones are an important waste, especially after the filleting process, which makes up 30% of the total weight. Fish bones are an important mineral source, and 60% of the mineral mass consists of calcium. Calcium has a very important place in human nutrition. Because calcium is the main component of teeth and bones, as well as having physiological functions in the body such as muscle contraction, wound healing, facilitating blood flow, regulating heart rate and transmitting nerve impulses. Since calcium deficiency in the body prevents these functions from being performed, it causes health problems. To prevent this deficiency, calcium is added to food. For this reason, in recent years, researchers have directed their studies on calcium obtained from fish bones, called "biocalcium". In this presentation, information will be given about biocalcium production stages and its use in the food field. In addition, information will be given about the preliminary results of our ongoing project. In this project, biocalcium production is being studied with different methods. This research was supported by The Scientific Research Projects Administration Unit of Akdeniz University with project number FDK-2024-6699.

Keywords: Fish waste, biocalcium, production methods, food

ID: 208 / SES-P-FQS-05: 5

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: Swiss chard powder, starter culture, nitrate, synthetic nitrites

COLOUR STABILITY AT THE END OF THE SHELF LIFE IN DRY CURED PORK LOIN PRODUCED WITH AN ALTERNATIVE NATURAL NITRITE SOURCE

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This study aimed to evaluate the color stability of dry-cured pork loin made with a natural nitrite source (Swiss chard powder) combined with the starter culture BactoFerm Rosa. The assessment was done at the end of the product's shelf life, both, immediately after slicing and after exposure to daylight at $20 \pm 2^\circ\text{C}$ under daylight conditions for varying durations of 30, 60, 90, and 120 minutes. The research was conducted within industrial settings. Five groups of dry cured pork loins are examined, as follows: TSD (table salt and dextrose); NSD (nitrite salt and dextrose); NSDS (nitrite salt, dextrose and starter culture); TSDSF (table salt, dextrose, Swiss chard powder - from the first producer and starter culture) and TSDSS (table salt, dextrose, chard powder - from the second producer and starter culture). The measured L-value ranges from 26.10 (NSDS) to 33.42 (TSD). In the NSDS, the share of red color is the largest (11.05). The share of yellow color ranges from 1.79 (TSD) to 3.74 (TSDSF). The h-value ranges from 15.620 (NSDS) to 34.670 (TSDSS). The lowest C-value, i.e. the weakest color intensity, is observed in TSD (3.34), while NSDS has the highest color intensity (11.50). The incorporation of Swiss chard powder, acting as a natural source of nitrites, along with BactoFerm Rosa starter culture, contributed to maintaining stable and acceptable color in dry-cured pork loin as it approached the end of its shelf life.

ID: 209 / SES-P-FQS-05: 2

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: fermented dry sausages, finely comminuted boiled sausages, semi-dry coarsely comminuted boiled sausages, boiled sausages made from meat pieces

ANALYSIS OF SODIUM CHLORIDE CONTENT IN SAUSAGE SAMPLES FROM THE MACEDONIAN MARKET

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In meat industry, table salt (sodium chloride) is an indispensable additive, but its excessive intake negatively impacts the human health. The aim of this study was to determine the sodium chloride content in commercially available sausages in the Macedonian market. A total of 200 samples from four sausage subgroups were analyzed: fermented dry sausages, finely comminuted boiled sausages, semi-dry coarsely comminuted boiled sausages, and boiled sausages made from meat pieces. Results showed significant variations in sodium chloride content, ranging from 1.63% (chicken bologna) to 5.82% (beef kulen). Fermented dry sausages exhibited the highest average sodium chloride content (4.21%), semi-dry coarsely comminuted boiled sausages (2.70%), boiled sausages made from meat pieces (2.57%), and finely comminuted boiled sausages (2.38%). Fermented sausages showed a relatively wide range of sodium chloride content (2.60–5.72%), while finely comminuted boiled sausages demonstrated a narrower range (1.90–2.47%). The highest coefficient of variation was observed in grilling sausage (19.28%), beef kulen (19.25%), and turkey ham (19.14%). Variations within the same type of sausage are attributed to differences in manufacturing practices among producers, each with their unique recipes and processing methods. While some producers follow trends of promoting the healthier diets with reduced salt content, the others maintain traditional recipes. Continuous monitoring and reduction of sodium chloride levels in processed meat products are necessary.

ID: 210 / SES-P-FQS-05: 3

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: innovation; perception; awareness; acceptance; ethics.

AWARENESS, ATTITUDE, AND ACCEPTANCE OF LABORATORY-GROWN MEAT BY THE MACEDONIAN CONSUMERS

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This study examines the awareness, attitudes, and acceptance of laboratory-grown meat among Macedonian consumers. The survey was conducted electronically via Google Forms platform, with the link distributed through social media and email. A total of 400 respondents from various demographic categories participated, with 252 (63.00%) being women and 148 (37.00%) men. Of these, 183 (45.80%) have higher education, 158 (39.50%) have secondary education, 42 (10.50%) have postgraduate education, and 17 (4.30%) have a doctoral degree. The largest group of respondents, 123 (30.80%), are aged 35-44, while the smallest group, 47 (11.80%), are over 55 years old. The results show that the majority, 254 (63.50%), of respondents are not familiar with the term "laboratory-grown meat," and of those, more than two-thirds are not interested in further information. Respondents who are familiar with the concept of laboratory-grown meat, generally, hold a negative view of it, with the primary concerns being health safety 82 (56.20%) and taste 39 (26.70%). Only 41 (28.10%) of those familiar with laboratory-grown meat would be willing to try it, and 31 (21.20%) would purchase it if available in the market. Correlation analysis shows that education has the strongest influence on awareness ($r = 0.73$) and attitudes toward laboratory-grown meat ($r = 0.62$), while age is a significant factor for willingness to try ($r = 0.51$) or purchase ($r = 0.65$) laboratory-grown meat. The results indicate significant skepticism and distrust among Macedonian consumers regarding the benefits and safety of laboratory-grown meat.

ID: 212 / SES-P-FQS-05: 12

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: Phacelia, productive characteristics, Honey plants, Nutrition.

PHACELIA TANACETIFOLIA BENTH. HONEY PLANTS-FOR NUTRITION AND HEALTH**Vera Popović¹, Elizabeta Miskoska Milevska², Vilianna Vasileva³, Valentin Kosev⁴, Jela Ikanović⁵, Vladimir Filipović⁶, Radmila Bojović⁷**

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Phacelia tanacetifolia Benth. is honey plants (Hydroclaceae subfamily of the Boraginaceae family). *Phacelia tanacetifolia* is a commercial species that beekeepers have long recognised as a favourite foraging plant for honeybees with a high potential for honey yield. *Phacelia tanacetifolia* Benth. is a highly appealing crop because of its deep blue blossoms and potent, pleasant scent. Up to 4.5 milligrammes of nectar with a 28% sugar content can be obtained from a single bloom. It has a high potential for honey yield, between 500 and 1200 kg of phacelia honey can be produced on 1 hectare. Lightbeige to white, phacelia honey has a fine, pleasant flavor—a good, subtle lemony scent and taste. They provide pollen and nectar, phacelia have a delicious and complete flower for honey bees. A new variety of phacelia NS Piora was created at the Institute. In an experiment carried out in the dry year of 2025 in Bački Petrovac on chernozem, the NS Piora variety bloomed for 55 days and achieved a high seed yield of 600 kg/ha. The NS Piora variety is an excellent honey crop. The potential of *Phacelia* as bee forage is noteworthy. *Phacelia* honey is beneficial to our well-being.

ACKNOWLEDGEMENTS

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ID: 215 / SES-P-FQS-05: 11

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: citrus fruits, nutrients, macroelements, microelements, minerals

IRON AND CALCIUM STATUS IN MANDARIN ON THE MARKET IN THE CITY OF ZAGREB

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Mandarin is a plant species that belongs to the group of winter seasonal fruits. At the time of purchase, consumers do not have complete information about the exact mineral composition of mandarins, which would give them a better insight into the quality of the product itself. This research was conducted in the Zagreb market to determine the iron and calcium content of mandarin fruits and compare the results with the sales channels (3 markets, 3 retail chains and 3 organic products shops). A decomposed sample was obtained by digestion with HNO₃ and HClO₄, from which calcium and iron were determined by atomic absorption spectrometry. The dry matter ranged from 7.4 to 9.33%. Iron in dry matter ranged from 15.8 to 29.3 mg Fe/kg, and calcium from 0.20 to 0.31 % Ca. In the fresh matter, iron content ranged from 0.21 to 0.40 mg Fe/100 g, and calcium from 21 to 42 mg Ca/100 g. The highest dry matter percentage was found in market samples (8.7%), the highest iron content in the dry matter of mandarins from retail chains (25.6 mg Fe/kg), and the highest calcium content in the dry matter was also found in mandarins from retail chains (0.27%). Nutritionally, 100 g of mandarins from retail chains provide approximately 4.29% of the daily calcium and 2.36% of the daily iron requirement. In comparison, those from markets provide 3.38% calcium and 1.57% iron, while organic shop mandarins offer 3.34% calcium and 1.86% iron.

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Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: flavanones, VCEAC values, QSAR models

VCEAC PREDICTION FOR SET OF FLAVANONES

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Flavonoids, phenolic plant constituents, are extensively disseminated in around 42 larger plant families. Depending on the type of plants, flavanones can be discovered in all plant parts (leaves, roots, flowers, fruits, seeds). As a result of structural differences, flavonoids are classified as: flavanols, flavanones, flavonols, isoflavones, flavones, and anthocyanins.

Flavanones occur in nature, mainly found in citrus, and have been isolated in an optically active form. Flavanones and their glycosides are responsible for many biological activities: antimicrobial, anti-inflammatory and antiviral activities; support and enhance the body's defenses against oxidative stress and help the organism in the prevention of cardiovascular diseases, atherosclerosis, and cancer.

Vitamin C equivalent antioxidant capacity (VCEAC) values are measure for the antioxidant capacity of the various natural chemicals. As a result of diverse biological activities, structure–activity relationship techniques (QSAR) have generated interest among chemists, biochemists, agronomists, medicinal.

The main goal of this investigation was to find QSAR correlation between the experimental VCEAC values and selected physico-chemical descriptors for a set of selected flavanones. The QSAR equations were analyzed in order to obtain the most reliable model for predicting the antioxidant capacity of both natural and synthetic flavanones.

The statistical significance of selected two, three and four models was measured by several statistical parameters (R², Radj.2, F-test). Statistical evaluation of the data used to test the quality of the obtained models indicated that all models are statistically significant when all parameters are summarized.

ID: 219 / SES-P-FQS-05: 18

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: Potato (*Solanum tuberosum* L.), phytochemical screening, Folin-Ciocalteu method

PHYTOCHEMICAL SCREENING AND TOTAL POLYPHENOLIC CONTENT DETERMINATION OF POTATO SAMPLES

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Potato (*Solanum tuberosum* L.) is a vital agricultural commodity, widely cultivated and consumed in the world. Potato peel is an excellent resource of valuable bioactive compounds and potentially can be used as a food preservative, supply of dietary fiber in bakery products, pharmaceutical ingredients and animal feed. The chemical composition of potatoes can vary depending on the species, the place and the method of production.

The aim of the present research was phytochemical screening and determination of total polyphenolic content of extracted samples.

The potatoes were purchased at a local store. Potato samples were all fresh and free of mechanical or physiological damage. 1 to 2 mm layer of skin was carefully removed with a knife as is usually done in any household. The samples were cut into small pieces and dried to constant mass. The finely ground samples of the peel and core were macerated for 6 days with occasional stirring. 80% methanol and ethanol solutions were used as solvents.

The presence of flavonoids, steroids, terpenoids, saponins, phenolic components, tannins alkaloids, glycosides was examined in extracted samples.

Total phenolic compounds were determined by the Folin-Ciocalteu photo-colorimetric method in relation to gallic acid used as a reference standard. The absorbance of each of the solutions is then measured at 760 and 765 nm using UV – Vis spectrophotometer.

ID: 221 / SES-O-FQS-03: 2

Abstract Submissions

Oral Presentation

Topics: Food Quality and Safety

Keywords: fraud, knowledge, consumer, food, risk.

CONSUMER AWARENESS AND KNOWLEDGE OF FOOD ADULTERATION IN THE REPUBLIC OF NORTH MACEDONIA

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With the modern technologies evolution, the frequency and sophistication of manipulations within food production and processing systems have become increasingly more present. In an effort to reduce production costs and maximize profits, some manufacturers resort to adulteration or misrepresenting products. Food adulteration can occur from the supply chain, production and processing, to distribution and trade, that potentially harming both consumers and business operators alike. Such practices mislead consumers and sometimes may cause serious health risks. To raise consumer awareness in North Macedonia about food adulteration and assess their understanding of its potential risks, we conducted an online survey-based study involving 508 respondents. According to the survey results, 54 % of respondents were unfamiliar with the term "food adulteration," while 45 % reported only partial awareness of its potential adverse health effects. Moreover, 57 % of respondents believe that the food they consume is subject to adulteration. Meat products were identified as the most frequently adulterated category. Also, 74% of respondents stated that they were unaware of the existing legislation regarding food adulteration, while 58% expressed confidence that the implementation of the legislation could effectively reduce or prevent the occurrence of this problem. Finally, 62 % of participants believed that this survey itself contributed to raising consumer awareness about food adulteration. Despite the legal definitions of food adulteration and food fraud, the findings in this research highlight the necessity for clearer delineation of actionable offenses and regulatory provisions to ensure effective oversight and mitigation of the consequences of food adulteration.

ID: 222 / SES-O-FQS-03: 4

Abstract Submissions

Oral Presentation

Topics: Food Quality and Safety

Keywords: assessment, caffeine, consumption, exposure, risk.

ESTIMATING CAFFEINE INTAKE FROM DIFFERENT FOOD PRODUCTS AND ASSESSING POPULATION HEALTH RISKS

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Caffeine, a naturally occurring psychostimulant, is frequently added to various commercial soft and energy beverages which have become a substantial component of the modern diet in the western societies. The influx of energy drinks with high concentrations of caffeine on the markets has raised health concerns in the health community considering caffeine's pharmacological profile and the potential interactions with alcohol, p-synephrine, and other stimulants. Although single doses of up to 3 mg/kg body weight are considered relatively safe in healthy adults, smaller doses of about 1.5 mg/kg body weight have shown to adversely affect sleep quality and latency in sensitive individuals when consumed before bedtime. For sensitive subpopulations, like pregnant women, children, older adults, and individuals with cardiovascular disorders, the recommended daily limit of ≤ 300 mg may exacerbate any potential health risks. However, the health implications of many soft and energy drinks have not been assessed to adequately inform the general population of the risks associated with excessive caffeine intake. This study aims to quantify caffeine intake and assess exposure levels to evaluate its health implications in a manner that is informative to the general population. Analyses were performed across a range of caffeine containing beverages and chocolate products where caffeine concentrations ranged from 37.37 mg/L to 323.1 mg/L. This data was used to estimate the daily exposures providing insight into population level risk assessments and normalizing the data into a form that is informative for the general populous.

ID: 238 / SES-O-FQS-03: 7

Abstract Submissions

Oral Presentation

Topics: Food Quality and Safety

Keywords: artificial sweeteners, caffeine, method validation, plant-based products, preservatives

VALIDATION OF HPLC METHOD FOR THE SIMULTANEOUS DETERMINATION OF SOME ADDITIVES IN PLANT-BASED FOOD PRODUCTS

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Artificial sweeteners, preservatives and caffeine are becoming increasingly included in plant-based foods in order to improve taste, shelf life, and consumer appeal. Although they are approved as safe, there is a lot of evidence of adverse effects on consumer health. Therefore, most additives have maximum concentration limits and strict rules for use. The aim of this paper was development and validation of reliable high-performance liquid chromatography (HPLC) method with ultraviolet-diode array detection (UV-DAD) for the simultaneous determination of the commonly used artificial sweeteners (acesulfame K, aspartame, and saccharin), preservatives (sodium benzoate and potassium sorbate) and caffeine in many plant-based food products, such as: marmalades, baby fruit and vegetable porridge, fruit and chocolate dressings, pasteurized olives and mushrooms, ketchup, tomato puree, ajvar, lutenica, soy sauce, etc. Chromatographic separation was achieved using isocratic elution with a mobile phase consisting of diluted phosphoric acid in water (pH = 3.8) and methanol on a C-18 stationary phase, at constant column temperature at 25 °C, flow rate of 1.0 mL/min and UV detection at 210, 230 and 260 nm. The method was validated assessing parameters such as specificity, linearity, precision, accuracy, limits of detection (LOD) and limits of quantification (LOQ). Linearity was confirmed in a concentration range of 1 to 100 mg/L with correlation coefficients exceeding 0.998 for all analytes. Accuracy was determined by recovery studies at two fortification levels, with recoveries ranging from 82 to 98 %. The validated method is suitable for routine analysis and monitoring of selected additives in plant-based food matrices.

ID: 239 / SES-O-FQS-03: 3

Abstract Submissions

Oral Presentation

Topics: Food Quality and Safety

Keywords: flavonoids, method validation, phenolic acids, RP-HPLC, tomato

DEVELOPMENT AND VALIDATION OF RP-HPLC METHOD FOR THE DETERMINATION OF POLYPHENOLS IN TOMATO

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Tomatoes are one of the most widely consumed vegetables in the world, rich in nutritional and phytochemical constituents. Polyphenols are important biofunctional components in tomatoes that, with their antioxidant properties, have a beneficial effect on the health of consumers. The main objective of this paper was to develop and validate a reliable reversed-phase high-performance liquid chromatography (RP-HPLC) method, coupled with ultraviolet diode array detection (UV-DAD) for simultaneous determination of main polyphenolic compounds in tomato. The chromatographic analyses were carried out on the C-18 stationary phase, using gradient elution with acetonitrile and 0.1 % formic acid in water as mobile phase, and constant column temperature at 25 °C. The chromatographic process was followed at 220, 325 and 360 nm. The extraction of polyphenols was performed with methanol acidified with acetic acid using ultrasound, followed by centrifugation and filtration. The developed method was validated testing linearity, precision, accuracy, the limits of detection (LOD) and quantification (LOQ). The method had a good linearity ($R^2 > 0.99$) and intra-day precisions ($RSD < 0.6\%$). The accuracy of the method was determined by recovery studies in tomato samples spiked with the analytes at two concentration levels. Using this method, successful separation and quantification of 15 polyphenols including flavonoids (rutin, quercetin, quercetin-3-glucoside, naringenin, kaempferol, kaempferol-3-rutinoside, kaempferol-3-glucoside) and phenolic acids (gallic, chlorogenic, caffeic, p coumaric, trans-ferulic, trans-isoferulic, benzoic, trans-cinamic) was achieved. The method was applied for determination of target analytes in red and rose tomato varieties cultivated in Skopje region.

ID: 266 / SES-P-FQS-05: 6

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: Oat fermentation · Lactic acid bacteria · Polyphenols · Antioxidant activity · Functional beverages

DEVELOPMENT OF FERMENTED OAT-BASED BEVERAGES ENRICHED WITH POLYPHENOL-RICH FRUITS: A FUNCTIONAL ALTERNATIVE TO DIARY

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The study investigates the development of dense oat-based beverages with improved nutritional and functional properties through controlled fermentation using starters from lactic acid bacteria (LAB) and plant ingredients rich in polyphenols. A starter culture was selected from three technological starters for dairy products, and fermentation was conducted at 37 °C. Oats were chosen as the main matrix due to the presence of soluble fibers, particularly β -glucan, recognized for its health benefits. Plant ingredients rich in polyphenols – hawthorn fruit (*Crataegus monogyna*), raspberries (*Rubus idaeus*) and lingonberries (*Vaccinium vitis-idaea* L.) – were added to the oats before pasteurization and subsequent fermentation. The changes in pH, total polyphenol concentrations, and antioxidant activity were monitored over the 12-hour fermentation period. The addition of hawthorn, raspberries, and lingonberries introduced natural polyphenols, leading to an increase in the antioxidant activity of the enriched beverages. The final product met low sodium criteria and exhibited elevated antioxidant potential. These features position the fermented oat beverages as promising plant-based alternatives to dairy products and conventional plant-based dairy substitutes.

ID: 314 / SES-P-FQS-05: 15

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: polyphenols, DPPH, FRAP, ABTS, Pearson correlations.

CORRELATION BETWEEN TOTAL POLYPHENOLS AND ANTIOXIDANT CAPACITY (DPPH, FRAP AND ABTS ASSAYS): PRINCIPLES AND LITERATURE INSIGHTS

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This work explores the foundational principles and methodological distinctions of three widely used antioxidant assays: DPPH (2,2-diphenyl-1-picrylhydrazyl assay), FRAP (Ferric Reducing Antioxidant Power), and ABTS (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)). Each assay targets different aspects of antioxidant behavior. DPPH measures hydrogen atom donation, FRAP quantifies reducing power in acidic conditions, and ABTS examines electron transfer potential with variations in sensitivity and selectivity for polyphenolic compounds. Literature data reveal that while the DPPH assay is more selective for certain hydroxylated phenolics, ABTS demonstrates broader reactivity but may lack specificity. The FRAP assay operates under unique low pH conditions, effectively assessing compounds with significant electron-donating abilities. Comparative studies indicate strong positive correlations between FRAP, ABTS, and total polyphenols, whereas DPPH correlations are more dependent on sample characteristics. Multiple studies demonstrate statistically significant Pearson correlations showing positive relationships between total polyphenolic content and antioxidant capacity measured by these assays. This synthesis of published research provides valuable context for interpreting antioxidant results and emphasizes the importance of assay selection and polyphenol profiling when correlating antioxidant activity with total phenolic content.

ID: 315 / SES-P-FQS-05: 16

Abstract Submissions

Poster Presentation

Topics: Food Quality and Safety

Keywords: extracts, thyme, mint, rosemary, yarrow

BIOACTIVE POTENTIAL OF AQUEOUS EXTRACTS FROM BULGARIAN HERBS: FLAVONOIDS AND PHENOLICS

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The increasing demand for natural antioxidants has brought medicinal and aromatic plants into focus as valuable reservoirs of bioactive compounds. This study evaluates aqueous extracts from Bulgarian wild and cultivated herbs, emphasizing total flavonoids and phenolics. The investigated species included thyme (*Thymus callieri* Borbás ex Velen), spearmint (*Mentha × piperita* L.), wild mint (*Mentha pulegium* L.), rose geranium (*Pelargonium roseum* Willd.), rosemary (*Rosmarinus officinalis* L.), and yarrow (*Achillea millefolium* L.).

Polyphenols were determined using the Folin–Ciocalteu method, expressed as mg gallic acid equivalents per gram of dry weight (mg GAE/g dw), while flavonoid concentration was measured with the aluminum chloride method, expressed as mg quercetin equivalents per gram of dry weight (mg QE/g dw). Flavonoid levels in extracts from coarsely chopped material ranged from 0.146 mg QE/g dw in rose geranium to 1.026 mg QE/g dw in yarrow. Ground samples generally yielded higher values, with spearmint showing the highest concentration (1.349 mg QE/g dw) and rose geranium the lowest (0.198 mg QE/g dw).

Total phenolic concentrations varied notably among species. Thyme exhibited the highest concentration (24.75 mg GAE/g dw), followed by wild mint (23.35 mg GAE/g dw) and rosemary (23.25 mg GAE/g dw). In contrast, rose geranium, yarrow, and spearmint displayed lower but significant levels.

These findings highlight the significant antioxidant potential of the studied herbs, particularly thyme, wild mint, and rosemary. Beyond confirming their bioactivity, the study emphasizes the effect of sample preparation on extract composition, providing insights for optimizing plant resource utilization in pharmaceutical and food applications.

