University of Banja Luka
Faculty of Agriculture

XV INTERNATIONAL SYMPOSIUM ON AGRICULTURAL SCIENCES

AGRORES
2026

BOOK OF ABSTRACTS

25-28 May 2026, Trebinje, Bosnia and Herzegovina

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25-28 May 2026, Trebinje, Bosnia and Herzegovina

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South Eastern Europe
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Symposium Program

SYMPOSIUM PROGRAM OVERVIEW
25-28 May 2026

Monday, 25 May 2026		
12.00 – 19.00	Participant Registration	Hotel Leotar, Lobby
17.00 – 17.30	Opening Ceremony	HET Hall
17.30 – 19.00	Plenary Session	HET Hall
19.00 – 20.00	Welcome Cocktail	Hotel Leotar
Tuesday, 26 May 2026		
08.30 – 17.00	Participant Registration	Hotel Leotar, Lobby
08.30 – 14.00	Session 1: Horticulture	Hotel Leotar, Large Salon
09.00 – 13.30	Session 2: Agricultural Economics and Rural Development	Hotel Leotar, Red Salon
17.30 – 18.30	Book promotion	Hotel Leotar, Large Salon
20.00 – 21.00	Concert	Trebinje Cultural Centre
Wednesday, 27 May 2026		
08.30 – 17.00	Participant Registration	Hotel Leotar, Lobby
09.00 – 13.30	Session 3: Crop Science	Hotel Leotar, Large Salon
09.00 – 12.10	Session 4: Animal Science	Hotel Leotar, Red Salon
15.00 – 17.00	Round Table: Best Practices in Developing Prosperous and Connected Rural Communities	Hotel Leotar, Large Salon
20.00	Gala Evening	Hotel Leotar, Restaurant
Thursday, 28 May 2026		
09.00 – 12.00	Excursion: Visit to Grančarevo Dam	

Monday, 25 May 2026

17.00 - 17.30	**OPENING CEREMONY**	HET Hall
	– Zlatan Kovačević, Dean of the Faculty of Agriculture, University of Banja Luka – Radoslav Gajanin, Rector of the University of Banja Luka – Anđelka Kuzmić, Minister of Agriculture, Forestry and Water Management of the Republic of Srpska – Draga Mastilović, Minister of Scientific and Technological Development and Higher Education of the Republic of Srpska – Mirko Ćurić, Mayor of the Trebinje City – Boris Pašalić, President of the Organizing Committee	

	PLENARY LECTURES	HET Hall
17.30 - 18.00 PL_01	Bridging science and practice: The role of applied research as interface between stakeholders in the fruit growing sector *Martin Penzel, Andreas Winkler, Elisabeth Schwitzky*	
18.00 - 18.30 PL_02	Organic forms of microelements - New horizons in modern animal nutrition *Dejan Perić, Dragan Šefer, Stamen Radulović, Dragoljub Jovanović, Branko Brkić, Radmila Marković*	
18.30 - 19.00 PL_03	Transforming research through immersive data analytics *Ivan Đurić*	

19.00 - 20.00	**WELCOME COCKTAIL**	Leotar Hotel

Tuesday, 26 May 2026

Session 1	**HORTICULTURE**
	Leotar Hotel, Large Salon | *Moderators: Miljan Cvetković, Dragana Šunjka*
08.30 - 08.40 O1_01	Knowledge transfer in hazelnut production: Networking is key for improving the sector *Penzel Martin, Schmiediger Hanna, Kleinschuster Anna, Riemer Natalia*
08.40 - 08.50 O1_02	Rootstock effects on growth, fruit quality, and yield of 'Gala' apple clones *Željana Balać, Maja Milović, Biserka Milić, Nenad Magazin, Gordana Barać, Stefan Gligorić*
08.50 - 09.00 O1_03	Root-associated beneficial microorganisms improve nutrient use efficiency and fruit functional quality in sustainable raspberry production *Marijana Pešaković, Jovana Todorović, Tamara Krstić Tomić, Jelena Tomić, Boris Rilak, Žaklina Karaklajić Stajić, Dragana Vranić*
09.00 - 09.10 O1_04	Agrisolar – Application of photovoltaic technologies in agriculture *Dragan Milićević, Bane Popadić, Boris Dumnić, Amar Hajdarpašić, Ivica Đalović, Siniša Mitrić, Tatjana Jovanović – Cvetković, Miljan Cvetković*
09.10 - 09.20 O1_05	Application of bacteriophages and antimicrobial peptides for the control of *Xylella fastidiosa* in Italy *Toufic El Beaino, Orges Cara, Miloud Sabri*
09.20 - 09.30 O1_06	Fruit concentrates as functional ingredients for polyphenol-enriched frozen desserts: Chemical, antioxidant, and antimicrobial characterization *Tatjana Radovanović Vukajlović, Aleksandra Žugelj, Darja Vrečar Badalič, Magdalina Mihajlovska, Tara Seničić, Valentina Ratoša, Anuša Skušek, Elizaveta Kunina, Duygu Delican, Mahmoud Ahmed, Kira Arčon, Mitja Martelanc, Lorena Butinar, Branka Mozetič Vodopivec*
09.30 - 09.40 O1_07	Modulation of aromatic, phenolic, and sensory attributes of pinela wines through different maceration approaches *Magdalina Mihajlovska, Melita Sternad Lemut, Guillaume Antalick, Marko Lesica*
09.40 - 09.50 O1_08	Tracing the pathways of zelen typicality: The role of maceration and fermentation strategies *Tara Seničić, Diana Alexandra Martin Rojas, Tatjana Radovanović Vukajlović, Guillaume Antalick, Lorena Butinar*
09.50 - 10.00 O1_09	Variability of morphological and chemical traits in grapevine seedlings derived from the Blatina × Vranac cross *Tatjana Jovanović - Cvetković, Anđela Bujić, Rada Grbić, Ana Miladinović*
10.00 - 10.10 O1_10	Quantifying resource use in Slovenian viticulture: A survey-based assessment *Jan Reščič, Špela Nusdorfer, Jelena Topić Božič*
10.10 - 10.20 O1_11	Organic vs. conventional viticulture: Implications for stilbene content in grapes *Aleksandra Šušnjar, Siniša Mitrić, Sanja Lazić, Jelena Ećimović, Dragana Šunjka*
10.20 - 10.30 O1_12	Integrating biocontrol and oenological functionality: The potential of indigenous yeasts in vineyard–winery systems *Melita Sternad Lemut, Jan Reščič, Erika Jež, Rowland Adetayo Adesida, Lorena Butinar*

10.30 - 10.45	Discussion
10.45 - 11.10	Coffe Break
	| *Moderators: Marijana