ID: 318 / SES-O-FQS-03: 5

Abstract Submissions

Oral Presentation

Topics: Food Quality and Safety

Keywords: Food Safety, FVA, EFSA, Cooperation

FOOD SAFETY IN FOCUS: MACEDONIA'S JOURNEY WITH EFSA

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The Food and Veterinary Agency of Macedonia (FVA) has developed a long-standing strong cooperation with the European Food Safety Authority (EFSA), which plays a key role in strengthening national capacities in food safety, animal health and plant health risk assessment as well as in risk communication.

Through nominated representatives, Macedonia actively participates in EFSA's working groups and scientific networks on zoonoses, chemical contaminants, AMR, BSE/TSE monitoring, and animal health and welfare. The purpose of these networks is to coordinate activities, exchange information, develop and implement methodologies and joint projects, and exchange expertise and best practices.

Macedonia also benefits from commitment of EFSA for integration of pre-accession countries to harmonize and streamline the data collection process. With the support of EFSA, Macedonia is actively reporting data to EFSA in several domains such as zoonosis, chemical contaminants, AMR, food-borne-outbreaks, TSE/BSE, AI, ASF, etc.

Active involvement in EFSA Advisory Forum meetings, Focal Point and communication networks, and the SIGMA project has allowed FVA to contribute to European-level knowledge while simultaneously upgrading its own systems for data collection, reporting, and analysis. This collaboration has strengthened institutional expertise and created opportunities for joint projects and international exchange of best practices.

Within this cooperation, the Safe2Eat campaign represents an important initiative that demonstrates how scientific information can be effectively translated into clear messages for citizens. By adapting EFSA's tools and communication approaches to the local context, FVA helps consumers make informed choices, increases awareness of food-related risks, and reinforces public trust in institutions.

FRUIT GROWING, VITICULTURE AND WINE PRODUCTION

ID: 102 / SES-O-FGVWP-01: 2

Abstract Submissions

Oral Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: Algafert, Biofat 600, leaf chlorophyll, yield, fruit traits

MICROALGAE-BASED BIOSTIMULANTS CHANGE PHYSIOLOGICAL, AGRONOMIC AND FRUIT QUALITY TRAITS OF 'SOLU RED' AND 'WAKEFIELD' RASPBERRIES

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This study illustrates the effect of the microalgae-based biostimulants 'Algafert' (0.75% N; 7.40% P₂O₅, 3.20% K₂O, 5.60% free amino acids) and 'Biofat 600' (2.70% N, 6.70% Ca, 0.10% P₂O₅, 0.10% K₂O, 6% free amino acids) on the leaf concentration of chlorophyll (SPAD) and nitrogen (mg/g), vegetative growth, productivity, biometric and chemical fruit properties of raspberry cultivars 'Solu Red' and 'WakeField'. The following treatments were applied: T1 - Biofat (2x foliar, 2 l/ha per application); T2 – Algafert (2x foliar, 1 l/ha per application) + Biofat (1x foliar, 2 l/ha) and To – control treatment. The first application was performed on May 17, 2024 (40% open flowers) followed by the second application during the fruit setting and growth. The research was carried out in a raspberry plantation of the company 'Floriva' located in southwestern Serbia. The planting was conducted in spring 2022 in 10-L pots filled with coco peat. Both biostimulants' treatments significantly enhanced the concentration of chlorophyll and nitrogen after the second application compared to the control. 'WakeField' had significantly higher chlorophyll and nitrogen concentration than 'Solu Red'. A significantly higher number of fruiting laterals (32.57) and yield per cane (1261.33 g) was recorded in 'Solu Red', while the number of fruits per cane did not differ significantly between cultivars tested. 'Solu Red' showed significantly higher values for the fruit volume-related traits and total acids compared to 'WakeField'. This study revealed that microalgae-based biostimulants offer a unique opportunity to strengthen the plants' capacity to cope with challenges amplified by climate change.

ID: 108 / SES-P-FGVWP-01: 1**Abstract Submissions****Poster Presentation***Topics:* Fruit Growing, Viticulture and Wine Production*Keywords:* biodiversity, CLIMED FRUIT, climate resilience, pollinators**ENHANCING POLLINATOR ACTIVITY IN AGRICULTURAL SYSTEMS: STRATEGIES TO SUPPORT AND ATTRACT BENEFICIAL INSECT SPECIES****Slavica Čolić¹, Marijana Maslovarić¹, Naouel Admane², Clara Gerardin³, Slađan Stanković¹, Ivana Stanimirović¹**¹Institute for Science Application in Agriculture, Belgrade, Serbia; ²Mediterranean Agronomic Institute of Bari, Bari, Italy; ³French wine and Vine Institute, Peyrole, France; slavicacol@yahoo.com

Pollinators are essential for maintaining biodiversity and ensuring agricultural productivity, yet their populations are declining due to habitat loss, pesticide use, and climate change. Enhancing pollinator activity within agricultural systems is critical for resilient food production and ecosystem health. This work presents some strategies for supporting and attracting beneficial insect species, focusing on habitat diversification, floral resource enhancement, and integrated pest and landscape management. The CLIMED FRUIT project, which explores climate-resilient approaches in Mediterranean fruit crop systems, provides a foundational context for this initiative. Within the project framework, we collect and analyse evidence on how diverse orchard systems, including the use of cover crops, hedgerows, and flowering strips, contribute to the conservation of wild pollinators and functional biodiversity. Emphasis is placed on the co-benefits of these practices—enhancing pollinator abundance and diversity and improving crop yields, pest regulation, and system resilience to climatic stress. Pilot studies conducted in Mediterranean agroecosystems illustrate effective methods for creating pollinator-friendly environments tailored to specific crop types and regional conditions. Integrating such strategies aligns with the CLIMED FRUIT objectives of promoting sustainable, adaptive agricultural models capable of withstanding climate variability while preserving ecological services. This work underscores the urgent need for landscape-level planning and stakeholder collaboration to embed pollinator support into standard farming practices, thereby reinforcing ecological intensification in fruit production systems across climate-sensitive regions

ID: 118 / SES-P-FGVWP-02: 5

Abstract Submissions

Poster Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: Projection, viticulture, spatial planning, R. N. Macedonia

PROJECTION FOR THE DEVELOPMENT OF VITICULTURE IN R. N. MACEDONIA FOR THE PERIOD 2021-2040

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Abstract. The forecast for viticulture development in North Macedonia for the period 2021-2040 was formulated to meet the spatial planning requirements of governmental institutions. The primary indicator for developmental assessment was the vineyard area measured in hectares. This projection integrated data sourced from the State Statistical Office, cross-referenced with annual reports issued by the Ministry of Agriculture, Forestry, and Water Management, relevant viticulture literature, and the finalized 2023 Viticulture and Winemaking Strategy of North Macedonia.

Analytical procedures established in statistical methodologies were employed for data evaluation, complemented by expert insights derived from academic learning and practical field experience.

Findings underscore the extensive growth opportunities in the viticultural sector of North Macedonia. Spatial planning initiatives anticipate an expanse of vineyards covering up to 38,000 hectares, matching the historical peaks noted in 1981.

The prevailing climate trends, characterized by escalating temperatures, necessitate adaptive measures, notably the establishment of vineyards at higher elevations, mainly within the wine-producing regions of Prespa and Ohrid.

Acknowledging the uncertainties posed by climatic fluctuations on grape cultivation and broader fruit production, a strategic shift from the traditional "French perfection" approach is advocated. Ensuring stability in production entails adopting an "American pragmatic" approach, which prioritizes the cultivation of resilient hybrid grape varieties and native American grapevine species. This strategic pivot aims to safeguard sustainable food sources for the populace amidst evolving environmental conditions.

ID: 119 / SES-O-FGVWP-02: 2

Abstract Submissions

Oral Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: variety, genotypic, phenotypic, clone, Končanka

GENOTYPIC AND PHENOTYPIC COMPARISONS OF MUSCAT HAMBURG AND KONČANKA GRAPE VARIETIES GROWN IN VINEYARDS IN THE R. N. MACEDONIA

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Abstract

The Muscat Hamburg variety has been introduced and has been cultivated for a long time in several vineyards in the Republic of Macedonia, while the Končanka variety was discovered as autochthonous in 2002 and has been limitedly propagated in collection plantations for the purpose of scientific research. In that context, the main goal of this paper is to make genotypic and phenotypic comparisons between the Muscat Hamburg and Končanka varieties (since they are similar in some characteristics) and to determine the possible common origin *Vitis Vinifera* L.

The studies were conducted from 2017 to 2023. The results obtained from the genotypic characteristics were obtained by examining and comparing the number, dimensions and possible abnormalities of the chromosomes in the examined varieties. The results obtained from the phenotypic characteristics are obtained by examining the external characteristics - mass of removed shoots (green mass - g), dimensions of bunch and grain, color and shades, number of seeds, chemical properties of the must, etc.

The analyses showed that the two varieties have great similarities but also have great differences. They are table varieties but can be used for processing into table wine and brandy. Končanka is an autochthonous variety and is only present as individual vines in the Konče area (Gevgelija–Valandovo vineyard). Based on our research, we have concluded that Končanka is not a clone of Muscat Hamburg, although they have very similar properties.

ID: 120 / SES-P-FGVWP-01: 2

Abstract Submissions

Poster Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: *Malus domestica*, 'Fuji', fruit thinning, yield efficiency, fruit size

COULD THE SIDE SUBSTITUTE THE KING? THE IMPORTANCE OF FLOWER POSITION IN AN APPLE CLUSTER

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With the increasingly pronounced effect of climate change, frequent spring frosts are inevitable in recent seasons. In apples, the king flowers in clusters, which are considered the most valuable, are the first to be damaged, while the lateral ones are more likely to survive and ensure yield. This study aimed to reveal whether the position of the flower in the cluster matters concerning yield efficiency. The experiment was conducted in 2023, in an apple orchard of cultivar 'Fuji' grafted on M9 rootstock. Hand thinning was performed, retaining only the king or the side (5th or 6th position in the cluster) flower at full bloom (KingF and SideF) and during fruit development when they were 7mm in diameter (King7 and Side7). On control trees, clusters were left unthinned. At harvest, all fruits were calibrated and divided into the following categories according to their diameter: pygmy fruits (<60 mm), 60-70 mm, 70-80 mm, and >80 mm, and the number of fruits and yield (kg) per fruit size class and tree were determined. All treatments resulted in an increase in fruit size compared to the control, which had the highest proportion (80 %) of unmarketable fruits (<70 mm). Treatments KingF and King7 slightly reduced the proportion of fruits <70 mm compared to the SideF and Side7, but the yield and number of larger fruit classes did not differ. The moment of thinning was also not impactful. This indicates the equal potential of the side and king fruits to provide marketable yield in specific circumstances.

ID: 122 / SES-P-FGVWP-01: 3

Abstract Submissions

Poster Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: *Corylus avellana*, chemometric classification, Principal Component Analysis, sporopollenin, lipids

CHEMICAL FINGERPRINT OF POLLEN IN THREE HAZELNUT CULTIVARS USING RAMAN SPECTROSCOPY

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The aim of this study was to determine the chemical composition of pollen from three hazelnut cultivars (Tonda Di Giffoni – TDG, Tonda Gentile Romana – TGR and Nocchione – N) using an XploRA Raman microspectrometer (Horiba Jobin Yvon). Bands in the ranges of 1560–1630 cm⁻¹ and 830–890 cm⁻¹ are related to sporopollenin, while band with higher intensity at 1440 cm⁻¹ to lipids, the carotenoid-associated bands are at around 1517, 1151 and at 999 cm⁻¹. The Principal Component Analysis model for the pollen grain samples resulted in two principal components that explained 65.35% of the total data variance. The loading plot of the PC1 shows the separation between the TDG and TGR cultivars from the N, which could be attributed to carotenoids (1002, 1155 and 1519 cm⁻¹) and lipids (1307, 1440 cm⁻¹). These results indicated that the TDG and TGR cultivars may differ from the N in lipids, while the N differ from others in carotenoids. PC2 shows the separation between the TDG and TGR cultivars from the N, corresponding to the negative loadings originating predominantly from sporopollenin (e.g. 1607 and 1565 cm⁻¹). Loadings to PC2 could indicated that N have a higher concentration of phenols than the TDG and TGR and which have higher concentration of proteins (1542 cm⁻¹) and carbohydrates (508, 768, 932, 1101 cm⁻¹). These data confirm that different pollen samples contain specific chemical profiles, which may indicate a different functional role and biological efficiency in the pollination and fertilization process, therefore fruit yield.

ID: 129 / SES-P-FGVWP-01: 4

Abstract Submissions

Poster Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: *Prunus domestica*, histology, development, flower bud

DIFFERENTIATION OF FLOWER BUDS IN SOME PLUM CULTIVARS UNDER THE ECOLOGIC CONDITIONS OF SERBIA

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The aim of this work was to determine the process of flower bud differentiation in three plum cultivars (Čačansk's Beauty, Valor and Reeves) under the ecological conditions of Belgrade (Serbia). The buds were harvested in 12 dates every seven days (from July 10 to September 25). Bud length, width, circumference and volume were measured on histological preparations, together with the observation of the process of flower element formation within the bud. After the 12-week trial, flower differentiation was found to be significantly different. The first signs that the bud would bear flowers occurred on July 24 for Reeves and one week later for the other cultivars. The bud width increased from 1.8 times (Čačansk's Beauty and Valor) to 2.1 times for 'Reeves' during the experiment. The bud length increased from 1.94 times (Valor) to 4.1 times (Reeves). The variation of the length/width ratio showed us that the buds were elongated from a round shape. The bud volume increased the least (6.7 times) in Valor and the most (18 times) in Reeves. At the time of the last sampling, all three varieties had two flowers per bud. The results from this study will improve the agricultural techniques and planning of plum production under the conditions in Serbia.

ID: 137 / SES-P-FGVWP-01: 5

Abstract Submissions

Poster Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: hazelnut, cultivars, morphological traits, kernel, oil content

ANALYSIS OF MORPHOLOGICAL AND CHEMICAL PROPERTIES OF HAZELNUT (CORYLUS AVELLANA L.) CULTIVARS GROWN IN SERBIA

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This study aimed to evaluate the morphological and chemical characteristics of fruits from seven hazelnut (*Corylus avellana* L.) cultivars commonly cultivated in Serbia: 'Ennis', 'Hallesche Riesen', 'San Giovanni', 'Romische Zellernuss', 'Tonda Gentile Romana', 'Tonda Francescana', and 'Tonda di Giffoni'. The research was conducted in commercial orchards near Jagodina, using standardized methods for measuring fruit dimensions and oil content. Key traits analyzed included fruit height, width, thickness, nut and kernel weight, kernel ratio, shell thickness, and oil content. The cultivar 'Ennis' exhibited the largest fruits and kernels, while 'San Giovanni' had the highest kernel yield and elongated fruit shape. 'Tonda Francescana' stood out with the highest oil content (69%), making it particularly suitable for confectionery use. 'Tonda Gentile Romana' had the thickest shell and the smallest kernel mass. Fruit shapes varied among cultivars, from round in 'Tonda Gentile Romana', 'Tonda Francescana', and 'Tonda di Giffoni', to oval in 'Ennis' and 'San Giovanni', and slightly flattened in 'Romische Zellernuss' and 'Hallesche Riesen'. All cultivars had oil content above 61%, confirming their nutritional and commercial value. The findings provide relevant insights for cultivar selection based on intended use, climatic suitability, and market preferences.

ID: 139 / SES-O-FGVWP-01: 3

Abstract Submissions

Oral Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: frost, flower, stone fruit.

SPRING FROST DAMAGE TO PLUM, CHERRY, AND SOUR CHERRY FLOWERS DURING THE 2025 SEASON IN ČAČAK

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During March 18th, 19th, and 20th, as well as April 7th and 8th, 2025, the Čačak region, along with most of Serbia, was affected by a cold air wave that caused severe frosts. According to data from the iMetos 3.3 weather station installed at the testing site, temperatures dropped to -2.92 °C on the night and morning of March 18th, -6.00 °C on March 19th, and -3.95 °C on March 20th. At that time, plum trees were in stages 54 and 55 of the BBCH scale for stone fruit development (individually formed flower buds visible and still enclosed by green sepals) and suffered no damage from the low temperatures. Sour cherry cultivars were at the same developmental stage as plums, but frost damage ranged from 9.1% ('Šumadinka') to 51.5% ('Oblačinska'). Sweet cherry cultivars ranged from stages 54 and 55 (as with plums) to stages 56 and 57 (beginning of the "balloon" stage). Frost damage in sweet cherry ranged from 9.6% ('Celeste') to 88.9% ('Junska Rana') and 90.1% ('Summit'). During the second cold wave, temperatures dropped to -1.99 °C on April 7th and -3.98 °C on April 8th. At that point, the tested plum cultivars were in stages 65 to 69 of the BBCH scale (full bloom – first petals falling, to end of flowering – all petals fallen). Differences in damage among cultivars were not significant, with frost damage ranging from 45.0% ('Nada') to 52.9% in the cultivar 'Čačanska Lepotica'.

ID: 144 / SES-P-FGVWP-02: 3

Abstract Submissions

Poster Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: ampelographic parameters, grape, Traminer, R1, VCR 6

AMPELOGRAPHIC GRAPE QUALITY PARAMETERS OF TRAMINER CV CLONES GROWN UNDER AGROECOLOGICAL CONDITIONS OF CENTRAL SERBIA WINE REGION

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The aim of this study was to determine the ampelographic quality parameters of two Italian Traminer clones (R1 and VCR 6) grown under the agroecological conditions of the Central Serbia wine region and the Grocka subregion. The research was carried out at the Faculty of Agriculture University of Belgrade in the experimental field "Radmilovac" (GPS coordinates 44°46'12'' N and 20°44'02'' E). The tested clones were grafted on rootstock V. berlandieri x V. rupestris - 110R clone VCR 114. Ampelographic parameters of the bunches and berries (bunch length, width and mass, bunch stem and berry mass, % of berry skin and mesocarp, etc.) were determined on 10 randomly selected bunches. The sugar content of the grape must was determined with the Oechsle hydrometer and the total acidity by titration method using 0.1 M NaOH. Clone VCR 6 was characterised by a higher average mass of bunches (86.6 g), weight of 100 berries (139 g), weight of berry skins (8.81 g) and sugar content in the grape juice (23.06%), while clone R1 had a higher number of seeds and a higher weight of skins of 100 berries (244 and 7.51 g) and a higher total acidity in the grape juice expressed as tartaric (6.01 g/l). Based on the obtained results, it can be concluded that the tested clones are suitable for growing in the Central Serbia wine region and that, based on the parameters shown, they can be recommended for the production of high quality wine.

ID: 172 / SES-P-FGVWP-01: 6

Abstract Submissions

Poster Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: paclobutrazol, prohexadione-calcium, mechanized harvest

EFFECT OF GROWTH REGULATORS ON PEDICEL LENGTH AND DETACHMENT FORCE IN SOUR CHERRY

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Mechanized harvest is the predominant method used in the production of 'Oblacinska' sour cherry, where reduced tree vigor and optimal fruit detachment force are crucial for mechanized harvest efficiency. The application of growth regulators (PGRs) affects not only vegetative growth but also traits relevant to mechanized harvest. This study investigated the influence of different rates of paclobutrazol (PBZ) and prohexadione-calcium (PRO-Ca) on pedicel length and fruit detachment force. PBZ was applied via soil drench (PBZ-R: 0.4, 0.7 and 1.3 L/ha) and foliar spray (PBZ-F: 1.0, 1.5 and 2.0 kg/ha), while PRO-Ca was applied foliar-only (1.0, 1.5 and 2.0 kg/ha). The trial was conducted at two locations (Mandelos and Gladnoš) in 2023 and 2024, with measurements in 2024. In Mandelos, the shortest pedicels were recorded under soil-applied PBZ (PBZ R) at the highest concentration in 2023, the longest under foliar-applied PBZ (PBZ F) at the highest concentration across both years, and the highest fruit detachment force was also observed with PBZ R in 2023 and PBZ F in 2024. In Gladnoš, the shortest pedicels were noted in PBZ-R at the highest concentration applied in 2023 and PBZ-F at the highest concentration applied in 2024. The highest detachment force was recorded under PBZ-R at the highest concentration applied in 2023, and the lowest in the untreated control. Soil-applied PBZ, particularly at higher concentrations, significantly increased fruit detachment force, while foliar-applied PBZ in repeated applications contributed to increased pedicel length.

ID: 176 / SES-O-FGVWP-01: 1**Abstract Submissions****Oral Presentation***Topics:* Fruit Growing, Viticulture and Wine Production*Keywords:* shoots, GA3, GA4/7, tree height, internode length, leaf area**ENHANCING TREE GROWTH OF COLUMNAR APPLE CULTIVARS BY USING GIBBERELLINS****Biserka Milić, Nenad Magazin, Maja Milović, Goran Barać, Gordana Barać, Stefan Gligorić**University of Novi Sad, Faculty of Agriculture, Serbia; biserka.milic@polj.edu.rs

Columnar apple cultivars have very few lateral shoots and are suitable for high-density planting, minimal pruning, and mechanical harvesting. They are characterized by fast growth, early bearing and high yield thus offering labor-saving opportunities for apple growers, as high-density planting increases yield per hectare. New cultivation systems and cultural practices suitable for columnar apples need to be developed, as their tree architecture is completely different from that of standard apples. The research aimed to enhance young columnar tree growth using gibberellins (GA3 and GA4/7) to stimulate canopy development. The experiment was set up in the orchard of three columnar apple cultivars 'Rumeno vreteno', 'Kraljica čardaša' and 'Vesna', planted in the spring 2024. at 3.5×0.3 m planting distance, in the second vegetative season. Gibberellins were applied four times at two-weeks intervals starting from two weeks after full bloom at the rates of 200 and 400 ppm. During the vegetative season, the length of main shoot was measured once a week and the daily growth rate was calculated. The internode length and leaf area was measured and the number of leaves was counted at the end of active growth period. Cultivars significantly differed in the length of main shoot throughout the season. GA3 400 ppm treatment resulted in the highest length of main shoot in all three cultivars, while the shoots were the shortest in the untreated control. GA4/7 had less potential for shoot elongation than GA3.

ID: 194 / SES-O-FGVWP-01: 4

Abstract Submissions

Oral Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: *Pyrus communis* L., interstock, vigor, yield, fruit quality

EFFECT OF INTERSTOCK ON GROWTH AND CROPPING OF THE 'PACKAM'S TRIUMPH PEAR ON WILD PEAR SEEDLINGS ROOTSTOCK

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The influence of an interstock on vigor, productivity, and fruit quality was investigated in a pear orchard located in the Veles region, in the central part of the Republic of Macedonia, over a period of ten consecutive years. The orchard was established during the 2010/2011 season on sandy clay loam soil, characterized by low humus content (1.65%), medium carbonate levels (6.5%), moderate alkaline pH (8.1), and good phosphorus and potassium availability. Trees were trained using a central leader system with a planting density of 4 meters between rows and 2.5 meters between trees (1,000 trees per hectare). The cultivar 'Williams' was grafted onto wild pear seedling rootstock and used as a 50 cm long interstock, onto which the cultivar 'Packham's Triumph' was grafted. As a control, trees were grafted directly onto wild pear seedling rootstock without the use of an interstock. Over the ten-year research period (2015–2024), data were collected on vegetative growth (shoot length, trunk cross-sectional area, and crown size), tree productivity (number of fruits, yield per tree and per hectare), and fruit size. The interstock had a significant influence on vegetative growth, number of fruits per tree, yield per tree and per hectare, yield efficiency, and fruit size. Trees with an interstock had smaller trunk diameters and crown volumes but showed improved cropping characteristics. Yield differences were especially notable during the early years of fruiting. Fruit weight was higher in trees without an interstock.

ID: 199 / SES-P-FGVWP-02: 4

Abstract Submissions

Poster Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: heavy metals, soil, vineyard, grapevine

RISK ASSESSMENT OF ARSENIC AND NICKEL IN SOILS OF POTENTIAL VINEYARDS IN THE VRANJE REGION

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Vranje region has specific conditions that represent an ideal environment for the production of quality wines. Soils potential contamination is of great importance for the viticulture sustainability. The aim of this research was to examine the content of potentially dangerous and harmful elements, more precisely the heavy metals arsenic and nickel, in the lands intended for the establishment of vineyards in the Vranje region. Arsenic is a metalloid that occurs naturally in soil, but can also come from anthropogenic sources, which can become toxic to plants. Nickel is an essential trace element in low concentrations, but in elevated doses it also shows harmful effects. Eighteen soil samples taken from two depths (0-30cm and 30-60cm) were analyzed in order to determine the total and available content of these elements. The results showed that the total content of arsenic at both sampling depths is below the maximum allowed concentration (MAC). At the first depth, it ranged from 1.7 to 10.3mg/kg, while at the second depth, the average value was 7.3 mg/kg of total arsenic. The total content of nickel varied from 6.7 to 53.8mg/kg, with six samples exceeding the MAC. The analysis of available nickel content (mean 6.6mg/kg) indicated that it doesn't represent a danger for growing vines. Although some samples showed an elevated content of total nickel, available content doesn't pose a risk for growing vines. Continuous control of soil fertility and constant monitoring of the content of heavy metals in the soils of the vineyards in this region is recommended.

ID: 235 / SES-O-FGVWP-01: 5

Abstract Submissions

Oral Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: nutrient management, fruit quality, data standardization, systematic reviews, horticultural research

FROM FIELD DATA TO EVIDENCE SYNTHESIS: A CASE STUDY ON PEAR FERTILIZATION

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On-farm trials provide critical data for optimizing fruit production, but their integration into evidence synthesis is often limited due to design inconsistencies and incomplete reporting. This study presents a four-year field experiment conducted in western Serbia to evaluate the effects of seven fertilization treatments—including organic, mineral, organo-mineral fertilizers, and zeolite—on the growth, yield, fruit quality, and foliar mineral composition of *Pyrus communis* L. cv. 'Williams'. The trial generated comprehensive agronomic and biochemical data under commercial conditions.

Univariate and multivariate analyses (ANOVA, PCA, correlation) were used to determine statistically significant effects and relationships between fertilizer types and measured parameters. The study highlights both the potential and limitations of on-farm data for informing broader evidence syntheses in fruit science. Key challenges include a lack of standardization, variability in site-specific factors, and insufficient contextual metadata. Recommendations are provided to improve experimental design and data documentation, enhancing compatibility with systematic reviews.

The paper aims to demonstrate how structured field trials can support transparent, evidence-based decision-making in sustainable horticulture. This work was supported by the CA23107 - Network for Evidence Synthesis in the Agri-Food Sector (EU-NESA).

ID: 243 / SES-P-FGVWP-01: 9

Abstract Submissions

Poster Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: bilberry, digital maps, distribution, productivity

DISTRIBUTION AND PRODUCTIVITY OF BILBERRY IN NATIONAL PARK PELISTER AND PRESPIA REGION

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Bilberry (*Vaccinium myrtillus* L.) is a significant wild forest fruit with high ecological and economic value, widely present in the forest ecosystems of Pelister National Park, North Macedonia. This research was conducted within the project "Sustainable Use of Plant Natural Resources in the Prespa Region," led by Prof. Dr. Silvana Manasievska. The main objective was to map bilberry's natural distribution, evaluate its biological and productive potential, and analyze traditional harvesting practices along with opportunities for sustainable use. The study included fieldwork applying geospatial analysis, surveys with local gatherers, and monitoring of bilberry populations across various altitudes and landscape exposures. Results showed that bilberry predominantly occurs 1,400 meters a. s. l, mainly on northern and northwestern exposures, thriving in acidic, well-drained soils. Yield capacity ranged from 50 to 180 kg/ha, depending on site conditions and the intensity of natural regeneration. Bilberry populations are distributed across various management zones in Pelister National Park: 3,058 ha in strict protection zone, 818 ha in active exploitation zone and 4,848 ha in sustainable use zone. In total, the bilberry's distribution area is 8,725 ha, with population density varying by location. The research highlighted the need for systematic and regulated harvesting practices, especially in response to rising market demand. Recommendations were provided regarding optimal harvest periods, picking techniques, and annual quotas, all aligned with the biodiversity protection and conservation principles upheld by the park. These findings lay the groundwork for sustainable forest fruit management models and offer potential for the inclusion of local communities in value-added activities.

ID: 244 / SES-P-FGVWP-01: 10

Abstract Submissions

Poster Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: apple, autochthonous varieties, GIS mapping, conservation, pear.

IDENTIFICATION AND MAPPING OF OLD TREES OF AUTOCHTHONOUS APPLE AND PEAR VARIETIES IN THE MALEŠEVO REGION

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This study focuses on the identification and geographic mapping of old trees belonging to autochthonous apple (*Malus domestica*) and pear (*Pyrus communis*) varieties in the Maleshevo region of North Macedonia. The preservation of traditional fruit tree varieties is of vital importance for maintaining agrobiodiversity, safeguarding cultural heritage, and ensuring the resilience and sustainability of local agricultural systems. Many of these old trees represent unique genotypes that have adapted over centuries to specific microclimatic and ecological conditions, making them valuable genetic resources for future breeding programs and climate adaptation. Field surveys were conducted across rural landscapes to locate and document individual trees using GPS coordinates, detailed morphological descriptions, and photographic records. The collected data were analyzed and compiled into a geographic information system (GIS) database, allowing spatial visualization and assessment of population distribution and density. This approach supports both in situ conservation and knowledge transfer to future generations. The results highlight the ecological and cultural significance of preserving ancient orchards and point to the urgent need for national and regional conservation strategies. The study also underscores the potential for integrating these native varieties into sustainable rural development initiatives, agro-tourism, and the production of high-quality, locally branded fruit products.

ID: 252 / SES-O-FGVWP-02: 5

Abstract Submissions

Oral Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: stanushina, varieties, fertility, yield, grape quality

THE VARIETY AS A FACTOR INFLUENCING THE GRAPE QUALITY OF THE STANUSHINA CULTIVAR

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The Tikveš wine-growing region is the largest area for grape and wine production in the Republic of North Macedonia and is also the region with the highest concentration of the only native grape variety – Stanushina. This indigenous variety has been cultivated since ancient times in the Tikveš region and belongs to the ecological-geographical group of Black Sea varieties, subgroup Balkanica.

Out of approximately 300 ha of vineyards planted with Stanushina, more than 250 hectares are located in the Tikveš region. In other wine regions, this variety is very rare and typically found only as individual vines. Stanushina exists in several biotypes (varieties), with the following identified: black, pink (sura), and reulava Stanushina.

This study presents a comparative analysis of two identified Stanushina varieties at two different micro-locations: the black variety was studied at the "Bela Česhma" site near the village of Resava, and the pink variety at "CrvenoBrdo," near the village of Begnište. Both sites use the vertical trellis (espalier) training system.

The objective of this research is to determine the differences between the two varieties in terms of average bunch weight, yield, fertility, and overall grape quality. The comparative analysis showed us a higher shoot yield coefficient and shoot fertility coefficient in the pink variety (Sura), and a higher average bunch mass in the black Stanushina variety.

ID: 260 / SES-P-FGVWP-02: 1

Abstract Submissions

Poster Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: wine, fermentation, selected yeasts, chemical composition, sensory properties.

THE INFLUENCE OF SELECTED YEAST STRAINS ON THE QUALITY OF WINE FROM THE “CABERNET SAUVIGNON” VARIETY

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Yeast plays a crucial role in the winemaking process. The primary function of selected yeast strains is to catalyze a rapid, complete, and efficient conversion of grape sugars into ethanol, during which specific aromatic compounds are transformed into various volatile derivatives, releasing energy in the form of carbon dioxide. The choice of yeast significantly impacts the organoleptic profile of the wine. Today, hundreds of commercially available wine yeast strains exist, providing winemakers with tools to tailor their wines to different consumer market segments.

This study aimed to evaluate the impact of fermentation using three different yeast strains on must from the Cabernet Sauvignon grape variety, focusing on chemical composition, tannin content, and the sensory characteristics of the final wines.

The analysis of the main wine components showed that the choice of yeast strain strongly influences various compositional parameters, including tannin levels. In all three fermentation trials, conducted under identical winemaking protocols, the following results were observed: The “VRB” yeast strain demonstrated the highest color intensity and total polyphenol content, contributing to sulfur stability and preservation of the wine’s primary aromas. The “Clos” strain proved to be the most robust, producing the highest alcohol content and retaining total acidity, which forms the backbone of the wine. In terms of sensory characteristics, each yeast strain contributed positively in its way. The “Clos” strain emphasized varietal character, particularly fruity-spicy notes; the wine fermented with “D-254” exhibited medium body and intense fruity aromas, while the “VRB” strain enhanced body and polyphenol structure, allowing for extended aging potential.

ID: 273 / SES-P-FGVWP-02: 2

Abstract Submissions

Poster Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: pruning, techniques, grape, Temjanika, viticulture

THE TYPE OF PRUNING AS A FACTOR AFFECTING THE YIELD AND QUALITY OF TEMJANIKA GRAPES

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Viticulture is considered one of the most profitable agricultural sectors in Macedonia. According to official data, in 2024 the total vineyard area was 21,984 hectares, accounting for approximately 4% of the country's total land area. Selecting the appropriate pruning technique plays a crucial role in maximizing the yield and quality of grape varieties, including Temjanika. This study focuses on three types of pruning methods applied to Temjanika vines: Double Guyot, Single Guyot, and Guyot-Poussard pruning method. These are presented as distinct variants within the experiment. Beyond productivity differences, the pruning methods also showed notable variation in both mechanical and technological aspects, all of which were analyzed in detail.

ID: 277 / SES-O-FGVWP-02: 1

Abstract Submissions

Oral Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: leaf plastochron index, grapevine, LPI, midday measurement

PHYSIOLOGICAL RESPONSES OF GRAPEVINE LEAVES IN RELATION TO LEAF AGE

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The aim of this study was to determine physiological responses of PIWI variety Muscaris leaves in relation to leaf age. After one month of active growth under controlled conditions in a greenhouse cabin, LPIs of 6 classes (3, 4, 5, 6, 10 and 11 according to base length 30 mm) were marked and their physiological responses were determined with a porometer for 5 consecutive days. All measurements were performed between 11 and 13 hours. R analysis results show that stomatal conductance (gs) stayed similar, slightly lower values in LPI3 and LPI4. Leaf temperature (Tleaf) was comparably higher in LPI 3 and 4 as opposed to LPI10 and 11, yet it stayed within a narrow range. This, in turn, resulted in similar response in vapor pressure deficit. Electron transport rate (ETR), on the other hand, is significantly higher in the lower LPIs and lowest in LPI 10 and 11. This means that younger leaves were more active in photosynthesis and older leaves might have been reaching an equilibrium as they grew. Respiration was lowest in all LPIs of control leaves and tended to increase until LPI 6 and then decreased in the rest of the treatments. This corresponded to the changes in ETR. The results show that not every leaf on a shoot reacts the same to environmental clues and physiological responses change.

ID: 278 / SES-O-FGVWP-01: 6

Abstract Submissions

Oral Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: post-harvest, edible coatings, natural preservatives, moisture loss

THE EFFECT OF SOME ALGINATE-BASED COATING SOLUTIONS ON THE QUALITY AND PHYSICOCHEMICAL CHARACTERISTICS OF BLUEBERRY FRUITS

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Over the last two decades, a significant increase in blueberry (*Vaccinium corymbosum* L.) fruit consumption has been observed, contributing to the worldwide growth of their cultivation area. With a variety of nutritional components and low-calorie content, they are primarily appreciated for their antioxidant and anti-inflammatory benefits. However, they are very perishable and are prone to rapid deterioration caused by fruit softening and decay during storage. Additionally, blueberries naturally host significant levels of yeasts, molds, and spoilage organisms, making them prone to pathogen contamination. Biopolymer coatings have recently gained attention as a practical solution for prolonging the shelf life of edible fruits. They can retain fruit freshness, decrease post-harvest losses, and appeal to consumers seeking natural preservation alternatives.

Our study consisted of four treatments: a 2% alginate-based coating solution, a 2% alginate-based solution supplemented with 9% rosemary extract, a 2% alginate-based solution supplemented with 9% olive leaf extract, and a control treatment. The study was performed on fresh and freeze-dried blueberry fruits via a spraying technique. The fruits were evaluated at 3 time points (day 0, 7, and 14) to assess their microbial stability (total plate count, and total fungal yeast and molds) and quality characteristics (colour determination, total soluble solids, pH). Additionally, biochemical analyses, including total phenolic content, total flavonoid content, and total anthocyanin content, were performed.

ID: 295 / SES-P-FGVWP-02: 7

Abstract Submissions

Poster Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: plum brandy, fermentation, plum varieties, sensory analysis, šljivovica

QUALITY AND SENSORY PROPERTIES OF PLUM BRANDY

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This study investigates the quality and sensory characteristics of plum brandy (šljivovica) produced from two plum cultivars - Stanley and Čačanska rodna - grown in North Macedonia. The research compares the physicochemical and sensory properties of brandy fermented with and without stones, followed by double distillation. Morphometric and chemical analyses of fresh fruits included fruit mass, stone mass, yield, height, and width. The technological process involved raw material preparation, fermentation, initial distillation (soft brandy), and redistillation of soft brandy from both cultivars and both fermentation methods.

Chemical analyses of the final distillates included ethanol, methanol, higher alcohols, esters, and acetaldehyde. Sensory evaluation assessed color, clarity, typicality, aroma, and taste.

The results highlight the impact of cultivar and fermentation method on the final product's quality. Sensory analysis revealed distinct differences in aroma and flavor depending on the presence or absence of fruit stones during fermentation, providing practical insights for improving plum brandy quality.

ID: 299 / SES-O-FGVWP-02: 3

Abstract Submissions

Oral Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: Sulphur dioxide, organoleptic qualities, wine, Riesling

THE INFLUENCE OF DIFFERENT CONCENTRATION OF SULFUR DIOXIDE ON THE ORGANOLEPTIC PROPERTIES AND QUALITY OF WINE RIESLING IN BOTTLE

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The influence of different concentration of sulfur dioxide on the organoleptic properties and quality of wine Riesling in bottle were researched. Four different samples were prepared; one was the untreated control sample and the others were prepared with three different dosage (15, 30 and 45 mg/l) of Sulphur dioxide. Riesling wine was placed in 750ml bottles closed with cork for period of 8 months. In this time the wine has been three time chemical and sensory tested.

Based on the obtained results the proposed hypothesis is confirmed. Different amount of sulfur dioxide has influence on the composition, aromas, complexity and quality of wine in bottle.

Due to chemical and sensory analyses the best results were obtained at the variant 1 with 15 mg/l added Sulphur dioxide.

Key words: Sulphur dioxide, organoleptic qualities, wine, Riesling

ID: 307 / SES-O-FGVWP-02: 4

Abstract Submissions

Oral Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: Vineyard, Viognier, fertility, technological characteristics, Veles

SOME AGROBIOLOGICAL AND TECHNOLOGICAL CHARACTERISTICS OF THE VIOGNIER VARIETY GROWN IN THE VELES VINEYARD

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Viticulture in the Republic of North Macedonia has a long tradition, dating back to the time of Philip II and Alexander the Great. Today, the Veles vineyard is one of the country's most important grape-growing areas, with approximately 3,400 ha under vine. This region cultivates both red varieties (Vranec, Cabernet Sauvignon, Merlot, Syrah, etc.) and white varieties (Chardonnay, Sauvignon Blanc, Riesling, Temjanika, etc.).

This research aims to evaluate the agrobiological and technological potential of the white Viognier variety under the conditions of the Veles vineyard. Although Viognier originated in the Rhône Valley—where it gained international recognition in the late 20th century—its adaptability to new regions has increased its global spread.

The study was carried out at the Babuna site (220 m a.s.l.), characterized by a moderately continental climate. Results on fertility and technological parameters indicate the most favorable pruning method for Viognier under local conditions, supporting its wider introduction in the Veles vineyard and potentially other Macedonian viticultural regions.

ID: 308 / SES-O-FGVWP-02: 6**Abstract Submissions****Oral Presentation***Topics:* Fruit Growing, Viticulture and Wine Production*Keywords:* climate change, Vranec, Smederevka, grape quality, water stress**IMPACT OF EXTREME CLIMATIC CONDITIONS ON THE GRAPE QUALITY OF VRANEC AND SMEDEREVKA VARIETIES****Zlatko Prculovski, Mihail Petkov, Krum Boshkov**

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The grapevine (*Vitis vinifera*) is one of the most important agricultural crops worldwide, cultivated on 6.7 million ha across 99 countries (FAO–OIV, 2022). Although primarily grown in regions with warm and dry summers, viticulture is increasingly threatened by climate change through the occurrence of heat waves, prolonged droughts, water stress, and extreme weather events.

The present study, conducted in 2024 at several sites in the Republic of North Macedonia, aimed to assess the impact of extreme climatic conditions on grape quality of the Vranec and Smederevka varieties. Mechanical and technological parameters of clusters and berries, as well as the chemical composition of grapes, were analyzed according to OIV standards.

The results showed a significant reduction in cluster weight and berry pulp in Vranec, accompanied by an increased proportion of skins and seeds, particularly under non-irrigated conditions. Smederevka exhibited smaller deviations from the long-term average, although statistically significant differences were observed between irrigated and non-irrigated variants. Both varieties displayed low phenolic maturity and elevated ethanol concentrations in berries, indicating strong stress during the vegetation period.

These findings confirm the sensitivity of grapevines to climate change and highlight the need for adaptive measures, primarily the introduction of irrigation systems and the application of appropriate viticultural practices.

ID: 320 / SES-P-FGVWP-02: 6

Abstract Submissions

Poster Presentation

Topics: Fruit Growing, Viticulture and Wine Production

Keywords: Inorganic nitrogen, alcoholic fermentation, *Saccharomyces cerevisiae*

THE IMPACT OF INORGANIC NITROGEN SOURCES ON FERMENTATION KINETICS OF INDIGENOUS AND COMMERCIAL WINE YEASTS

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This work studied the influences of sources of inorganic nitrogen on the development of alcoholic fermentation as well as yeast growth during winemaking. The three sources of nitrogen—diammonium phosphate $((\text{NH}_4)_2\text{HPO}_4)$, ammonium sulfate $((\text{NH}_4)_2\text{SO}_4)$, and calcium chloride (CaCl_2) were selected for studying their contribution towards the efficiency of fermentation of five strains of *Saccharomyces cerevisiae* which comprised two local isolates (BCC-Y 59 and BCC-Y 63) coupled with three commercial strains. Each of the compounds was studied at three concentrations towards their respective influences on major fermentation parameters.

In the first stage of experimentation, fermentative processes were conducted in a specially designed basal medium both at stationary and at aerobic conditions. Fermentation kinetics and yeast activity were assessed by monitoring turbidity, carbon dioxide production, pH shifts, biomass formation, and ethanol yield. These parameters allowed the establishment of optimal concentrations of each of the inorganic sources of nitrogen.

In the subsequent phase, specific concentrations were administered to grape must micro fermentations to assess yeast performance under conditions that mimic actual winemaking processes. The findings offer valuable insights regarding the impact of various types and quantities of inorganic nitrogen on yeast metabolism, with potential implications for optimizing fermentation management, supporting indigenous yeast survival, and improving the overall quality of wine.

VEGETABLE, FLOWER AND DECORATIVE PLANTS PRODUCTION

ID: 104 / SES-P-VFDP-03: 5

Abstract Submissions

Poster Presentation

Topics: Vegetable, Flower and Decorative Plants Production

Keywords: SMS, SMC, growing medium, composition, sustainability

FROM WASTE TO GROWTH: MUSHROOM RESIDUES IN HORTICULTURE

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The global expansion of mushroom cultivation has positioned it as a significant agribusiness and a promising avenue for sustainable agro-waste management. However, this growth has led to the accumulation of approximately 100 million tons of spent mushroom substrate (SMS) annually, posing serious environmental and logistical challenges. For each kilogram of fresh mushrooms harvested, around five kilograms of SMS are generated. While SMS has demonstrated potential as an alternative horticultural growing medium, its direct application is constrained by high electrical conductivity, unstable pH, low water retention, and continued decomposition. This review highlights the compositional variability of spent mushroom compost (SMC), particularly from *Agaricus bisporus*, and examines its physicochemical properties post-composting, leaching, and weathering. Research indicates that SMC, when appropriately processed and incorporated at up to 25–50% into potting mixtures, supports robust seedling development, especially in tomato cultivation, and serves as a viable source of essential nutrients (N, P, K). Furthermore, SMS offers additional agronomic benefits, such as pathogen suppression, absence of viable weed seeds, and the provision of a beneficial microbial community. Despite these advantages, variability in SMS composition driven by mushroom species, substrate formulation, and seasonal factors necessitates further investigation to optimize standardization and large-scale application. This study underscores the need for interdisciplinary research into SMS valorization, particularly concerning nutrient dynamics, environmental impact, and sustainable horticultural practices.

ID: 105 / SES-P-VFDPP-03: 6

Abstract Submissions

Poster Presentation

Topics: Vegetable, Flower and Decorative Plants Production

Keywords: Lycopersicon esculentum, Mill., infrared light, LED light, plantlets, quality parameters

INFLUENCE OF ARTIFICIAL LIGHT ON TOMATO SEEDLING DEVELOPMENT IN THE PROTECTED ENVIRONMENT

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Growing tomato seedlings in high-quality, controlled environments significantly enhances yield and plant quality while minimizing the incidence of pests and diseases. Traditional seasonal cultivation often faces extreme weather, cold, low light, and heavy rain in winter–spring, or intense heat, strong sunlight, and sudden rainfall in summer-autumn, hindering seedling development. Controlled-environment cultivation has thus become a vital modern alternative. An experiment was conducted in a closed, protected facility in Ilinden, Skopje, to evaluate the impact of different light sources on the quality of tomato seedlings (cv. Marglobe). Three treatments were applied: natural daylight in a closed environment, LED light (80W), and infrared light (250W). Seedlings were grown over a two-month period, with each treatment including 30 plants in three replications. Fifty days after sowing, several parameters were measured destructively: total plant weight (g), plant height (mm), stem thickness (mm), root length (mm), root weight (g), number of leaves, and leaf weight (g). Data were analyzed using ANOVA and tested with a t-test at 1% and 5% probability levels. Results revealed highly significant differences in all parameters for seedlings grown under LED light, indicating its superior effect on seedling quality. Although the current protected environment posed some challenges, the findings highlight the potential of controlled-environment cultivation and underscore the need for further research and modification.

ID: 107 / SES-P-VFDDP-03: 4

Abstract Submissions

Poster Presentation

Topics: Vegetable, Flower and Decorative Plants Production

Keywords: ethnobotany, food, greens, medicines, North Macedonia

ETHNOBOTANICAL SURVEY OF LEAFY VEGETABLES IN NORTH MACEDONIA

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Edible leafy vegetables have been incorporated into both culinary traditions and folk medicine for generations. This research highlights the ethnobotanical study of leafy vegetables in North Macedonia and provides an overview of their key roles in both cuisine and traditional healing practices in the region. During year 2024, 67 respondents were interviewed using a structured questionnaire. All 67 interviewees reported using leafy vegetables, but only 41.8 % of them grow leafy vegetables themselves. For each plant species, the botanical family, scientific and folk names, culinary and medicinal applications, along with the relative frequency of citation (RFC) index, are presented. According to the results, twenty-one species belonging to ten plant families were identified as leafy vegetables. Most of the species are part of the Apiaceae (4) and Asteraceae (4) families. *Spinacia oleracea* showed the highest relative citation frequency index (0.58). The species mentioned in the study are used not only as food but also in the treatment of various health conditions. Ethnobotanical studies focused on leafy vegetables in the Republic of North Macedonia remain limited, underscoring the necessity for more comprehensive research to fully understand their cultural, nutritional, and environmental significance. To preserve this traditional knowledge from being lost, it is essential to continue conducting ethnobotanical research.

ID: 111 / SES-P-VFDPP-03: 9

Abstract Submissions

Poster Presentation

Topics: Vegetable, Flower and Decorative Plants Production

Keywords: flower buds, flowers, leaves, plant height

THE EFFECT OF TWO DIFFERENT FERTILIZERS ON THE QUALITY OF CYCLAMEN PERSICUM MILL.

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This research was carried out to analyze the effect of different fertilizers with different concentrations on the morphological features of *Cyclamen persicum* Mill., as well as to determine the most appropriate concentration of fertilizer to obtain the highest plant quality. In this experiment were used two fertilizers - Magnicvet with NPK 7-1-5 + microelements (0,2%; 0,3%; 0,4%) and Magnihortal with NPK 10-5-5 + microelements (0,2%; 0,3%; 0,4%). For measurement, 30 plants were used per treatment, four months after planting into plastic containers. To examine the quality of the plants, the following parameters were analyzed: plant height (mm), number of leaves, number of flower buds, and number of flowers. Measurements of biometric parameters showed that the liquid mineral fertilizer Magnihortal with NPK 10-5-5 + microelements and a concentration of 0,3% showed the highest average height of plant. Magnihortal with NPK 10-5-5 + microelements and concentration of 0,4% showed the highest average number of leaves and highest average number of flower buds. Magnihortal with NPK 10-5-5 + microelements and concentration of 0,2% showed the highest average number of flowers. Magnihortal with NPK 10-5-5 + microelements and concentration of 0,4% can be recommended in practice.

ID: 112 / SES-P-VFDPP-03: 3

Abstract Submissions

Poster Presentation

Topics: Vegetable, Flower and Decorative Plants Production

Keywords: in vitro culture, LED lighting, *Melissa officinalis*, morphological traits, plant growth.

EFFECT OF LED LIGHTING ON THE GROWTH AND DEVELOPMENT OF LEMON BALM (*MELISSA OFFICINALIS* L.) EXPLANTS UNDER IN VITRO CONDITIONS

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Lemon balm (*Melissa officinalis* L.) is a plant from the Lamiaceae family, commonly known as lemon balm or lemon herb due to its lemon-scented leaves. It is widely cultivated for its culinary and medicinal properties and has broad applications in various processing industries.

Light is a key factor influencing plant physiology, growth, development, and chemical composition. Two main types of lighting are used in plant cultivation: SL-type (sunlight) and FAL-type (artificial light). FAL-type lighting allows precise control of growth conditions and supports stable, year-round production regardless of seasonal or climatic changes.

This study aimed to examine the effect of LED lighting on the growth and development of lemon balm (*Melissa officinalis* L.) explants under in vitro conditions. Fluorescent light was used as the control, while red, blue, and a combination of red and blue LED lights were tested as treatments. Morphological traits were evaluated, including number of leaves, root development, number of lateral shoots, plant height, and fresh and dry biomass.

The results indicated that red LED light promoted the greatest plant height and the highest percentage of root development. The combined red and blue LED treatment resulted in the highest number of leaves and lateral branches, as well as the greatest average fresh and dry mass. Statistically significant differences in plant growth and development were observed across treatments, suggesting that LED lighting can serve as an effective alternative to conventional fluorescent lighting under in vitro conditions

ID: 114 / SES-P-VFDPP-03: 8

Abstract Submissions

Poster Presentation

Topics: Vegetable, Flower and Decorative Plants Production

Keywords: Apiaceae, biostimulant, cultivation, dormancy, germination energy

SEED PRIMING EFFECTS ON GERMINATION OF PARSNIP (*PASTINACA SATIVA* L.)

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Parsnip (*Pastinaca sativa* L.) is a biennial plant species belonging to the Apiaceae family that is valued both as a food and for its remarkable medicinal properties. However, one of the major challenges in parsnip cultivation is the low seed germination rate, which leads to irregular seedling emergence of seedlings and makes field management difficult. The aim of this study was therefore to investigate how different seed priming treatments affect the germination rate and germination energy of parsnip seeds. A laboratory experiment was conducted to investigate the effects of three seed priming treatments: distilled water, the biostimulant Eco Green and a plant waste extract. A total of 400 seeds were used, divided into four groups of 100 seeds each. The seeds were soaked in the respective solutions for 24 hours in the dark: one group in distilled water, one in the Eco Green biostimulant solution, one in the plant waste extract and an untreated group served as a control. The seeds were then germinated under controlled conditions at a constant temperature of 25 °C and a light regime of 16/8 h day/night. At the end of the experimental period, the germination parameters of the seeds were calculated. The results showed that the seed priming treatments applied did not significantly improve the overall germination rates, but they influenced the mean germination time (day), the uniformity of the germination process and the germination index. That is, the treatments contributed to faster and more uniform germination, which may facilitate further cultivation phases.

ID: 149 / SES-P-VFDPP-03: 1

Abstract Submissions

Poster Presentation

Topics: Vegetable, Flower and Decorative Plants Production

Keywords: Bioactive compounds, Edible flowers, Functional food, Phytochemical composition

EDIBLE FLOWERS AS SOURCE OF BIOACTIVE COMPOUNDS: A FUNCTIONAL FOOD PERSPECTIVE

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Edible flowers have increased significantly in recent years, owing to their health-promoting phytochemicals. To date, there is scarce research on the phytochemical composition of flower species and their benefits as food. Several studies have shown that edible flowers are an excellent source of minerals, vitamins, and antioxidants, helping the body to eliminate toxins. Additionally, edible flowers have important anti-inflammatory effects in humans. Nowadays, edible flowers are used as garnishes and mostly consumed fresh, but can also be consumed dried and for different purposes. This review aimed to present research spectrophotometric findings on the phytochemical composition of selected flower species. Flowers from five plant species—*Tropaeolum majus* L., *Eschscholzia californica* Cham., *Brassica juncea* (L.) Czern., *Lamium purpureum* L., and *Tulbaghia violacea* Harv.—originating from cultivated and wild flora, including ornamental plants and vegetables, were collected at full bloom. The flower samples were extracted using 80% (v/v) acetone and methanol, with a material-to-solvent ratio of 1:10 (w/v). Acetone extracts were used for pigment analysis (chlorophyll a and b, total carotenoid content (TCC)), while methanol extracts were analyzed for phytochemical content, including total phenolic content (TPC), total flavonoid content (TFC), and hydroxycinnamic acid derivatives (HCAs). The results revealed that flowers—regardless of whether they originate from ornamental, vegetable, or wild species, represent a rich source of bioactive compounds. Future studies should focus on evaluating their antioxidant potential and further exploring their role as functional food ingredients.

ID: 274 / SES-P-VFDPP-03: 7

Abstract Submissions

Poster Presentation

Topics: Vegetable, Flower and Decorative Plants Production

Keywords: biodiversity, tradition, gastronomy, edible flower market

PLANT SPECIES OF MEADOWS AND PASTURES FOR THE PRODUCTION OF EDIBLE FLOWERS

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Edible flowers are increasingly used in domestic and international gastronomy, not only as a garnish for dishes, but also as a complete meal. With intensive agriculture, we are losing more and more meadows and natural pastures, which reduces the biodiversity of species. The production of edible flowers, which is an integral part of natural meadows and pastures, thus ensures the preservation of biodiversity and can serve as a system for organising the organic production of edible flowers in Croatia.

The paper lists and describes in a table the possible plant species for the production of edible flowers determined at 4 locations of natural meadows and pasture Čistine in Slavonia. Their floral element and life form are added.

ID: 275 / SES-O-VFDPP-3: 3

Abstract Submissions

Oral Presentation

Topics: Vegetable, Flower and Decorative Plants Production

Keywords: Capsicum annuum, climate change, Solanum lycopersicum, subsurface irrigation

SUBSURFACE IRRIGATION SYSTEMS FOR TOMATO (SOLANUM LYCOPERSICUM) AND PEPPER (CAPSICUM ANNUM) CULTIVATION

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This study aims to address disruptions in vegetable production caused by the global climate crisis, rising air temperatures, and related issues, such as water access problems and salinity. The study also aims to ensure the continuity of production. This study was conducted in March 2023 in the application and research fields of the Department of Horticulture at Dicle University's Faculty of Agriculture. The plant material included local Lice tomato and Çermik pepper seeds, as well as commercially available Falcon tomato and Üçburun pepper seeds. The experiment used a total of 180 seedlings per variety, with three replicates and 60 seedlings per replicate. The pipes laid underground were positioned at the soil surface, 15 cm below the surface, and 30 cm below the surface. The measurements and observations taken at the end of the study are as follows: determination of plant height and diameter, determination of leaf number, leaf temperature, leaf relative water content (%), membrane damage in leaf cells, leaf area index, fresh and dry weights of plant green parts, chlorophyll content (Chlorophyll a, b, total chlorophyll), carotenoid content, pH content and determination of L*, a*, b* color contents in leaves. The most effective irrigation methods for all parameters in pepper and tomato vegetables were determined to be: 15 cm depth > surface irrigation > 30 cm depth. The findings were in line with those of other academic studies, and it is recommended that subsurface irrigation be used in vegetable gardens to efficiently and effectively use water.

ID: 276 / SES-O-VFDPP-3: 2

Abstract Submissions

Oral Presentation

Topics: Vegetable, Flower and Decorative Plants Production

Keywords: Lactuca sativa, river water, soil-less agriculture, yield

LETTUCE CULTIVATION IN THE WATER CULTURE FLOWING ON THE TIGRIS RIVER

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This study was conducted during the 2023 growing season on the Dicle River and adjacent open land. Early lettuce varieties, such as Iceberg, Curly, and Yedikule, were used to observe different results based on variety. The seedlings were secured in seedling trays with pumice stone and perlite. Eighteen holes were drilled in the styrofoam trays, into which the seedling trays were placed. There was a 20 cm distance between rows and between plants. Thus, each styrofoam tray contained 18 seedlings, considered one replicate. Four styrofoam trays were placed in water, resulting in four replicates and 72 plants total for the experiment. Four replicates of plantings were made on a control group of riverbank land in the same manner, and fertilization application methods were carried out in the same way. The following parameters were examined at the end of the study: total plant weight, marketable head weight, total number of leaves, plant and root length, marketable yield, soluble sugar content, titratable acidity, pH, 0–4 damage index, relative water content of leaves, membrane damage in leaves, leaf area index, and chlorophyll and carotenoid content. Leaf color was investigated using the L^* , a^* , and b^* values. Upon analyzing the data obtained at the end of the study, it was found that lettuce varieties grown in different cultivation environments generally contributed to more parameters in river cultivation than in soil cultivation. It can be concluded that lettuce grown in river water is superior to soil-grown lettuce in terms of quality and market value.

ID: 287 / SES-O-VFDPP-3: 1

Abstract Submissions

Oral Presentation

Topics: Vegetable, Flower and Decorative Plants Production

Keywords: walk-in tunnels, energy conservation, greenhouse microclimate

FROM STAGNATION TO SUSTAINABILITY: A LOW-COST TECHNOLOGY ROADMAP FOR MACEDONIAN TUNNEL CULTIVATION

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The protected cultivation sector in the Republic of North Macedonia is defined by a paradox: despite a favorable modified-Mediterranean climate and a history of horticultural leadership, the industry faces economic stagnation. This is primarily due to a critical technology mismatch, where growers use high-cost inputs, such as advanced hybrid seeds, within low-performance polyethylene (PE) walk-in tunnels that cannot leverage their genetic potential. The result is low yields, short production seasons, and dwindling profitability. This report presents a comprehensive review of integrated, low-cost technologies designed to enhance the microclimate, extend growing seasons, and increase yields in these tunnels. The analysis synthesizes technical literature on passive solar design, advanced materials, and intensive agronomic practices applicable to the Macedonian context. Key recommendations include foundational upgrades to the tunnel cover, such as the adoption of double-inflated polyethylene films with infrared (IR) and anti-condensate (AC) properties, and the use of movable thermal screens. Furthermore, two strategic agronomic pathways are detailed: optimizing existing soil-based systems through strategic mulching and transitioning to intensive soilless bag-cultivation using locally sourced substrates. The report concludes that a phased, integrated systems approach, supported by robust farmer training, is essential for breaking the cycle of low productivity, restoring profitability, and building a resilient and modern protected agriculture sector in the region.

ID: 304 / SES-O-VFDPP-3: 4

Abstract Submissions

Oral Presentation

Topics: Vegetable, Flower and Decorative Plants Production

Keywords: tempeh, industrial production, fermentation, plant-based protein.

THE PRODUCTION OF TEMPEH SNACK

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Tempeh is a traditional fermented food originating from Indonesia. This product has a rich history and a unique production process that sets it apart from other plant-based protein sources. Believed to have been discovered accidentally, tempeh's production began with the fermentation of soybeans wrapped in leaves by naturally occurring *Rhizopus* spp. mold on a leaf surface. Over time, this fermentation process evolved into a culinary practice that reached the global stage. It is consumed in many forms including fried, boiled, steamed or grilled. Tempeh can be made from other legumes and grains, offering a variety of flavours and textures. Tempeh stands out not only for its unique taste and texture but also for its impressive nutritional profile.

Recently, there is a global emergence of initiatives to rebrand tempeh as an affordable, sustainable, and healthy plant-based product. Tempeh also provides a lot of health benefits which are results of its bioactive compounds.

Production of tempeh includes different processes: washing of the beans, soaking, cooking, cooling and drying, mixing and stuffing of the tempeh mass, fermentation, cooling of the tempeh sausage, unwrapping and slicing, soaking in water and salt, frying, seasoning, packaging and storage. The fermentation process in tempeh introduces probiotics, contributing to its potential health benefits for gut health. Modern methods often involve the use of controlled environments and commercially available starter cultures to ensure consistency in quality and safety.

ID: 305 / SES-P-VFDDP-03: 2

Abstract Submissions

Poster Presentation

Topics: Vegetable, Flower and Decorative Plants Production

Keywords: edible flowers, nutritional properties, bioactive compounds, sustainable diets.

EDIBLE FLOWERS IN DIET

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Flowers that can be consumed without harmful effects on human health are called edible flowers. Changing eating habits and lifestyles of consumers have increased the demand for healthier food. Edible flowers are a storehouse of bioactive ingredients with numerous health benefits, including antioxidants, anti-inflammatory and antimicrobial properties. The consumption of edible flowers has been recorded in various cultures as part of traditional cuisine, alternative medicine and as a decoration. Edible flowers also have significant nutritional value as a source of protein and essential amino acids. These properties make it important for the expansion of the food market due to its sensory and nutritional characteristics beneficial to health. Nutritional properties, pharmacological benefits, chemical composition and forms of preparation of edible species are increasingly being studied, stimulating the demand for natural and healthy food. Not only that the plant is being used for consumption but also modern methods of extracting bioactive compounds enable the development of functional ingredients for the food industry.

However, risks associated with the consumption of edible flowers include the possibility of allergic reactions, pesticide contamination, and a lack of standardization in flower identification and processing. Lack of knowledge about taste, sensory properties and potential health benefits limits its use. Consumer education and further research are key to improving the safety, understanding and popularization of edible flowers as part of a healthy and functional diet, emphasizing the role of the nutritionist.

ID: 312 / SES-O-VFDPP-3: 5**Abstract Submissions****Oral Presentation***Topics:* Vegetable, Flower and Decorative Plants Production*Keywords:* organic seed system, seed availability, EU Regulation 2018/848, seed derogations**ORGANIC SEEDS: BOTTLENECK FOR FURTHER DEVELOPMENT OF ORGANIC FARMING****Rukie Agic, Gordana Popsimonova, Zvezda Bogevska, Margarita Davitkovska**Ss. Cyril and Methodius University in Skopje Faculty of Agricultural Sciences and Food-Skopje, North Macedonia, Republic of; rukieagic@fznh.ukim.edu.mk

Despite the rapid global expansion of organic agriculture reaching 98.9 million hectares the limited availability, diversity, and accessibility of certified organic seed remains a critical bottleneck. The global organic seed market is projected to grow significantly by 2030, yet supply continues to lag behind demand. Many organic farmers, particularly in large-scale systems, still rely on untreated conventional seed, undermining the integrity and sustainability of organic production.

In the European Union, the use of organic seed was formally regulated under Regulation (EU) 2018/848, which came into force on January 1, 2022. An important point in this regulation is that by December 31, 2036, all exceptions will end, and non-organic seed will no longer be allowed in organic farming. This deadline is likely to affect the organic farming sector by putting more pressure on seed supply, encouraging new organic breeding, and creating differences in how it is applied between member and non-member countries.

These implications will also affect countries like North Macedonia, where organic seed systems—particularly for vegetables—remain underdeveloped. Organic farmers will face a range of practical and systemic challenges that hinder the adoption of certified organic seed for their climate, soil, and market needs. This report outlines the core challenges, including regulatory gaps, limited breeding programs, and the dominance of conventional seed supply chains. It also highlights potential solutions such as participatory breeding, policy support, and decentralized seed networks. Without targeted interventions, the expansion of organic agriculture risks being constrained by its weakest link: seed.

DIGITAL AGRICULTURE & NATURAL RESOURCES MANAGEMENT

ID: 140 / SES-O-DANRM-01: 2

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: physical-mechanical properties, characteristics, heavy metals

SPATIAL DISTRIBUTION OF COPPER (CU) IN APPLE ORCHARDS IN THE RESEN REGION

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The soils in apple orchards in the Resen region were examined. The field research was carried out in 2024, during which 26 surface soil samples were taken. In the framework of this master's thesis, an examination of some physical and chemical properties of the soil, as well as the content of the total forms of heavy metals, was carried out. Several soil types are formed in the area covered by the Resen region: regosols, cinnamon forest soils, colluvial soils, and complexes thereof. Based on the obtained values for the mechanical composition, for the most part, the soils in the surface part are sandy clay loam (SCL) at 41%, sandy loam (SL) at 36%, and loamy (L) soils at 23%. The content of total forms of heavy metals in all samples was analyzed using atomic emission spectrometry with inductively coupled plasma (AEICP). All laboratory investigations were recorded at the two higher points, and the obtained values of the examined properties were statistically processed, using R software for data analysis, including PCA, correlation matrix and cluster analysis methods to ensure accuracy and relevance of the data. Distribution maps were produced using interpolation with IDW Inverse Distance Weighting in Arc GIS 10.8 software. The obtained results allow us to distinguish between possible anthropogenic influences on the presence of heavy metals in the soils of in the Resen region and their lithological origin.

ID: 157 / SES-O-DANRM-04: 1

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: Asian countries, irrigation efficiency, Irrigation management, water productivity

CHALLENGES AND IMPROVEMENT WAYS IN IRRIGATION MANAGEMENT IN MIDDLE EAST AND SOME ASIAN COUNTRIES

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Water use for agricultural sector varies between 40-93% depending on the country. The amount of water used in agricultural irrigation varies considerably between 6000-12000 m³ ha⁻¹ in different countries and geographies of the world. The most important and/or the main reasons for excess water use are lack of the infrastructures, insufficient management, the education, culture, political approaches and instability in water management of countries or water users, as well as the fact that surface irrigation is still predominantly practiced. For this reason, there are countries with irrigation efficiency (IE) as low as 35%, there are also countries where this value is above 70%. Accordingly, the values of water productivity, the economic productivity of water vary considerably. Unfortunately, data show that water used in irrigation is not used effectively especially in the Middle East and/or some Asian countries. One of the ways of effective and efficient use of water in irrigation is the dissemination of modern irrigation systems, and besides the use of technology, increasing capacity building, training of users and political approaches also play an important role. The quickly and/or suddenly changes are difficult in agriculture, which is a fragile sector considering both the technical and social situation. From this perspective, a general and global assessment of irrigation efficiency, water and economic productivity values and total water use in agricultural irrigation in some Middle Eastern and Asian countries compared the data in some developed countries are discussed, and challenges in irrigation management and solution recommendations are also given.

ID: 182 / SES-O-DANRM-04: 2

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: rye, soil, petroleum hydrocarbons, phytoremediation, microbiological fertilizers

ASSESSMENT OF PHYTOREMEDIATION POTENTIAL OF RYE COMBINED WITH MICROBIOLOGICAL FERTILIZERS ON PETROLEUM HYDROCARBONS MIXED SOIL

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Phytoremediation is the use of plants to assimilate, transform, metabolize, immobilize, or degrade various pollutants into environmentally safe forms within the soil. It is widely regarded as an eco-friendly, cost-effective, and socially acceptable method of remediation. This study assessed the growth and phytoremediation potential of rye (*Secale cereale* L.) in combination with microbiological fertilizers on soil contaminated with petroleum hydrocarbons (PHCs). Rye was selected for its high potential to remediate PHCs, and three different microbiological fertilizers were applied. Field experiments were established in the OKTA basins using a randomized block design consisting four treatment variants in three replications, totaling twelve experimental microplots. Morphological characteristics (plant height and spike length), productive characteristics (spikelet number, spike mass, number of grains, grain mass and mass of 1000 grains) and chemical properties of plant material were analyzed. Also the mechanical composition and some chemical properties (pH of the soil solution, carbonate content, humus, total nitrogen, available forms of phosphorus and potassium, total heavy metals Pb, Cd, Zn, and total hydrocarbons) were analyzed on soil samples. Results showed that most morphological and productive traits were enhanced by microbiological fertilizer treatments compared to the control. An exception was the absolute grain mass, which was higher in the control. Protein content in the plant material increased in two variants with microbiological fertilizer, while phosphorus and potassium levels either declined or remained unchanged compared to the control. Importantly, total PHCs content in the soil decreased, confirming that the combined application of phytoremediation and bioremediation significantly contributes to reducing petroleum hydrocarbon contamination.

ID: 184 / SES-P-DANRM-05: 1

Abstract Submissions

Poster Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: sorghum, soil, petroleum hydrocarbons, phytoremediation, microbiological fertilizers

REMEDIATION OF SOIL MIXED WITH PETROLEUM HYDROCARBONS WITH SORGHUM AND MICROBIOLOGICAL FERTILIZERS

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Bioremediation is a process that employs green plants, associated microorganisms, soil amendments, and agronomic techniques to remove, retain, or transform harmful substances into environmentally harmless forms. This study evaluates the effectiveness of bioremediation using *Sorghum vulgare* L. in combination with microbiological fertilizers to treat soils contaminated with petroleum hydrocarbons (PHCs). Sorghum was selected for its high potential to remediate PHCs and three different microbiological fertilizers were applied. Field experiments were conducted at the OKTA basins following a randomized block design with four treatment variants and three replications, comprising twelve experimental microplots. Morphological characteristics and chemical properties of plant material were analyzed. Also the mechanical composition and some chemical properties (pH of the soil solution, carbonate content, humus, total nitrogen, available forms of phosphorus and potassium, total heavy metals Pb, Cd, Zn, and total hydrocarbons) were analyzed on soil samples. The results revealed that sorghum plants treated with Zeo Pullus and Slavol exhibited greater height and higher protein and nitrogen content compared to the control. The mineral matter content showed only minor reductions when microbiological fertilizers were applied. While phosphorus levels in plant material remained consistent across treatments, potassium levels increased in all fertilizer-treated variants. Importantly, all microbiological treatments contributed to a decrease in total PHC concentrations in the soil. These findings highlight the potential of integrated phytoremediation strategies using sorghum and microbiological fertilizers to improve soil health and mitigate hydrocarbon pollution.

ID: 185 / SES-O-DANRM-01: 3

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: copper (Cu) content, mechanical composition, chemical properties, orchards, digital maps

SPATIAL DISTRIBUTION OF COPPER IN THE SOILS UNDER ORCHARDS IN THE KUMANOVO REGION

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A total of 22 soil samples from 11 locations under fruit orchards in the Kumanovo region were analyzed to determine the total copper content. The samples were taken from orchards with different fruit crops at a depth of 0 - 30 cm and 30 - 60 cm i.e. at the depth were the largest part of the fruit tree root system develops. The orchards are in their fruit-bearing phase and are regularly treated with copper-containing pesticides, as well as mineral and organic fertilizers. The analyses were conducted in order to determine whether the copper content is a result on anthropogenic impact through the use of pesticides and mineral fertilizers, or if it has a lithological origin.

For proper interpretation of the copper results in the soil, the mechanical composition and same chemical properties of the soil (soil solution pH, carbonate content, humus, electrical conductivity, etc.) that affect the availability of copper for fruit crops were analyzed.

The total copper content is higher in the topsoil layer 0 - 30 cm compared to the deeper layer 30 - 60 cm, which indicates the anthropogenic impact resulting from the use of copper-containing pesticides.

ID: 201 / SES-O-DANRM-01: 4

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: Climate Adaptation, Green Transition, River revitalization, Urban waterways, Urban Governance

WATERWAYS IN TRANSITION: INTEGRATING HYDROLOGY AND POLICY IN SKOPJE'S VARDAR AND PRISHTINA'S CULVERTED RIVERS

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Rivers have long shaped how cities grow, function, and connect. Yet in many post-socialist contexts, river spaces have been reshaped, erased, or repurposed, reflecting shifting political priorities and fragmented planning. This paper looks at two very different cases, Skopje's Vardar River and Prishtina's covered rivers (Prishtevka and Vellusha) to explore what happens when water systems are either monumentalized or made invisible.

Skopje's central river corridor has been dramatically redesigned over the past decade, especially under the Skopje 2014 project, where public space along the Vardar became a site of national symbolism, heavy infrastructure, and visual control. In contrast, Prishtina's rivers, once active parts of the urban landscape, have been gradually covered and forgotten, yet in recent years, conversations about re-opening them have emerged as part of broader calls for green, livable, and just urban futures.

This research asks how hydrological knowledge and spatial policy might be better connected in these two cities. What would it mean to design river spaces that respond not only to flood risk and climate pressures, but also to questions of public memory, access, and civic agency? Drawing on spatial analysis, policy documents, and emerging civic initiatives, the paper reflects on what can be learned from these two contrasting trajectories, one of excessive presence, the other of near-complete absence, and how rivers might once again become meaningful parts of the public realm in the city. It contributes to debates on climate adaptation, spatial justice, and the green and just transition in the Western Balkans.

ID: 231 / SES-P-DANRM-05: 2

Abstract Submissions

Poster Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: Istria, viticulture, copper, organic matter, soil pH

COMPARISON OF CONVENTIONAL AND ORGANIC VITICULTURE: IMPACT ON COPPER ACCUMULATION AND SOIL CONTAMINATION IN ISTRIA, CROATIA

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Copper (Cu) has been used as a fungicide in agriculture for over 135 years, particularly in organic viticulture due to the lack of effective alternatives. However, prolonged use leads to soil accumulation and environmental concerns. Although the EU has introduced regulations to reduce Cu use, ongoing monitoring is essential for sustainable soil management. This study aimed to assess copper contamination in vineyard soils under organic and conventional systems in Istria, Croatia. Conducted in spring 2025, the research included two organic and two conventional vineyards in Poreč, Petrovija, and Umag, all with similar characteristics (cover, age, slope, exposure, and Terra Rossa soil type). Soil samples were collected at two depths (0–10 cm and 10–30 cm) and three slope positions (top, middle, bottom). Total Cu content was measured using portable X-ray fluorescence (pXRF), while soil organic matter (SOM) and pH were determined using standard methods. Results indicated that Cu levels in all organic vineyard samples exceeded the legal limit (>60 mg/kg, OG 71/19), with a maximum of 96.0 mg/kg in the surface layer at the bottom slope in Petrovija. In contrast, none of the conventional vineyard samples exceeded the limit. Multifactorial ANOVA revealed that Cu concentrations decreased significantly with depth and increased from the top to the bottom of the slope. Strong correlations were found between Cu and both pH ($r = 0.82$) and SOM ($r = 0.71$) in organic vineyards, while in conventional vineyards, Cu correlated strongly only with pH ($r = 0.73$), showing no significant link with SOM ($r = 0.16$).

ID: 247 / SES-P-DANRM-05: 3

Abstract Submissions

Poster Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: gravity-fed irrigation, porous-clay emitter, smallholder farming, subsurface irrigation, water savings

SELF-REGULATING LOW-ENERGY CLAY-BASED IRRIGATION (SLECI)

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Water scarcity and rising energy costs threaten the viability of irrigated small-holder agriculture in arid and semi-arid regions. In this study shows the Self-Regulating Low-Energy Clay-Based Irrigation (SLECI) system, an energy-free technology designed to help smallholder farmers manage with acute water shortages. The SLECI system uses small, porous clay tubes placed next to the plant roots. Each emitter functions as a pressure-responsive membrane, releases water according to on soil-moisture, the drier the surrounding soil, the more water it releases; as moisture returns, the discharge tapers to only what is still needed. A simple water tank positioned about 2 m above the field creates the constant pressure needed, so pumps and electronics are unnecessary.

Two field-tested configurations support different agronomic contexts. Type A, a surface network of 16 mm mains and cross-lines with 6 mm branches feeding single-ended emitters, and Type B, fully buried SLECI lines comprising double-ended emitters pre-linked with 6 mm hose and placed at around two-thirds of the depth from the soil surface to the root zone. The modular component set combines clay emitters (sizes M/L/XL). All layouts employed bio-based polyethylene piping, polypropylene/PE push-fit fittings, a mesh filtration unit, and a float-valve vertical control assembly.

Pilot trials in Botswana and Namibia showed that SLECI required about 55 % less irrigation water than conventional drip while maintaining comparable crop yields, confirming the system's potential as a low-carbon, Do-It-Yourself (DIY) repairable solution for water-constrained smallholders.

ID: 253 / SES-O-DANRM-02: 4

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: Holistic, Environment, Economic viability, Social equity, Smallholder.

SUSTAINABLE AGRICULTURE NEEDS A HOLISTIC APPROACH: CASE STUDY KWANDABA, KWA-ZULU-NATAL, SOUTH AFRICA

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Across the world, the sustainable use of natural resources presents an urgent challenge. Achieving the Sustainable Development Goals (SDGs), requires a holistic approach that integrates various techniques and actions to protect the environment, enhance economic viability, and promote social equity. The DIVAGRI project (Revenue Diversification pathways in Africa through bio-based, circular Agricultural Innovations) explored sustainable farming practices adapted to African smallholder conditions. Through a network of pilot (controlled) and demonstration (real-world) sites, this project intended to utilise local resources optimally, transform agricultural waste into valuable products and enhance the viability and productivity of smallholder farmers by creating business opportunities. The DIVAGRI project was implemented in five African countries. This case study focussed on the KwaNdaba site in the Maputaland Coastal Plain, KwaZulu-Natal, South Africa. It represents a biodiversity-rich and ecologically sensitive area that needs to be conserved for future generations. Stakeholder feedback indicated that key challenges include market access and security, insufficient collaboration, and lack of transparency (i.e. challenges in community dynamics). Although the farmers at KwaNdaba struggle with record keeping, they perceived the project's impact as positive. Synergies with multiple entities working together, performed well to achieve a positive outcome and promote sustainable livelihoods (e.g. manufacturing traditional crafts and agri-tourism). However, success depends on both voluntary and funded networks of individuals and organisations, committed to integrating cultural and natural aspects, contributing to project leadership, expert advice, and raising awareness. A post-project strategy explores mechanisms for continuous support, while the Policy Brief, supported by the project research findings, made recommendations.

ID: 255 / SES-O-DANRM-02: 3

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: SLECI, Hydrus 2D, Drip irrigation, Soil Water, DIVAGRI.

HYDRUS 2D SIMULATION OF WATER DYNAMICS UNDER SLECI AND DRIP IRRIGATION SYSTEMS AT BUAN IN BOTSWANA.

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The scarcity of water for agricultural development in Botswana is due to inadequate and unreliable rainfall, which leads to constrained food production. The distribution of soil water largely depends on the type of irrigation system. A greater understanding of soil water distribution leads to the efficient use of scarce water resources, optimal fertigation of crops, and a safer environment. However, due to the complex nature of soil-water movement, it is often challenging to accurately evaluate the distribution of soil water without the use of modeling tools. This study utilized the Hydrus 2D numerical model to simulate soil water distribution and validated the results with observed measurements under SLECI and Drip plots. The results show that $r^2 = 0.51$, $RMSE = 0.9$, and $NSE = 0.5$ for Hydrus 2D simulations, whereas $r^2 = 0.24$, $RMSE = 25$, and $NSE = -3$ for Hydrus 2D simulations with Drip irrigation. These results show that there was not a good fit of the model to the measured data under both SLECI and Drip irrigation. The RMSE values indicate that Hydrus 2D simulations were better with SLECI than with Drip irrigation. The model efficiency values (NSE) indicate that Hydrus 2D had a better prediction efficiency under SLECI than with Drip simulations. Predictive models are essential for soil water management.

Acknowledgement: The project "Revenue diversification pathways in Europe and Africa through bio-based, circular and sustainable agricultural innovations" (DIVAGRI) has received funding from the European Union Horizon 2020 programme under grant No. 101000348 <https://divagri.org/>

ID: 256 / SES-O-DANRM-02: 2

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: Bio-based irrigation technologies, Irrigation techniques, Intercropping, Sustainable agriculture.

THE INFLUENCE OF A SELF-REGULATING, LOW-ENERGY, CLAY-BASED IRRIGATION (SLECI) SYSTEM ON WATER PRODUCTIVITY AND YIELD IN MORINGA AND COWPEA CULTIVATION

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This study evaluated the effects of sub-surface SLECI, and conventional sub-surface and surface drip on the performance of *Moringa oleifera* (moringa) and *Vigna unguiculata* (cowpea), cultivated either as mono crops or in intercropping systems. The trial was conducted in an open experimental field in South Africa. The main aim was to assess water productivity and yield performance in different irrigation systems over two growing seasons. The results showed that SLECI irrigation system was more suitable for *Moringa oleifera*, while *Vigna unguiculata* performed best with standard drip irrigation. The *Moringa oleifera* fresh leaf biomass was higher under SLECI with sand around the clay element and surface drip irrigation with 1.42 t/ha, followed by SLECI treatment without sand with 1.25 t/ha, while the least yield was noted in subsurface drip irrigation treatment with 1.18 t/ha. *Vigna unguiculata* pod biomass performed best results under subsurface drip irrigation treatment with 66.26 t/ha, followed by SLECI treatment without sand with 61.51 t/ha, surface while drip and SLECI with sand showed similar yield with 52.34 and 52.31 t/ha. The irrigation water productivity (IWP) in *Moringa oleifera* ranged from 0.26 kg/m³ under surface to 0.65 kg/m³ for SLECI treatment with sand. IWP in *Vigna unguiculata* treatments varied from 9.5 kg/m³ in surface drip irrigation up to 27.5 kg/m³ in SLECI without sand. The findings have important implications for sustainable agriculture under water-limited conditions.

ID: 257 / SES-O-DANRM-02: 5

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: Biochar, Carbon-rich byproduct, Moringa oleifera L., Organic soil amendments, Sustainable agriculture.

MORINGA STEMS USED AS FEEDSTOCK FOR FUNCTIONAL BIOCHAR

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In line with the need for farming practices to become more environmentally friendly, a study was undertaken to evaluate the effects of biochar produced as a carbon-rich byproduct of Moringa oleifera stems pyrolysis on the growth, physiology and yield of Moringa oleifera leaves harvested using a cutback method before and after winter. A trial was conducted on 6- to 7-year-old trees growing on an open field at the Agricultural Research Council - Vegetable, Industrial and Medicinal Plants, Pretoria, South Africa, over two consecutive growing seasons (2023-2024 and 2024-2025). In both seasons, Moringa oleifera crop productivity was significantly higher with biochar application, particularly when the trees were cut back after the cold winter period. Trees treated with biochar revealed significantly higher plant height (185-307 cm), canopy length (134-160 cm), canopy width (106-146 cm), leaf area index (1.9-2.4 m² m⁻²), fractional interception of photosynthetically active radiation (55-76%), fresh (41-57 ton/ha) and dry leaf yield (11.2-19.2 ton/ha) compared to the rest of the treatments (plant height = 151-200 cm; canopy length = 116-138 cm; canopy width = 100-146 cm; leaf area index = 0.8-1.4 m² m⁻²; fractional interception of photosynthetically active radiation = 46-55%; fresh and dry leaf yield = 13-49 and 4-14 ton/ha, respectively). The study established that Moringa oleifera growth, physiology and yield can be enhanced through the application of biochar, particularly when the trees are cut back after winter. The findings have important implications for farmers who rely on locally available organic soil amendments for improved crop production as it promotes sustainable agriculture.

ID: 258 / SES-O-DANRM-03: 1

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: Biochar, Greenhouse Gas Emissions, Soil Fertility, Invasive Plants, Agricultural Productivity.

ALTERNATIVE USE OF INVASIVE PLANTS AS BIOCHAR FEEDSTOCK TO IMPROVE PLANT GROWTH AND SOIL WATER RETENTION

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In South Africa, efforts to mitigate greenhouse gas (GHG) emissions from the agricultural sector have identified the production and application of biochar as a promising strategy. Biochar not only has the potential to reduce GHG emissions but also offers various agricultural benefits, such as enhancing soil fertility, improving crop yields, and increasing nutrient availability (i.e. captured in both soil fertility and nutritional quality) and water retention. The incorporation of biochar from invasive plants has been underexplored, particularly in relation to its effects on *Beta vulgaris* subsp. *vulgaris* (Swiss chard) growth. This study investigated the effects of biochar derived from three invasive species *Lantana camara* L., *Azadirachta indica*, *Solanum mauritianum* stems, and *Moringa oleifera* stems, on *Beta vulgaris* growth, yield, and nutritional quality, and on soil water retention in a controlled glasshouse environment in a randomized complete block experiment with six replicates. Results indicated that *Moringa oleifera* biochar significantly enhanced *Beta vulgaris*'s chlorophyll content and dry shoot mass compared to other treatments, contributing prominently to overall treatment variation. No significant differences were observed in leaf number, plant height, or fresh shoot mass. *Moringa oleifera* biochar, followed by *Solanum mauritianum*, were also noted for their ability to retain water and improve soil quality, suggesting potential biochar application in rural communities to enhance agricultural productivity and alleviate poverty. This study supports the use of *Moringa oleifera* biochar as a strategic agricultural practice to improve soil microbiology, while reducing the prevalence of invasive species.

ID: 267 / SES-P-DANRM-05: 4

Abstract Submissions

Poster Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: Drip irrigation, water consumption, soil moisture, BBT, yield performance

DRIP FERTIGATION AND BIO-BASED TECHNOLOGIES FOR EFFICIENT PEAR ORCHARD WATER MANAGEMENT

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This study examines the effects of different drip irrigation regimes and bio-based soil amendments on water use, soil moisture dynamics, and yield performance in a pear orchard in the Kumanovo region. Three irrigation regimes were tested in this study: every three days (V3), every five days (V5), and sensor-based scheduling (Vs), all combined with fertigation. As sub-treatments, pelletized sheep wool (WP) and biochar (BCh) were compared to a control. The results showed that Vs treatment recorded the lowest water consumption (5028.22 m³/ha), while WP sub-treatment had the lowest water use among the sub-treatments (5217.53 m³/ha). The V3 regime maintained the most favorable soil moisture conditions, whereas WP demonstrated the best performance among the sub-treatments. The highest number of fruits per tree was observed in the V3 and WP. Furthermore, the highest number of fruits with an average total fruit mass was recorded in V3. The highest average length of shoots is recorded in the Vs treatment (33.96 cm), while the lowest was in V5 (29.29 cm). For average trunk cross-sectional growth, V5 recorded the best result (0.89 cm²), followed by V3 (0.75 cm²) and Vs (0.70 cm²). The highest average number of flower buds was found in V5 and BCh.

Acknowledgements: This investigation is funded by Ss. Cyril and Methodius University funds within the project "Effect of Drip Irrigation Regime and Fertigation on Water Use Efficiency in Pear Orchards in the Kumanovo Region". Also, the authors are grateful to the EU funded DIVAGRI project, under grant No. 101000348, for sharing their idea and experience about Biochar BBT.

ID: 268 / SES-O-DANRM-03: 4

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: SLECI, drip irrigation, maize yield, irrigation water use, water productivity

IRRIGATION WATER PRODUCTIVITY IN MAIZE CROP PRODUCTION UNDER SUSTAINABLE IRRIGATION TECHNIQUES

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The study evaluated the efficiency of self-regulating, low-energy, clay based irrigation (SLECI) for maize cultivation in Ghana. The field experiment, part of the EU-funded DIVAGRI project, summarizes two consecutive season (3rd August to December 18th in 2023 and 5th August to December 19th in 2024) that compared surface and sub-surface SLECI and surface drip irrigation in maize crop production. This study, was established at Crops Research Institute in Fumesua, Ashanti Region of Ghana. The main objectives were to assess yield, irrigation water use, and irrigation water productivity (IWP) in maize crop. According to the obtained results, sub-surface SLECI achieved the highest maize yield (4.56 t/ha), followed by surface drip (4.07 t/ha) and surface SLECI (4.03 t/ha). Cob weights followed similar trends, with the highest average in sub-surface SLECI treatment. The most efficient treatment regarding water use was surface SLECI, using only 2600 m³/ha of water and attaining the highest IWP (1.55 kg/m³), while surface drip consumed 3800 m³ water per hectare with the lowest IWP (1.07 kg/m³). Soil moisture was highest in sub-surface SLECI at the 0–15 cm depth, though surface SLECI showed improved moisture content in deeper layers after prolonged cultivation. These findings underscore SLECI's potential to enhance maize productivity while reducing water demand, offering a promising alternative for smallholder farmers facing water access constraints.

Acknowledgements: The project “Revenue diversification pathways in Europe and Africa through bio-based, circular and sustainable agricultural innovations” (DIVAGRI) has received funding from the European Union Horizon 2020 programme under grant No. 101000348 <https://divagri.org/>

ID: 269 / SES-O-DANRM-03: 5

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management*Keywords:* Efficient irrigation technologies, maize yield, irrigation water productivity, soil moisture**SLECI IRRIGATION SYSTEM AS A CLIMATE-RESILIENT SOLUTION FOR SMALLHOLDER AGRICULTURAL PRODUCERS****V. Tanaskovikj¹, K. Mmolawa², O. Chukaliev¹, A. Clift-Hill², S. Trinath Suryadevara³, S. Malchev⁴, J. Siering⁵, S. Nechkovski¹, M. Markoski¹, R. Kabranova¹, I. Iljovski¹**¹University of St. Cyril and Methodius in Skopje, Faculty of Agricultural Sciences and Food, Skopje, North Macedonia; ²Botswana University of Agriculture and Natural Resources-BUAN, Botswana;³Institute of Polymer and Production Technologies, Germany; ⁴Fruit Growing Institute – Plovdiv, Agricultural Academy, Bulgaria; ⁵Robert-Schmidt-Institut, Hochschule Wismar University of Applied Sciences: Technology, Business and Design, Germany; vtanaskovic@fznh.ukim.edu.mk

Botswana's agriculture faces significant challenges due to its arid climate, limited rainfall, and high evaporation. Efficient irrigation technologies are essential to sustain crop production, particularly for maize, the country's staple food. The Botswana University of Agriculture and Natural Resources partnered with the EU-funded DIVAGRI project, evaluates the performance of self-regulating, low-energy, clay-based irrigation (SLECI) with surface drip irrigation in maize crop production. This study present one season investigation results realized from 14 February to 7 June 2023. Two plots (blocks) using each as a separate irrigation technique were established during this investigation (each measuring 84 m²). The obtained results showed higher average fresh and dry maize yield in SLECI compared with surface drip irrigation, or 27.4 vs. 25.7 kg and 8.7 vs. 8.56 kg yield per plot, respectively. The water savings potential of SLECI is for 3.24 m³ better compared to the surface drip irrigation, or 5.74 vs. 8.98 m³ per plot. The results for irrigation water productivity (IRW) show that SLECI produced 4.77 and 1.52 kilograms fresh and dry maize for every cubic meter of applied water or around 67 and 59% more fresh and dry yield than surface drip irrigation. Furthermore, SLECI plots produced more maize cobs and maintained more stable soil moisture levels. Finally, additional investigations in different soil types and crops are recommended.

Acknowledgements: The project "Revenue diversification pathways in Europe and Africa through bio-based, circular and sustainable agricultural innovations" (DIVAGRI) has received funding from the European Union Horizon 2020 programme under grant No. 101000348 <https://divagri.org/>

ID: 270 / SES-O-DANRM-03: 6

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: Self-regulating low-energy clay-based irrigation, surface drip irrigation, gem squash yield, irrigation water productivity

SUSTAINABLE IRRIGATION TECHNOLOGIES FOR ARID ENVIRONMENTS: A PILOT STUDY ON SLECI IN GEM SQUASH CULTIVATION

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Namibia's agricultural productivity is constrained by low rainfall and prolonged dry spells, placing pressure on groundwater resources. At Ombe Guestfarm and Safari, Okahandja, Namibia, a pilot study was conducted to evaluate the performance of self-regulating, low-energy, clay-based irrigation (SLECI) compared to surface drip irrigation in gem squash cultivation. The study, part of the EU funded DIVAGRI project, aimed to assess yield outcomes, water consumption, and irrigation water productivity (IRW) under both systems. The study, conducted from November 2022 to February 2023, involved five replicated rows of 40 meters each for both irrigation methods. The results showed a small differences of the gem squash yield when comparing the irrigation techniques. The surface drip irrigation produced 345 kg fresh weight yield of gem squash or only 1.2% more than the 341 kg recorded under sub-surface SLECI irrigation treatment. The water savings potential during the vegetation period is higher in sub-surface SLECI then the surface drip irrigation treatment. Sub-surface SLECI consumed only 108 m³ water per treatment per season, while drip irrigation showed 125% higher water use or 243.4 m³. In addition, the results for irrigation water productivity (IRW) show that sub-surface SLECI produced 3.15 kilograms of fresh gem squash yield for every cubic meter of applied water or nearly one and the third time more than treatment with surface drip irrigation treatment.

Acknowledgements: The project "Revenue diversification pathways in Europe and Africa through bio-based, circular and sustainable agricultural innovations" (DIVAGRI) has received funding from the European Union Horizon 2020 programme under grant No. 101000348 <https://divagri.org/>

ID: 271 / SES-O-DANRM-03: 2**Abstract Submissions****Oral Presentation***Topics:* Digital Agriculture & Natural Resources Management*Keywords:* SLECI, surface drip irrigation, sub-surface drip irrigation, efficient use of water**EVALUATING A NOVEL CLAY-BASED IRRIGATION SYSTEM FOR IMPROVING WATER PRODUCTIVITY IN ROSEMARY AND LAVENDER CROPS****O. Chukaliev¹, H.B. Stander², V. Tanaskovikj¹, G.M. Wolfaardt², S. Trinath Suryadevara³, S. Malchev⁴, J. Siering⁵, A. Martinovska Stojcheska¹, Z. Dimov¹, S. Nechkovski¹**

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As part of the EU funded DIVAGRI project this study evaluated the performance of a novel self-regulating, low-energy, clay-based irrigation (SLECI) as a sustainable alternative to surface and sub-surface drip irrigation in a water-scarce agricultural environment. The investigation was carried out with Rosemary (*Salvia rosmarinus*, Tuscan Blue variety) and Lavender (*Lavandula stoechas*, Hollandia variety) cultivated in an open field conditions on the Welgevallen Experimental Farm, Stellenbosch, South Africa, during the hot and dry summer season (1st November 2023 to 31st January 2024). The highest fresh biomass yields were recorded under sub-surface drip irrigation for rosemary (5.8 kg) and under conventional drip treatment for lavender (23.20 kg), respectively, which was notably higher than the SLECI treatment, which used significantly less water (2.67 m³ per treatment) over the 3-month period compared to the surface (34.58 m³) and the sub-surface drip line (15.30 m³). However, the calculated irrigation water productivity (IRW) revealed the water-savings potential of SLECI, which yielded 1.88 kg of fresh lavender per cubic meter of applied water which was nearly three times more than treatment with surface drip irrigation. Similar results were obtained with rosemary, where the fresh yield with SLECI was 0.67 kg/m³ of applied water, which was over four and a half times greater than the yield obtained with the surface drip system (0.15 kg/m³).

Acknowledgements: The project “Revenue diversification pathways in Europe and Africa through bio-based, circular and sustainable agricultural innovations” (DIVAGRI) has received funding from the European Union Horizon 2020 programme under grant No. 101000348 <https://divagri.org/>

ID: 272 / SES-O-DANRM-03: 3

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: Low-energy irrigation, clay emitters, surface drip irrigation, tomato yield response, water productivity

FIELD EVALUATION OF TOMATO CROP PRODUCTION UNDER SLECI IRRIGATION

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Ghana's diverse agroecological zones support a wide range of crops, with tomato ranking among the most cultivated vegetables due to market demand and quickly sell. However, during cultivation tomato has high water consumption and this sometimes poses a challenge in the face of erratic rainfall patterns and climate change. The daily water needs of a single tomato plant can range up to 6 litres during a dry and hot days. Therefore, a methods and techniques which can improve water potential are very important for their production. This study, conducted by the University of Cape Coast under the EU-funded DIVAGRI project, evaluated the performance of self-regulating, low-energy, clay-based irrigation (SLECI) compared to conventional surface drip irrigation (CSDI) for tomato cultivation. The obtained results show that SLECI treatment delivered 78% more tomato yield in comparison with CSDI. SLECI showed 564.5 m³/ha used water during the season and 4.5 kilograms of fresh tomato yield with each m³ of used water. Furthermore, results showed that there was no significant difference in leaf length, plant height, leaf width, or stem diameter for tomato plants and for both SLECI and CSDI fields for the duration of 14 to 42 days after transplanting. Finally, the results obtained in this study will be useful for all interested parties from the agricultural sector in Ghana and beyond.

Acknowledgements: The project "Revenue diversification pathways in Europe and Africa through bio-based, circular and sustainable agricultural innovations" (DIVAGRI) has received funding from the European Union Horizon 2020 programme under grant No. 101000348 <https://divagri.org/>

ID: 286 / SES-O-DANRM-04: 3

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: soil texture, chemical properties, Gazi Baba Forest Park, North Macedonia

MECHANICAL COMPOSITION AND SELECTED CHEMICAL PROPERTIES OF THE SOILS IN THE GAZI BABA FOREST PARK

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This study aimed to examine the mechanical composition (texture) and selected chemical properties of soils in the Gazi Baba Forest Park. Several soil types are formed in the area, including regosols, cinnamon forest soils, colluvial soils, and their complexes. The analyses of the mechanical composition of the samples revealed that the fine sand fraction predominates in the total sand content, averaging 39.02%, compared to 8.98% for coarse sand. The average value of the physical sand fraction (fine + coarse sand) was 48.00%, which is lower than the physical clay fraction (clay + dust) at 52.00%. Within the clay fraction, the highest average value was for clay (27.19%; range 11.70–51.60%), followed by silt (24.80%). Most of the soils in the surface area are sandy clay loam (41%), 36% sandy loam, and 23% loam. The soil density ranges from 1.24 to 1.54 g/cm³, while hygroscopic moisture averages 2.52%. Soil pH in water ranges from 7.58 to 8.81, indicating weakly to strongly alkaline conditions. Adsorption capacity varies between 13.15 and 59.38 cmol/kg. Available phosphorus (P₂O₅) ranges from 4.31 to 48.94 mg/100 g soil, while potassium (K₂O) ranges from 34.76 to 72.13 mg/100 g soil. Calcium content is high (mean 5.19%), as well as magnesium (ranges from 1.12 to 4.16 %). Data analyses were performed using R and ArcGIS 10.8 software. The results provide a comprehensive baseline for understanding soil characteristics in Gazi Baba Forest Park, supporting its sustainable management, ecological conservation, and potential land-use planning.

ID: 293 / SES-O-DANRM-04: 4

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: correlation, global scale, paradox, strategic food production, unsustainable.

FIELD IRRIGATION FAILS TO ENSURE FOOD PRODUCTION - QUANTITATIVE HYDRO-SOCIOLOGICAL PERSPECTIVE

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Field irrigation is a land intensification management practice that has increased crop production globally. In the context of the promising outcomes suggested by the framework of Boserup (1965) involving agricultural land intensification, the benefits of irrigated agriculture appear to vary considerably from region to region. I reveal an outdated mechanical link between field irrigation and aridity postulated decades ago, by quantifying the correlation of irrigated land and food variables as measures for country self-sufficiency. I reveal Mann-Kendall monotonic trends of the time series of area equipped for irrigation (AEI; ×1000 ha year⁻¹) available on a global scale from either Aquastat national annual statistics (1973 to 2023; FAO) or sub-national gridded statistics (years 2000, 2005, 2010, and 2015; Meier). Both datasets provided comparable results of AEI largest expansion in India, China, Brazil, and Bangladesh, of respectively, 860, 690, 108 and 105, and also Pakistan (140, FAO) and the USA (132, Meier). Countries with AEI recession were Russia, Kazakhstan, Japan and Portugal, with 19/93, 67/21, 17/12 and 12/7 for FAO/Meier, but also Colombia (12, FAO), and Romania and Bulgaria (35 each, Meier); these regions also had clear monotonic downward trend of food consumption and domestic food supply. Paradoxically, Sub-Saharan Africa and few countries in South-East Asia with increasing trend in AEI overlapped decreasing trend in all food variables. These disparities prompt rethinking irrigated agriculture driven by unsuitable cropping systems and farmers cultivating foreign subsidized export crops over national food supply. Implications for southeastern Europe and the Balkans are also discussed.

ID: 296 / SES-P-DANRM-05: 5

Abstract Submissions

Poster Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: P pool, K pool, total N, C/N ratio, modelling

ORGANIC C, P AND K STOCKS IN THE TOPSOIL AND SUBSOIL OF VINEYARDS IN CROATIA AND NORTH MACEDONIA

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The aim of this research is to analyse nutrient pools in vineyard soils and determine possible correlations for modelling in cases of missing data. The chemical properties (pH, SOM, P, K, total N) were analysed in topsoil (0-30 cm) and subsoil (30-60 cm) of vineyards in Croatia (1,482 plots on 3,350.8 ha) and North Macedonia (66 plots). On average, 1.12% OC (1.92% SOM) was determined in the topsoil, and 0.88% OC in the subsoil in Croatia. In the area of Veles (North Macedonia), a higher content of OC was in topsoil (1.71%), but lower in subsoil (0.64%). On average, 47,379 kg/ha of OC was found in the topsoil in Croatia, and 37,198 kg/ha in subsoil as a stock of 271,065,165 kg OC in both layers. The mentioned vineyard areas contain an average of 364.5 and 1,096 kg/ha plant available P and K in topsoil and 283.2 and 844.5 kg/ha P and K in subsoil, which makes a pool of 2,190,188.9 kg available P and 5,185,688 kg K. The total pool of N was 26,349,232 kg (average 4,927 kg/ha in topsoil and 3,900 kg/ha in subsoil). In conclusion, the amounts of available nutrients are very variable, but very significant correlations among topsoil and subsoil, and among organic C, total N, C/N ratio, and available K were found. This enables the effective modelling for predicting soil properties at both depths, whether it is a matter of possible verification of laboratory results, or whether it is to fill in missing data in databases.

ID: 298 / SES-P-DANRM-05: 6

Abstract Submissions

Poster Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: Occupational health and safety, Digital technologies in agriculture, Stakeholder surveys, Decision support

A SYSTEMIC APPROACH TO SMART FARMING ASSESSMENT: THE MLSAT TOOL IN THE AGRO-WELL PROJECT

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The agricultural sector involves physically demanding and hazardous work, leading to high accident rates and long-term health issues. Manual, repetitive tasks reduce its appeal, particularly to younger generations. Digitalization, structural changes, climate risks, and environmental targets are increasing demands on occupational safety, health, and decision-making. This highlights the need for tools to guide the implementation of digital technologies in agriculture.

Within the AGRO-WELL project, Work Package 4 (WP4) will design and apply the Multi-Level System Analysis Tool (MLSAT) to evaluate the sustainability impacts of smart farming technologies. Five digital solutions—Smart Traps, autonomous mobile robots (AMRs), the Vitality Tracker, an AR app, and AIReact—will be tested across demonstration sites in open fields, orchards, pig farms, and greenhouses.

MLSAT combines on-site measurements, technology performance logs, and two structured survey streams: (i) "inside" surveys with farmers, workers, and local stakeholders to assess operational changes, labor conditions, and perceived benefits or risks; and (ii) "outside" surveys with technology providers and institutional actors, focusing on feasibility, scalability, and market readiness.

The tool processes this data through an impact assessment framework covering Environmental Sustainability, Economic Viability, Social and Labor Impact, Technological Feasibility, and Institutional Scalability. Outputs include comparative dashboards, radar plots, composite sustainability indices, and tailored recommendations.

By integrating life-cycle methodologies (LCA, S-LCA, TEA) with stakeholder-derived data, MLSAT will serve as a decision-support system to guide adoption strategies, inform policy, and promote safer, more sustainable agricultural transitions, aligning with AGRO-WELL's mission.

ID: 300 / SES-P-DANRM-05: 7

Abstract Submissions

Poster Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: agricultural land monitoring, nacional Soil Classification, WRB Classification

IMPLEMENTATION OF AGRICULTURAL LAND MONITORING IN THE REPUBLIC OF CROATIA

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The aim of this research is to continuously collect information on agricultural land and introduce timely responses to record or mitigate the changes that have occurred. 2.580.000 ha of Croatian land is used for various agricultural purposes; crop production, livestock farming and fishing. Unfortunately, data on land management methods, and especially on soil quality for the majority of these areas, are unavailable. There was no system in Croatia that would collect and process this information in a quality manner. In 2023, the establishment of monitoring in the Republic of Croatia began and so far 60 out of a total of 90 locations have been established. A station is a place for permanent monitoring of the condition of agricultural land, which, with its geomorphological position, pedosystematic unit and method of use, represents the agro-ecological area, or rather, the agricultural subregion in which it is located. Soil classification was carried out according to three different systems. Soil Classification of Yugoslavia (Škorić, A. et al, 1973, 1985), the classification according to the "Soil Classification of Croatia (Husnjak, 2014.) and World Reference Base for Soil Resources (IUSS Working Group WRB, 2022) is an international classification system. The results obtained from agricultural land monitoring will be placed in the Information System for the Protection of Agricultural Land

ID: 313 / SES-O-DANRM-01: 5

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: agriculture, climate vulnerability, innovation, resilience

GREEN AGENDA FOR THE WESTERN BALKANS: SUPPORTING THE WESTERN BALKANS IN ADAPTING TO CLIMATE CHANGE

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The Western Balkan countries are increasingly vulnerable to climate change, experiencing intensified extreme weather and gradual environmental degradation. In response, as part of the Regional Climate Partnership between Germany and the Western Balkans, the project "Green Agenda: Supporting the Western Balkans in Adapting to Climate Change", implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, supports the region's alignment with the Green Agenda for the Western Balkans (GAWB). The project adopts a multi-level, evidence-based approach to strengthen capacities for climate adaptation planning and implementation at regional, national, and local levels. It consists of three components: (1) regional adaptation strategies and knowledge exchange; (2) climate adaptation in agriculture; and (3) urban transport resilience.

The Regional Rural Development Standing Working Group in Southeast Europe (SWG) is a key implementation partner for the agriculture component.

Methods include development of regional strategies, policy support, and implementation of scalable demonstration projects, particularly in agriculture, where pilot projects in Albania and North Macedonia test technologies such as fertigation systems, weather data integration, precision irrigation and climate-resilient crop varieties. A key methodology involves stakeholder engagement and capacity building through the Quadruple Helix innovation model.

Initial results show improved regional cooperation, development of strategic policy documents, increased stakeholder capacity and adoption of innovative technologies. Demonstration pilots provide transferable knowledge for broader application across the region. The project ultimately contributes to reducing climate vulnerability and enhancing long-term resilience in the Western Balkans' agricultural and infrastructure sectors.

ID: 322 / SES-O-DANRM-01: 1

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: to be added

DIGITAL AGRICULTURE FOR SMARTER WATER MANAGEMENT: FROM DATA TO SUSTAINABLE DECISIONS

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To be added

ID: 323 / SES-O-DANRM-02: 1

Abstract Submissions

Oral Presentation

Topics: Digital Agriculture & Natural Resources Management

Keywords: SLECI, bio-based solutions, clay-based irrigation

LINKING EUROPE AND AFRICA TROUGH SUSTAINABLE BIO-BASED SOLLUTIONS

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The DIVAGRI project, funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000348, fosters sustainable agricultural transformation in Sub-Saharan Africa by transferring innovative bio-based solutions (BBS) from European partners to African pilot sites. These include mobile biorefineries, optimized biochar and biogas systems, and the Self-regulating Low-Energy Clay-based Irrigation (SLECI) system. SLECI, developed at Wismar University, uses buried microporous clay emitters to deliver water precisely at root level, triggered by soil moisture tension—without electricity or sensors. Tested in Bulgaria and Africa, SLECI enhances water and fertilizer efficiency, stabilizes soil moisture under climatic stress, and supports crop yield and uniformity. Its passive, gravity-driven design makes it ideal for smallholder and subsistence farmers in arid regions. DIVAGRI's integrated approach promotes climate resilience, resource efficiency, and local economic development through circular agriculture and sustainable innovation.

FIELD CROP PRODUCTION

ID: 103 / SES-P-FCP-01: 5

Abstract Submissions

Poster Presentation

Topics: Field Crop Production

Keywords: Nanotechnology; Nano Plant Nutrition; New Fertilizer; Sustainable Agriculture; Chemical Analysis.

NANO-FERTILIZATION AND ITS EFFECT ON THE CHEMICAL COMPOSITION OF 'CHERRY' TOMATO LEAVES AND FRUIT

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Plant nutrition aims to provide optimal nutrients throughout growth. Fertilization is key in agriculture and regulated across farming types. Nano-fertilizers, enhanced by nanotechnology, offer improved efficiency and productivity over traditional fertilizers, benefiting overall farming quality and sustainability.

The aim of this research was to determine the impact of newly produced organic nano NPK fertilizer on the chemical composition of both the leaves and fruit of 'Cherry' tomatoes (*Solanum lycopersicum*), cultivated under controlled laboratory conditions.

The experimental design included four treatment groups: 1. Control (untreated); 2. Conventional mineral NPK (20:20:20) fertilization; 3. Nano NPK (20:20:20) + Nano Zn (3 g/L); and 4. Nano NPK (20:20:20) + Nano Zn (5 g/L). Three foliar applications were applied during the growing season: one pre-flowering (10-15 days before), one post-flowering (15-20 days), and the final application at the berry stage of fruit development.

It was found that the treatments with nano-fertilizer resulted in a significantly higher ($p < 0.05$) content of all analyzed parameters, compared to both the conventional NPK fertilizer-treated variants and the control variant. A strong positive correlation ($r > 0.90$, $p < 0.01$) was observed between the use of nano-fertilizers and the improvement in the chemical composition of tomatoes.

Key factors that influence the efficacy of nanoparticles include their particle size and surface structure. Nano-fertilizers enable the controlled and sustained release of nutrients, thereby enhancing absorption efficiency while reducing environmental losses. Furthermore, nano-fertilizers hold the potential to be integrated into advanced crop production systems, in line with the principles of sustainable agriculture.

ID: 132 / SES-O-FCP-02: 3

Abstract Submissions

Oral Presentation

Topics: Field Crop Production

Keywords: Nitrogen management, fertigation, melon (*Cucumis melo* L.), nitrate leaching, arid agriculture

SUSTAINABLE NITROGEN MANAGEMENT IN MELON FARMING IN SOUTHERN TUNISIA: IMPLICATIONS FOR YIELD, FRUIT QUALITY, AND SOIL DYNAMICS

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Excessive nitrogen fertilizer use in Mediterranean agriculture contributes to nitrate leaching, soil degradation, and water pollution. The Telenitro project, conducted in Spain, Italy, Morocco, and Tunisia, aims to reduce nitrogen inputs while maintaining yield and quality through sustainable practices. By integrating natural nitrification inhibitors (NIs), hyperspectral imaging, and decision-support systems (DSS), the project supports nitrogen use efficiency and aligns with the European Green Deal and Sustainable Development Goals. In Tunisia, the focus was on Canary Yellow melon (*Cucumis melo* L.) under fertigation in arid conditions. A field experiment in Gabes tested five nitrogen levels (100%, 120%, 70%, 30%, 15% of crop needs) using a randomized block design. Soil and leaf nitrogen, fruit yield, quality parameters, and nitrate leaching risk were assessed. Moderate nitrogen reduction (70%) provided optimal results: 25.92 tons/ha yield and the highest average fruit weight (4.61 kg). Reducing nitrogen further (30%) increased total yield to 30 tons/ha, though with smaller fruits, and improved quality. Lower nitrogen treatments (N4, N5) enhanced sugar content (up to 114.95 mg sucrose/100g) and soluble solids (up to 13.87°Brix). High nitrogen levels (N1, N2) led to soil nitrate accumulation (up to 59.32 mg/L) and inefficient uptake, increasing environmental risks without yield benefits. These results demonstrate that reducing nitrogen to 70% of conventional levels balances yield, quality, and sustainability. When combined with digital tools and optimized fertigation, this approach enhances nitrogen efficiency and environmental protection in arid horticulture.

ID: 135 / SES-P-FCP-01: 2

Abstract Submissions

Poster Presentation

Topics: Field Crop Production

Keywords: beans, forage, intercropping, nutritional value, yield

INFLUENCE OF INTERCROPPING MAIZE WITH CLIMBING BEAN ON FORAGE YIELD AND NUTRIENT COMPOSITION

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Since legumes have a low dry matter yield, low forage yield and unsatisfactory quality, they are often used in intercropping with cereals, which contributes to a higher yield and better forage quality than in pure culture. In this research, corn (*Zea mays* L.) and climbing beans (*Phaseolus vulgaris* L.) were sown in different sowing densities in order to determine the best ratio in the intercropping system of corn and beans to achieve high yield and good nutritional value of silage. A pure maize crop (75000 grains ha⁻¹) and maize in intercropping with beans were sown: 75000 grains ha⁻¹ of maize and 37000 grains ha⁻¹ of beans, 75000 grains ha⁻¹ of maize and 50000 grains ha⁻¹ of beans and 75000 grains ha⁻¹ of corn and 75000 grains ha⁻¹ of beans. The highest yield of dry matter was determined with the highest proportion of beans (20.6 t ha⁻¹), and the lowest yield with 75000 plants ha⁻¹ of corn and 37000 plants ha⁻¹ of beans (18.7 t ha⁻¹). All intercrop had higher crude protein values in dry matter 88 g kg⁻¹ for the 37500 plants ha⁻¹ of beans, 99 g kg⁻¹ for the 50000 plants ha⁻¹ of beans and 112 g kg⁻¹ for the 75000 plants ha⁻¹ of beans than the monocrop maize (75 g kg⁻¹). Based on the yield and nutritional composition of silage, we can conclude that the intercropping with the highest proportion of beans had the highest yield and the best nutritional value of silage.

ID: 136 / SES-P-FCP-01: 4

Abstract Submissions

Poster Presentation

Topics: Field Crop Production

Keywords: Italian ryegrass, nutrient value, sowing ratio, vetch, yield

INFLUENCE OF SOWING RATIO COMMON VETCH WITH ITALIAN RYEGRASS ON FORAGE YIELD AND NUTRIENT COMPOSITION

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Mixing grasses with legume crops is an efficient approach for improving forage production and ensuring the sustainable development of agriculture and livestock. However, the knowledge of the relationship between forage production and interspecific competition in the forage common vetch (*Vicia sativa* L.) and Italian ryegrass (*Lolium multiflorum* Lam.) mixed cropping system remains unclear. A 2-year field study was carried out to determine the dry matter yield, quality, and competition of common vetch (*Vicia sativa* L.) and Italian ryegrass (*Lolium multiflorum* Lam.) mixtures at various ratios (100:0, 80:20, 60:40, 40:60, 20:80 and 0:100%). Dry matter yield and crude protein yield, neutral detergent fiber (NDF) and acid detergent fiber (ADF) of the mixtures were determined. The results showed that the system forage yield increased by 7.9-34.9% when forage common vetch was mixed with ryegrass ($P < 0.05$). Additionally, the forage common vetch-ryegrass mixed cropping improved crude protein yield by 20.7-58.7% compared with monocultures Italian ryegrass ($P < 0.05$). It was determined that common vetch-Italian ryegrass mixtures had higher dry matter yield and quality scores compared to sole Italian ryegrass planting. The highest dry matter and crude protein yield (respectively; 8.5 and 1.46 t/ha) was obtained from 60% common vetch + 40% Italian ryegrass mixture and it revealed lower NDF and ADF ratios than any other mixtures.

ID: 156 / SES-P-FCP-01: 7

Abstract Submissions

Poster Presentation

Topics: Field Crop Production

Keywords: opium poppy, strategy, production, seed, capsules

STATUS AND PRODUCTION POTENTIAL OF OPIUM POPPY BASED ON A SWOT ANALYSES AND TOWS MATRIX

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Opium poppy (*Papaver somniferum* L.) has a long tradition in North Macedonia and is internationally recognized for its high quality. Despite this, cultivated areas have steadily declined, dropping to 35 hectares in 2022, with average capsule yields of 300 kg/ha and seed yields of 583 kg/ha. A SWOT analysis highlights several strengths: favorable agro-climatic conditions, domestic varieties, experienced farmers, and a pharmaceutical buyer. Additional advantages include government subsidies and the impossibility of synthesizing morphine. However, production is limited by small-scale farming, low yields and prices, outdated mechanization, and a lack of guaranteed seed markets. Legal barriers also restrict capsule exports, while buyer interest remains limited. Opportunities include developing poppy seed oil production, expanding seed exports, establishing small processing units, and engaging in international research. Spring cultivation adds flexibility, supported by local knowledge and tradition. Threats such as potential misuse, public stigma, aging farmers, market volatility, and increasing climate extremes hinder sector stability. The TOWS matrix offers actionable strategies. Strengths and opportunities should be leveraged to promote value-added products and export potential. Weaknesses can be addressed through cooperative models, modernization, and public-private investment. Targeted campaigns can counter social resistance, while infrastructure improvements and youth incentives could secure future production. Although facing notable constraints, opium poppy production in North Macedonia has significant potential. Through integrated policies, investment in infrastructure, and strategic market development, it can evolve into a sustainable and competitive agricultural sector.

ID: 173 / SES-P-FCP-01: 6

Abstract Submissions

Poster Presentation

Topics: Field Crop Production

Keywords: grass mixes, turf mixes, seed production quantity, turf weeds, turf color, turf density

PROPERTIES OF SELECTED TURF MIXES ONE YEAR AFTER AUTUMN SEEDING

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In this experiment we studied properties of selected turf blends one year after autumn seeding. Trial age, that lasted from September 24th 2009 till October 8th 2010, was conducted at experimental field of Rakičan Biotechnical Secondary School. Seven different mixes were seeded on 10 m² sized areas in four rounds. We documented following properties: date of first rise from earth, empty patches in the surface, occurrences of weeds, quantity of seed production, density and color of the turf. Mix No.3 - grass mix (Tall Fescue (*Festuca arundinacea*), arid 3, 50%; Perennial Ryegrass (*Lolium perenne*), panderosa 25%; Perennial Ryegrass (*Lolium perenne*), mondial 25%) and mix No.4 (Red Fescue (*Festuca rubra*), gondolin 40%; Perennial Ryegrass (*Lolium perenne*), panderosa 20%, Perennial Ryegrass (*Lolium perenne*), mondial 20%; Common MeadowGrass (*Poa pratensis*), balin 20%) were standing out of average of other mixes. Quantity of seed production was adequate, but the turf color of mix No.3 was more dark green than the color of mix No.4, both had very few weeds and a nice clean surface with few bare spots.

ID: 175 / SES-O-FCP-02: 6

Abstract Submissions

Oral Presentation

Topics: Field Crop Production

Keywords: alfalfa, seeding rate, stand density, forage yield

DOES A HIGHER ALFALFA SEEDING RATE RESULT IN HIGHER STEM AND PLANT DENSITY AND FORAGE YIELD?

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High seeding rates (between 20 and 30 kg ha⁻¹) is common practice in alfalfa cultivation in the Republic of North Macedonia. This forage crop is usually grown as a secondary crop on small arable areas within family farms, with high seeding rates aimed at achieving high forage yields. Understanding the effect of seeding rate on stand density and forage yield is of crucial importance for alfalfa producers. A three-year experiment (2023 – 2025) was conducted in the Republic of North Macedonia to investigate the effect of different seeding rates on stem and plant density and dry matter yield (DMY). The experimental design was a randomized complete block with three replications. Two seeding rates (8 and 16 kg ha⁻¹) and four cultivars (Banat VS, NS Jelena, Debarska, and Nijagara) were evaluated. It was discovered that a higher seeding rate of 16 kg ha⁻¹ resulted in higher plant (134 plants m⁻¹) and stem density (367 stems m²). However, the obtained DMY values were similar among the examined seeding rates. Higher mean DMY (21.2 t ha⁻¹) was registered with a lower seeding rate (8 kg ha⁻¹) without any significant difference with obtained DMY (20.9 t ha⁻¹) when a higher seeding rate (16 kg ha⁻¹) was applied. In conclusion, increasing the seeding rate may result in higher plant and stem density but does not enhance forage yield.

ID: 187 / SES-P-FCP-01: 1

Abstract Submissions

Poster Presentation

Topics: Field Crop Production

Keywords: wheat, barley, maize, biomass, energy potential, forecast

ENERGY POTENTIAL AND PERSPECTIVES OF BIOMASS DERIVED FROM WHEAT, BARLEY AND MAIZE

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Plant residues from field crops have the potential to be used as a source of energy, which is the foundation for a different approach on biomass in plant production. In order to achieve energy potential of biomass we used statistical data for 2005-2024 (total arable area, production and yield), literature data (residue product ratio RPR, calorific value CV, dry matter DM), two method for obtaining energy potential (mathematical and BEP) and exponential trend with 15 years forecast. From total arable area ($\pm$ 517461ha, 2005-2014), 30.1% were at represented wheat, barley and maize (15.4%, 8.7%, 6.0%) or 155605 ha. The prediction 2025 - 2040 of total arable land show a tendency towards stagnation in maize and barley and a reduction in wheat (32339 ha), total production decrease for wheat (20.3%), and increase for barley and maize (22.3 %, 2.8 %), and in terms of yield show a towards growing tendency. Biomass energy potential 2005-2024 shows the highest percentage of total production for wheat (48.5%), compared to barley (28.3%) and maize (23.2%). In terms of yield the highest percentage of biomass achieved in maize (37.6%). Prediction 2025-2040 of total biomass production increases by 7% for barley and 1% for maize, as well as 2% barley and 3% maize in terms of yield biomass in kg/h. The total energy potential of studied crops according to the mathematical model showed 10564 GJ for 2005-2024 and 10226 GJ for forecast period, and was higher than the BEP method (9281 GJ, 8999 GJ) by 13.6%.

ID: 211 / SES-P-FCP-01: 8

Abstract Submissions

Poster Presentation

Topics: Field Crop Production

Keywords: agroecological conditions, Srem, spelt wheat variety, morphological and productive characteristics, organic production.

THE INFLUENCE OF THE VARIETY ON THE TRITICUM SPELTA L. PRODUCTIVITY GROWN BY ORGANIC CONDITIONS IN SREM

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Spelt wheat - *Triticum spelta* L. is one of the oldest known types of hexaploid group wheat, with hulled kernels. Spelt is important for biodiversity, successfully adapts to unfavorable climatic conditions and uses favorable elements of the environment. Due to its better adaptation to unfavorable biotic and abiotic conditions than ordinary wheat, large wheat is suitable for cultivation in the ecological agricultural production system. This paper presents the results of the examination of the morphological and productive characteristics of two varieties of Spelt, namely: Nirvana and Ostra during 2023/2024 in the agroecological conditions of Srem, in Pančevo, in the organic system of production. The following characteristics of the spelt were examined: plant height, spike length and weight of 1000 grains. The results showed that the variety Nirvana gave higher values of the examined parameters compared to the variety Ostra. Nirvana variety had higher values for plant height (83.90 cm), spike length (11.98 cm) and 1000 grains mass (42.82 g), compared to Ostra variety (81.10 cm; 11.74 cm and 42.20 g). For the agro-ecological conditions of eastern Srem, the variety Nirvana can be recommended for achieving higher and more stable yields.

ACKNOWLEDGEMENTS

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ID: 240 / SES-P-FCP-01: 3**Abstract Submissions****Poster Presentation***Topics:* Field Crop Production*Keywords:* winter wheat, sowing date, weather conditions, yield, properties**INFLUENCE OF SOWING DATE AND VARIETY ON YIELD AND AGRONOMIC CHARACTERISTICS OF WINTER WHEAT IN EASTERN CROATIA****Dario Ilijkić**Faculty of Agrobiotechnical Sciences Osijek, Croatia; diljkić@fazos.hr

This study aimed to assess the yield performance, yield components, and selected morphological and agronomic characteristics of three winter wheat (*Triticum aestivum* L.) varieties, Maja, Viktorija, and Sofru, sown on three different dates: 15 October, 30 October, and 15 November 2018. An additional objective was to analyze the weather conditions during the 2018/2019 growing season and their influence on yield and other evaluated parameters. The experiment was carried out in three replications on the Vidaković family farm in Strošinci, eastern Croatia, during the 2018/2019 vegetation period. Weather conditions, particularly rainfall and temperature, were generally favorable for winter wheat development, with only slight deviations from the long-term averages. The analysis of variance (ANOVA) revealed a statistically significant impact of both variety and sowing date, as well as their interaction, on yield, yield components, and morphological traits. Of the varieties tested, Maja sown on the earliest date (15 October) achieved the highest yield and demonstrated superior agronomic performance, making it the most advantageous choice for wheat producers in eastern Croatia. The Sofru variety also produced competitive results, showing minimal differences compared to Maja. In contrast, the Viktorija variety performed better when sown later (30 October or 15 November), suggesting its suitability for delayed sowing under less-than-optimal conditions. These findings highlight the potential for increased productivity through appropriate variety selection and adherence to earlier sowing dates.

ID: 265 / SES-O-FCP-02: 1

Abstract Submissions

Oral Presentation

Topics: Field Crop Production

Keywords: Grain yield, Oat, Sow Rate, Plant Height, Harvest Indeks Interaction

GRAIN YIELD POTENTIALS OF NEWLY IMPROVED OAT VARIETIES AT DIFFERENT SOWING DENSITIES

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Abstract

In this study, which was carried out with three newly developed oat genotypes and one candidate genotype in Edirne TTAE Trial Area according to the randomized block design in the 2019-2020 growing season, variety and varietyxdensity interaction were found to be significant for grain yield character.

The grain yields of oat varieties varied between 710.72 kg/da and 847.78 kg/da. The highest grain yield was obtained in Küçükyayla variety, followed by Kahraman variety (777.50 kg/da) and YVBD-5 (736.11 kg/da) advanced line, and the variety with the lowest grain yield was found to be Kırklar variety. In terms of planting density, grain yield varied between 812.50 kg/da and 689.09 kg/da. The lowest grain yield was obtained at 200 m²/seed planting density, and the highest grain yield was obtained at 600 m²/seed planting density. The highest grain yield obtained at 600 m²/seed planting density was followed by planting densities of 700 m²/seed (802.09 kg/da) and 500 m²/seed (796.59 kg/da), respectively.

ID: 302 / SES-O-FCP-02: 2

Abstract Submissions

Oral Presentation

Topics: Field Crop Production

Keywords: Bread Wheat, Double Haploid, Gamma Rays, Grain Yield, Quality Traits, Anther Culture, Mutant Line.

MUTANT DOUBLED-HAPLOID LINES OBTAINED BY COMBINED GAMMA RADIATION AND ANTHER CULTURE APPLICATIONS

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ABSTRACT

The research was carried out to examine the agricultural characteristics of 25 bread wheat genotypes, including 19 mutant double haploid advanced lines developed by anther culture from M 0 populations created by gamma ray, 6 standard varieties, according to the randomized block trial design with 4 replications during the 2015-2016 growing year under Tekirdağ ecological conditions.

In addition to some quality characteristics, bread quality characteristics were examined by determining wet gluten rate and zeleny sedimentation values. Based on the data obtained in the experiment conducted, plant height, spike length, number of spikelets per spike, number of grains per spike, number of grains per spike, grain weight per spike, harvest index, thousand grain weight, test weight, grain yield, protein ratio, wet gluten rate, gluten index, zeleny sedimentation value, averages of bread wheat varieties were 92,20 cm, 10,03 cm, 20,93 adet, 41,68 adet, 1,74 g, %44,70, 43,71 g, 77,65 kg hl -1 , 753,76 kg da -1 %14,75, %34,59, %83,44, 58,56 ml respectively. As a result, when evaluated together with grain yield and quality characteristics examined, BSB 150/3, BSB 300/3, BSB 300/12, BSB 350/5 ve BSB 300/3 bread wheat varieties have higher yields than other varieties. It was concluded that they have high performance and that these varieties may be the most suitable varieties for the bread wheat production regions of our country, especially the Thrace region.

ID: 309 / SES-O-FCP-02: 5

Abstract Submissions

Oral Presentation

Topics: Field Crop Production

Keywords: Bread wheat, mutant, crossing, yield, heterosis

INVESTIGATION OF CHANGES IN GRAIN YIELD AND SOME YIELD COMPONENTS IN HYBRIDS AMONG BREAD WHEAT MUTANTS

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This research was carried out to determine the variation in some agricultural and physiological traits of the three different originated bread wheat cultivars (NKU Lider, Bezostaja and GK Beke's) and the reciprocal hybrids of their genotypes obtained by applying different gamma ray doses (0, 100, 200, 300 Gy). The experiment was conducted in a randomized complete block design with 3 replicates during the 2017-2018 wheat growing seasons. In the study, plant height, spike length, number of spikelet per spike, number of grain per spike, grain weight per spike varied between 85.93-118.44 cm, 10,69-12,86 cm, 20,4-24,57 no, 37,09-64,8 no, 2,26-3,56 g, respectively. For grain yield trait, the average of hybrid combinations and mutant populations varied between 445 kg/da and 926 kg/da. The lowest heterosis and heterobeltiosis values for grain yield were found in the Beke-300 × Lider-300 (-39.429% and -42.704%) combination, while the highest heterosis and heterobeltiosis values were found in the Beke-100 × Bezostaja-100 (42.393% and 40.644%) hybrid combination. In the study, NKU Lider-0 × GK Beke's -0, NKU Lider-200 × GK Beke's -200, Bezostaja-100 × GK Beke's -100, GK Beke's -0 × NKU Lider-0, GK Beke's -100 × NKU Lider-100, GK Beke's-100 × Bezostaja-100, GK Beke's -300 × Bezostaja-300, Bezostaja-100 × NKU Lider-100, Bezostaja-200 × NKU Lider-200, Bezostaja-300 × NKU Lider-300 hybrid combinations showing high performance in more than one character were determined as promising combinations.

ID: 310 / SES-O-FCP-02: 4

Abstract Submissions

Oral Presentation

Topics: Field Crop Production

Keywords: Kırık Wheat, Populations, Sowing Densities, Yield, Quality

THE EFFECT OF DIFFERENT SOWING DENSITIES ON GRAIN YIELD AND QUALITY TRAITS IN KIRIK WHEAT

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The study conducted during the 2023-2024 growing season at the Tekirdağ Namık Kemal University Faculty of Agriculture experimental area, involved four different Kırık wheat populations and six sowing densities (200, 300, 400, 500, 600, and 700 m²/seed). The study was conducted using a split-plot design with three replications. The study was examined grain yield per decare, thousand-grain weight, test weight, sedimentation value, delayed sedimentation value, wet gluten, wet gluten index, protein content, sunn pest rate, and embryo darkening. According to the obtained data, grain yield varied between 106.5 and 215.00 kg/da. The highest grain yield was obtained with 300 seeds per square meter of kırık population 3 and 400 seeds per square meter of kırık population 4. The lowest grain yield was obtained with 700 seeds per square meter of kırık population 2. The highest grain yield was achieved at 200-300 seed per square meter, while yield decreases occurred at sowing rates greater than 500 seed per square meter. When quality characteristics were examined, significant changes in quality characteristics were observed depending on the population and sowing densities. In the study, wet gluten ratio varied between 26-38%, gluten index varied between 73-97%, test weight values varied between 71.50-80.50 kg/hl, normal sedimentation varied between 34-50 ml, delayed sedimentation varied between 10-48 ml, sunn damage ratio varied between 0.0-3.5%, embryo black point varied between 0.0-1.0% and protein ratio varied between 13.60-17.90%.

GENETICS, BREEDING AND GENETIC RESOURCES

ID: 116 / SES-P-GBGR-02: 5

Abstract Submissions

Poster Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: _breeding value, genomic selection, Holstein-Friesian cattle

IMPORTANCE OF GENOMIC ANALYSIS IN INHERITANCE OF MILK PRODUCTION TRAITS IN HOLSTEIN COWS

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This paper presents the theoretical foundations for evaluating breeding values using traditional methods (progeny testing, pedigree, and performance testing) and genomic analysis. A statistical analysis was also conducted comparing two practical methods for assessing the breeding value of Holstein heifers. Cartilage tissue samples from ear tags were collected for genomic analysis from 71 female calves born between early October 2022 and the end of March 2023. The analysis was conducted at the LABOGENA laboratory in France according to USDA-CDCB standards, comparing the chip with DNA samples and evaluating the impact of 60,000 SNP density markers.

Breeding value assessment based on ancestry averages was carried out using software for genetic positioning, planning, and mating. The reliability of the genomic analysis method for predicting the ability to transmit milk production traits (PTAM, PTAF, PTAP) in female individuals of the Holstein population ranges between 65–70%. The reliability of the same trait estimates using the pedigree method ranges from 35% to 40%. Average values and coefficients of variation for PTAM, PTAF, and PTAP estimated from ancestry are significantly higher than those estimated from genomic analysis. The correlation between the two methods for assessing breeding value in terms of milk yield, protein yield, and fat yield-expressed through Pearson and Spearman coefficients-is positive and strong.

ID: 123 / SES-P-GBGR-02: 3

Abstract Submissions

Poster Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: morphological traits, productive traits, grain yield, productive panicles, linear correlation

CORRELATION ANALYSIS BETWEEN YIELD AND YIELD ATTRIBUTES IN SOME RICE (ORYZA SATIVA L.) VARIETIES

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This research was conducted to examine the correlation between yield and yield attributes in certain rice varieties. The results of the study, which included 15 rice varieties of different origins, are presented. Two of the varieties served as standards for evaluating the other 13 introduced varieties. Seven are commercial varieties from Italy, and the remaining six are from Turkey. The experiment was conducted in 2023 in the Kochani rice production region under its specific agro-climatic conditions, using a randomized block design with four replications. The following attributes were examined: panicle length, panicle mass, number of primary branches per panicle, number of productive grains per panicle, mass of productive grains per panicle, number of productive panicles, and grain yield per m². The results from the analysis of variance in this study showed significant variability for all yield-related traits in rice. High phenotypic and genotypic coefficients of variation were observed for all examined traits. The linear correlation analysis between yield attributes in the examined rice varieties showed that grain yield was significantly and positively influenced by the number of productive panicles per m². Therefore, this trait can be used as a selection criterion in breeding programs to improve the yield of rice varieties. The obtained results were processed and analyzed using analysis of variance, linear correlation, and tested using the LSD test (significance levels of 0.05 and 0.01). The analysis of variance for different genotypes regarding morphological and productive traits showed that all genotypes had statistically significant differences for all examined traits.

ID: 128 / SES-O-GBGR-02: 2

Abstract Submissions

Oral Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: Scanning electron microscopy, pollen tube length, correlation, exine ornamentation

A POSSIBLE INTERDEPENDENCE BETWEEN SOME MORPHOLOGICAL POLLEN FEATURES AND ITS GERMINATION IN FOUR MALUS SP. CULTIVARS

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The palynomorphology and pollen grain germination of four different *Malus* sp. cultivars, namely, 'Eden', 'Fryd', 'Professor Sprenger' and 'Rubinstep' were analyzed in order to determine whether there is a correlation between the characteristics of exine ornamentation and the percentage of germinated grains (%G) and pollen tube length (PTL). Examination of the pollen grain morphological features such as size, shape, polarity, symmetry, exine ornamentation, apertures, length of polar (P) and equatorial axis (E), were made using scanning electron microscopy (SEM). Pollen germination and pollen tube length was determined after 24h of incubation on 5°, 10°, 15° and 20° C. The longest polar axis ($P = 45.50 \pm 3.89 \mu\text{m}$), as well as the equatorial diameter ($E = 25.60 \pm 1.65 \mu\text{m}$), were recorded in the 'Eden'. Pollen shape is prolate, as indicated by the P/E ratio ranging from 1.68 ± 0.22 to 1.86 ± 0.18 . The exine sculpturing is striate with the striae running parallel to the polar axis while the tectum is irregularly perforated. The stria thickness and the groove width did not differ significantly among cultivars, but the highest number of striae per unit area of $5 \times 5 \mu\text{m}$ was found in 'Eden' (39.33 ± 3.57), while the highest number of perforations on the same surface was recorded in 'Rubinstep'. Correlation determined that P/E ratio and stria thickness were negatively correlated to almost all %G and PTL. Number of perforations was negatively correlated with all measured PTLs, while the distance between the striae were positively correlated with all %G and PTL.

ID: 145 / SES-O-GBGR-02: 1

Abstract Submissions

Oral Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: Genetic engineering, Gene editing, Genetically modified crops, CRISPR/Cas9 system, PCR

IDENTIFYING GENETICALLY MODIFIED ORGANISMS (GMOS) IN FOOD PRODUCTS ON THE MONTENEGRIN MARKET

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The term genetically modified organism refers to all types of food whose phenotypic properties have been altered by one of the genetic engineering techniques. People's opinions are divided regarding the safety of GMO consumption. This thesis examines all the benefits, but also assesses the risks of consuming GMOs. The use and labeling of GMOs are regulated by the legal framework. In Montenegro, the use of GMOs is prohibited in the process of food production, and therefore, within the research part of the work, the presence of GMOs in food imported to the Montenegrin market is checked using real-time PCR. The research was conducted to determine the compliance of imported products with domestic legislation. The research part also includes a survey that examines the attitudes of students from different universities in Montenegro about the consumption of GMOs. The survey examines the representation of the topic of genetically modified organisms in the educational system in Montenegro, as well as the influence of different sources of information on the attitudes of students on the mentioned topic.

ID: 155 / SES-P-GBGR-02: 10

Abstract Submissions

Poster Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: yield kg/ha, tobacco, variety, gross income, nicotine.

PRODUCTION CHARACTERISTICS AND NICOTINE CONTENT IN RECOGNIZED ORIENTAL TOBACCO VARIETIES OF THE PRILEP TYPE

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In 2023, eight recognized Prilep-type tobacco varieties were planted at the Scientific Tobacco Institute - Prilep: P 10-3/2 (control), NS 72, Prilep 79-94, Prilep 26, Prilep 123/7, P 66-9, P 76/86 and P 90. The experiment was set up in three replications using the Randomized Block System method. The evaluation of the raw tobacco was conducted according to the current Rulebook for the procurement of raw leaf tobacco of oriental aromatic tobacco types (Official Gazette of the Republic of North Macedonia No. 250/2021).

The aim of this study was to examine the production characteristics: g/plant, kg/ha and gross monetary income (MKD/ha), which were also statistically analyzed using the analysis of variance method (LSD test).

According to the obtained data, the yield in kg/ha ranged from 3,145 kg/ha for the P 66-9 variety to 1,550 kg/ha for the control variety P 10-3/2. All varieties were grown under the same soil and climatic conditions. Their gross monetary income ranged from 919,070 MKD/ha for the P 66-9 variety to 227,442 MKD/ha for the control variety. Due to its higher quality, the P 90 variety showed a higher average price per class during evaluation, amounting to 301.6 MKD/kg. The nicotine content in the tested varieties during this harvest was lower, ranging from 0.86% in P 66-9 to 0.33% in the control variety P 10-3/2. This study provides an overview of the genetic potential of the recognized Prilep-type tobacco varieties.

ID: 168 / SES-P-GBGR-02: 6

Abstract Submissions

Poster Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: Conservation, sustainable use, gene bank.

IN VITRO COLLECTION OF GARLIC (ALLIUM SATIVUM L.) IN THE REPUBLIC OF SRPSKA: ESTABLISHMENT AND CONSERVATION

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Inventory of the local garlic accessions was conducted during 2024 in order to create an in vitro collection within the Gene Bank of the Republic Srpska. Thirteen local genotypes were collected from various regions of the Republic of Srpska: Slivlja, Dobrelji, Mihaljače, Stepen (Gacko), Ljubinje, Bileća, Sitnica, Manjača, Lokvari, Piljagići (Potkozarje), Lijevče polje, and Nevesinje. The aim was to obtain healthy, pathogen-free plant material suitable for further micropropagation, genetic resource conservation, and virus-free production. Plant material included prepared garlic shoots and cloves, where cloves were dissected into five parts to assess regenerative potential. Explants were cultured on standard Murashige and Skoog (MS) nutrient medium under controlled conditions of 22 °C temperature, 13.000 lux light intensity, and a photoperiod of 8 hours light and 16 hours dark. Cultivation lasted 5 weeks under sterile conditions. Shoot regeneration was successfully achieved for genotypes from Dobrelji, Mihaljače, Stepen (Gacko), Ljubinje, Manjača, and Lokvari. Successful regeneration from dissected cloves was observed only in parts containing the basal plate, specifically from genotypes originating from Dobrelji, Mihaljače, Stepen (Gacko), Ljubinje, Sitnica, Manjača, Lokvari, Piljagići (Potkozarje), Lijevče polje, and Nevesinje. Contamination posed a significant challenge, all genotypes showed at least 50% contamination, while those from Slivlja, Bileća, Sitnica and one variety from Stepen (Gacko) exhibited 100% contamination, preventing further cultivation. These results emphasize the need for improved sterilization protocols and careful explant selection to establish a stable and sustainable in vitro garlic collection aimed at its long-term preservation and utilization.

ID: 171 / SES-P-GBGR-02: 2

Abstract Submissions

Poster Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: oriental tobacco, quantitative traits, variability.

BASIC MORPHOLOGICAL CHARACTERISTICS OF ORIENTAL VARIETIES FROM THE TYPES YAKA, DJEBEL AND BASMAK

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Seven oriental varieties, owned by the Scientific Institute of Tobacco – Prilep (three varieties of Yaka, two of Djebel and two of the Basmak type), were examined for morphological traits: plant height with inflorescence, number of leaves per plant and dimensions of leaves from the middle belt. The experiment was set up at the Experimental Field at SIT-Prilep, in 2022, in a randomised block design with four replications, using traditional agricultural practices. Measurements were taken during the budding and flowering stages of plant development.

The results were statistically processed.

The aim of the research is to study the morphological traits of oriental genotypes, to determine the stability of the population through their variability and to highlight the best among the selected assortment.

The examined varieties showed a high degree of homogeneity, as a result of their homozygosity. The coefficient of variation of the traits was less than 10%, which is a sign of their stability. In terms of morphological characteristics, all varieties belong to certain types of tobacco. The varieties JK 141 1 and JK 10-7/ JK 10-7/1 dominated in terms of the number of leaves per plant. JK 261 is distinguished by the largest leaves in the middle zone of the plant, while JK 10-7/1, JK 141 and Dzebel N01 are distinguished by the smallest dimensions. The paper offers valuable data for producers and buyers of oriental tobacco.

ID: 174 / SES-P-GBGR-02: 11

Abstract Submissions

Poster Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: cattle, simmental breed, bulls, quality, future

THE QUALITY OF SIMMENTAL CATTLE COMES FROM THE BREEDING FACILITY OF SIMMENTAL BREEDING BULLS OF SLOVENIA IN MURSKA SOBOTA

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In the long sixty-year history of our own breeding of breeding bulls at the Institute of Agriculture and Forestry Murska Sobota, solid foundations have been laid for the development and future progress of the Simmental breed in Slovenia. The stud bulls and their descendants are the carriers of the best lines that Simmental has on a European and global scale. All these characteristics provide the breeder with a wide range of choice in animal breeding, a huge number of types and combinations of animals, without the risk of inbreeding. Therefore, Simmental is the best combined breed allowing the breeder a double income - from the production of quality milk and quality meat. The quality of Simmental breed is based on the past and is developing into the future.

ID: 178 / SES-P-GBGR-02: 8

Abstract Submissions

Poster Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: Sorghum silage, lactic acid bacteria, 16S rRNA gene, molecular phylogeny, bacterial diversity, silage microbiota

MOLECULAR PHYLOGENETIC CHARACTERIZATION OF LACTIC ACID BACTERIA ISOLATED FROM SORGHUM SILAGES BASED ON 16S RRNA GENE SEQUENCES

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This study presents the phylogenetic characterization of lactic acid bacteria (LAB) isolated from sorghum (*Sorghum bicolor*) silages treated with different microbial inoculants. The objective was to assess the genetic diversity and taxonomic identity of silage-associated LAB using molecular approaches targeting the 16S rRNA gene region. DNA was extracted from representative bacterial colonies isolated from silage samples, and approximately 900 bp fragments of the 16S rRNA gene were amplified via PCR. Sequencing was performed using the Sanger method, and consensus sequences were aligned with reference strains using ClustalW. Phylogenetic trees were constructed employing the Neighbor-Joining algorithm in MEGA software.

The resulting phylogenetic analysis revealed the presence of multiple LAB taxa, including *Lactobacillus buchneri*, *Lactobacillus plantarum*, *Lactobacillus brevis*, and *Weissella cibaria*, with high sequence homology to corresponding type strains. In addition, several isolates showed phylogenetic proximity to non-LAB genera such as *Bacillus safensis*, *B. pumilus*, and *B. zhangzhouensis*. The distribution pattern of isolates demonstrated both intra- and interspecific genetic variation, suggesting a complex microbial ecology influenced by inoculant type and silage environment.

These findings provide valuable insights into the phylogenetic structure of sorghum silage microbiota and contribute to the understanding of functional LAB communities in fermented forages. The study constitutes a molecular component of a doctoral dissertation and underscores the utility of 16S rRNA gene-based phylogenetic analysis in silage microbiology research.

ID: 214 / SES-P-GBGR-02: 7

Abstract Submissions

Poster Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: Tolerance test, wilting, adventitious roots, yellow leaves

INFLUENCE OF WATERLOGGING ON TOLERANCE PERFORMANCE OF SELECTED TOMATO GENOTYPES FROM GENE BANK OF REPUBLIC OF SRPSKA

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Waterlogging is environmental stress that is increasingly occurring throughout the world and it severely influences crop growth and productivity. The aim of this research is to study the impact of waterlogging on two tomato (*Solanum lycopersicum* L.) genotypes from Gene Bank of Republic of Srpska – „Trebinjski sitni“ and „Žuti“ and reference variety „Novosadski jabučar“. The experiment was established in 2023 season. Plants were divided into three groups: F1, F2 and control. F1 plants underwent 24 hours lasting flooding treatment in stage of seedlings with five developed leaves. F2 plants underwent the same treatment and in addition 24 hours lasting flooding treatment in stage of full flowering on the first truss. Control plants were grown under regular non-flooded conditions. One week after the first and second waterlogging treatments, tomato plants were visually scored for waterlogging tolerance and adventitious root formation according to Yeboah et al. (2008) and yellow leaf percentage according to Ezin et al. (2010).

The results of the tolerance test showed that waterlogging was not lethal for any individual plant from F1 and F2 group. In the F1 group, 80 % of the plants formed adventitious roots, while in the F2 group 83.33 % of the plants formed adventitious roots. In the control group, wilting, the formation of adventitious roots and yellowing of the leaves were not observed. The results showed different morphological changes in tomato plants influenced by waterlogging, but none of them were lethal for the plants.

ID: 216 / SES-P-GBGR-02: 4

Abstract Submissions

Poster Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: genetic diversity, seed composition, NIRS analysis, bioactive compounds, breeding potential

EVALUATION OF OIL AND PROTEIN CONTENT VARIABILITY IN CAMELINA GENOTYPES

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Camelina sativa (L.) Crantz, a re-emerging oilseed crop of the Brassicaceae family, has attracted growing attention due to its valuable seed oil composition and high-quality meal. The oil is rich in essential fatty acids and potentially beneficial for human health, while the protein-rich meal has value for animal feed. This study assessed the oil and protein content variability in 20 camelina genotypes selected from diverse origins. A field trial was conducted at the experimental site of Rimski Šančevi, Serbia, and seed composition was analyzed using near-infrared reflectance spectroscopy (NIRS). Oil content ranged from 29.90% to 36.73% (mean 33.22%), while protein content ranged from 29.02% to 35.59% (mean 32.84%). Analysis of variance showed significant genotypic differences ($p < 0.001$), and cluster analysis grouped genotypes into three major clusters with one unclassified genotype. The results confirm the existence of substantial genetic variability, which can be exploited in breeding programs aiming to improve camelina seed composition. As a result of ongoing breeding activities at the Institute of Field and Vegetable Crops (IFVCNS), two camelina cultivars have been developed and commercially released: NS Slatka and NS Zlatka. These findings support the potential of camelina as a source of health-promoting bioactive compounds and contribute to its development as a sustainable crop for food and feed applications.

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ID: 233 / SES-P-GBGR-02: 1

Abstract Submissions

Poster Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: fruit quality, ethylene, allele, breeding

ALLELIC POLYMORPHISM OF MD-ACS1 AND MD-ACO1 GENES IN COLUMNAR APPLE (MALUS × DOMESTICA BORKH.) CULTIVARS

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Ethylene, a crucial plant hormone, plays a pivotal role in regulating the ripening process of climacteric fruits such as apples. Ethylene biosynthesis is directly linked to the induction and progression of ripening, ultimately influencing fruit quality and senescence. Understanding the dynamics of ethylene production in apples is important, as it holds significant implications for optimizing post-harvest handling and extending the storage capabilities of apple fruit, thereby minimizing spoilage and maximizing market availability. Molecular markers for Md-ACS1 and Md-ACO1 were used for the determination of the allelic constitution of ethylene production genes in columnar apples Kraljica cardasa, Vasma and Rumeno vreteno and four commercial apple cultivars (Gala, Red delicious, Golden delicious and Granny Smith). All columnar cultivars were homozygous for the less favorable allele for gene Md-ACO1 and were heterozygous for Md-ACS1. All standard cultivars had genotypes according to previous literature findings. Observed results indicate that all columnar cultivars can be used for further improvement, especially if they are crossed with homozygous cultivars that have low ethylene production.

ID: 280 / SES-O-GBGR-02: 3

Abstract Submissions

Oral Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: Cucumis sativus, SNP analysis, genetic diversity, Macedonian local varieties

SNP-BASED DIVERSITY ASSESSMENT OF MACEDONIAN LOCAL VARIETIES OF CUCUMBER (CUCUMIS SATIVUS L.)

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Cucumber (*Cucumis sativus* L.) is a globally important vegetable crop with substantial diversity in local varieties. Despite their agronomic value, Macedonian local cucumber varieties have not yet been genetically characterized. This study presents the first genome-wide single nucleotide polymorphism (SNP) analysis of 32 Macedonian local cucumber accessions, with the primary objective of assessing genetic diversity and population structure. Thirty SNP markers, evenly distributed across the cucumber genome, were used to genotype diverse local varieties. Genetic relationship analysis grouped the accessions into three main clusters, revealing clear genetic structuring. The first cluster contained a single unique accession, the second comprised 13 genotypes, while the third encompassed the remaining 18 genotypes, indicating higher internal variability. The results show moderate overall diversity, with several closely related accessions suggesting potential genetic erosion. Conversely, the identified distinct genotypes represent valuable material for future breeding. This study emphasizes the importance of conserving and utilizing local genetic resources to broaden the genetic base of cucumber breeding programs. It also establishes a basis for future genetic improvement, targeted conservation strategies, and the potential inclusion of Macedonian local cucumber varieties in regional and international germplasm collections.

ID: 281 / SES-O-GBGR-01: 2

Abstract Submissions

Oral Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: Macedonian scarlet runner bean, unique genetic trait, GWAS, morphological studies, targeted breeding

SNP-BASED ASSOCIATION AND CANDIDATE GENES FOR A NOVEL DEVIATION FROM THE TYPICAL TRIFOLIATE LEAF TRAIT IN PHASEOLUS COCCINEUS

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Scarlet runner bean (*Phaseolus coccineus*) typically has trifoliate (three-leaflet) compound leaves. Until now, no deviations from the typical trifoliate leaf phenotype have been documented in *Phaseolus* species. The aim of this study was to report the first discovery of extended foliation beyond the trifoliate form in *P. coccineus* genotypes. Moreover, a genome-wide SNP analysis was performed to investigate the genetic basis of this novel trait. Principal component analysis (PCA) was applied to assess population structure, and a genome-wide association study (GWAS) was conducted to identify trait-associated loci and possible candidate genes responsible for its expression. A total of 31 Macedonian *P. coccineus* local varieties were genotyped at 1,865 SNP loci after quality filtering. PCA revealed moderate genetic structure, with the >3-leaflet varieties clustering closely, suggesting a shared genetic background distinct from most trifoliate genotypes. GWAS identified SNP loci on chromosomes Pv03, Pv06, Pv08, and Pv10 significantly associated with this novel trait ($p < 0.05$). By uncovering genetic loci associated with this rare foliar phenotype, the present study expands the taxonomic and genetic understanding of leaf morphology in *P. coccineus*, providing new insights for functional genomic studies, targeted trait improvement, and the potential integration of leaf architecture into advanced legume breeding strategies.

ID: 282 / SES-O-GBGR-01: 3

Abstract Submissions

Oral Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: Citrullus lanatus, Macedonian germplasm, SNP markers, Genetic resources conservation

GENETIC DIVERSITY OF MACEDONIAN WATERMELON LOCAL VARIETIES BASED ON SNP ANALYSIS

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Watermelon (*Citrullus lanatus*) is a globally important crop, but Macedonian local varieties remain largely unexplored both phenotypically and genetically. This study presents the first genome-wide single nucleotide polymorphism (SNP) analysis of 22 Macedonian watermelon accessions to assess genetic diversity, population structure, and breeding potential. Thirty-three genome-wide SNP markers were applied for genotyping. Genetic relationship analysis revealed three distinct clusters among Macedonian accessions. Group I contained a single genetically unique accession (W57). Group II comprised 13 closely related accessions (W25, W47, W35, W14, W37, W29, W38, W79, W23, W72, W27, W36 and W4), suggesting a shared genetic background. Group III contained eight accessions (W43, W78, W55, W1, W74, W58, W45, and W39), forming a genetically more diverse cluster. Most Macedonian local varieties carried anthracnose-resistance alleles, a trait absent in several other germplasm sources, making them valuable for disease-resistance breeding. The clustering indicates the presence of unique genetic resources, alongside groups with reduced variability, highlighting the need for targeted conservation to mitigate genetic erosion. The analyzed Macedonian watermelon germplasm exhibits moderate genetic diversity, with certain unique accessions offering strong breeding potential. Conservation and strategic use of these resources, as well as phenotypic and genetic characterization of additional Macedonian watermelon local varieties, are essential to broaden the genetic base of future watermelon improvement programs.

ID: 283 / SES-O-GBGR-02: 4**Abstract Submissions****Oral Presentation***Topics:* Genetics, Breeding and Genetic Resources*Keywords:* Capsicum, agrobiodiversity, morphological traits, cluster analysis, germplasm conservation**DETERMINATION OF GENETIC DIVERSITY OF MACEDONIAN MILD EMBROIDERED PEPPER GENOTYPES BASED ON QUALITATIVE TRAITS****Nadica Sandeva Atanasova, Sonja Ivanovska, Mirjana Jankulovska**

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Macedonian embroidered peppers (*Capsicum annum* L.) represent unique local varieties of exceptional cultural, culinary, and genetic value. Yet, they remain underrepresented in global germplasm characterization. The aim of this study was to assess the genetic diversity of 59 mild embroidered pepper genotypes using 21 qualitative morphological traits associated with plant, stem, leaf, and fruit characteristics. Genetic distances were calculated using Gower's method, and hierarchical clustering (UPGMA) was applied to evaluate relationships among genotypes. The analysis revealed considerable morphological variation, with no duplicates detected, confirming the uniqueness of each genotype. Ten distinct clusters were identified, four of which contained single, highly differentiated genotypes with rare trait combinations, including triangular fruit morphology and uncommon color transitions. The observed diversity highlights the embroidered pepper as a genetically rich and distinctive resource, offering significant potential for breeding programs focused on adaptability, niche markets, and high-value products. Given its strong cultural heritage and rising consumer demand for traditional food products, the conservation of this germplasm is a priority for North Macedonia. Integrating these unique genotypes into global *Capsicum* breeding networks could enhance genetic diversity, broaden breeding options, and safeguard an important element of agricultural biodiversity. This research provides a foundation for future studies and strategic conservation measures, ensuring the continued utilization and preservation of this valuable pepper resource.

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Abstract Submissions

Poster Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: Biodiversity, animal genetic resources, autochthonous breeds, gene bank (in situ and ex situ)

NEW PROGRAM FOR PROTECTION OF BIODIVERSITY IN ANIMAL HUSBANDRY IN THE REPUBLIC OF NORTH MACEDONIA 2025–2031

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The Draft Programme for the Protection of Biodiversity in Animal Husbandry for the period 2025–2031 is a strategic and operational document of the Republic of North Macedonia, aimed at ensuring the systematic protection, sustainable use, and long-term conservation of animal genetic resources. The document has been prepared in accordance with Article 45 of the Law on Animal Husbandry ("Official Gazette of RNM" No. 87/2023) and is aligned with national strategies and international obligations, particularly the four priority areas of the FAO Global Plan of Action for Animal Genetic Resources. The Programme includes the legal framework, an analysis of the status of autochthonous breeds, a review of relevant national and international documents, and a detailed activity plan for the next seven years. It provides for measures such as: characterization, inventory, and monitoring of trends and risks (with a focus on systematic documentation, evaluation, and surveillance of indigenous breeds); support for traditional production systems (emphasizing the sustainable use of genetic resources without disrupting biological balance); establishment and maintenance of gene banks (both in situ and ex situ, focused on the preservation and long-term safeguarding of native breeds); and strengthening of institutional capacities, public awareness, scientific research, and education (emphasizing institutional support and capacity building). This Programme affirms the state's commitment to the preservation of biodiversity in livestock farming as a national asset and a tool for promoting sustainable agriculture, rural development, and climate change adaptation, positioning North Macedonia among the responsible nations on a global scale.

ID: 294 / SES-O-GBGR-01: 4**Abstract Submissions****Oral Presentation***Topics:* Genetics, Breeding and Genetic Resources*Keywords:* conversion, manure, productivity, small grains**MORPHOPHYSIOLOGICAL AND PRODUCTIVE TRAITS OF SMALL GRAINS SPECIES GROWN IN CONVERSION PERIOD****Olivera Nikolić, Zorana Sreckov, Zorica Mrkonjic**

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The paper deals with morphophysiological and productive traits of small grains species grown in system of conversion. The trial was carried out on the property of Agricultural School in Svilajnac, Serbia and included small grains as follows: wheat (Evropa 90, Etida and Milijana), oat (NS Jadar), barley (Atlas) and spelt (Nirvana). It was set up in three replications, with two fertilization variants (control and manure application). The sowing was done on 5th November 2018. Standard agrotechnical procedures were done. The plant samples were taken in maturity phase, 10 plants per replication, for each sowing densities and fertilization variants. The next traits were measured: plant height, head length, number of grains per head, mass of 1000 grains and hectoliter mass. Results were statistically processed by two - factorial analysis of variance. Applied manure caused differences among studied traits, increasing them for 10 - 15% in relation to control variant. Manure use did not cause lodging of plants, except in the barley crop. The best results for head length were registered in oat (14,66cm in control and 20,66cm in fertilized variant). This species obtained the largest number of grains per head (38,66) as well as wheat genotype Evropa 90 which obtained 31.83 and 37.63 grains per head in control and fertilized variant, respectively. Evropa 90 showed the largest grains mass per head in both of variants that is good precondition for grain yield. Evropa 90 and NS Jadar were registered as important regarding to organic agricultural practice, but small grains selection and breeding, too.

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Abstract Submissions

Oral Presentation

Topics: Genetics, Breeding and Genetic Resources

Keywords: sheep populations, genomic signatures, environmental adaptation

GENOMIC BASES OF ENVIRONMENTAL ADAPTATION IN MONTENEGRIN SHEEP POPULATIONS

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Understanding of environmental adaptation in local livestock breeds is essential for conserving genetic diversity and promoting sustainable agriculture under conditions of environmental change. The indigenous sheep breeds of Montenegro represent valuable genetic resources shaped by long-term adaptation to diverse mountainous and Mediterranean ecosystems. The aim of this study was to identify genomic regions associated with environmental adaptation in sheep populations by integrating ecological characterization with genome–environment association analyses. Environmental clusters were defined using historical climatic data (1979–2018), capturing spatial and seasonal variation relevant to traditional grazing systems. Three clustering schemes were applied: winter, summer, and a composite cluster integrating both seasons. Genomic data, obtained through SNP array genotyping, were analyzed using latent factor mixed models (LFMM2) to detect genotype–environment associations while accounting for population structure. The analysis identified five single nucleotide polymorphisms significantly associated with specific environmental clusters. Strong signals were detected on chromosomes 2 and 24 under winter and composite conditions, and on chromosome 1 in relation to summer environments. Candidate gene annotation within ± 40 kb of these SNPs identified genes involved in cellular stress response, osmoregulation, metabolic regulation, and growth pathways, including NPR2, CREB3, TFR2, and TMEM8B. Breed-specific patterns of environmental association corresponded with traditional management practices, including transhumance and stationary grazing. This integrative approach highlights the genomic basis of adaptation in Montenegrin sheep, emphasizing the role of environment-driven selection in shaping genetic diversity and resilience. The results provide a valuable foundation for conservation efforts and breed improvement programs aimed at sustaining local livestock production under current and future climatic challenges.

ID: 317 / SES-P-GBGR-02: 12**Abstract Submissions****Poster Presentation***Topics:* Genetics, Breeding and Genetic Resources*Keywords:* Crop Wild Relatives, Pre-breeding, Genetic Diversity, Malus, Pyrus, Prunus, Multi-omics, Horizon Europe**EXPLOITING THE UNTAPPED POTENTIAL OF FRUIT TREE WILD DIVERSITY FOR SUSTAINABLE AGRICULTURE (FRUITDIV PROJECT)****Vlatko Andonovski¹, Nikolco Velkovski¹, Viktorija Brndevska Stipanovic¹, Ivana Janeska Stamenkovska²**¹University Ss. Cyril and Methodius in Skopje, Hams Em-Faculty of Forest Sciences, North Macedonia, Republic of; ²University Ss. Cyril and Methodius in Skopje, Faculty of Agricultural Sciences and Food- Skopje; vandonovski@sf.ukim.edu.mk

The domestication of fruit trees has resulted in a significant genetic bottleneck, limiting the resilience of modern cultivars to abiotic and biotic stresses driven by climate change. Crop Wild Relatives (CWR) of major pome (apple, pear) and stone (cherry, plum, etc.) fruits represent a critical, yet underutilized, reservoir of genetic diversity for traits like disease resistance and drought tolerance. The FRUITDIV project, a 5-year Horizon Europe initiative (2024-2028), aims to systematically monitor, characterize, use, and conserve the diversity of fruit tree CWR to enhance the sustainability and climate resilience of European fruit production. A multidisciplinary consortium of 27 partners from 14 countries employs an integrated approach across six core research work packages. This includes: (1) creating a comprehensive CWR inventory; (2) advanced genotypic and ex-situ phenotypic characterization; (3) developing multi-omics resources for data analysis and sharing; and (4) using these data to strategically introduce CWR alleles into pre-breeding programs. FRUITDIV will generate and make publicly available a suite of resources, including a detailed CWR knowledge base, genomic datasets, phenotyping data on valuable agronomic traits, and novel pre-breeding plant materials. The project will also deliver frameworks for the sustainable conservation and economic valuation of CWR genetic resources. By bridging the gap between conservation and breeding, FRUITDIV will unlock the genetic potential of wild fruit species. The project's outputs are designed to provide breeders and farmers with the tools and genetic material needed to develop robust fruit varieties, ensuring the long-term productivity and sustainability of European agriculture.

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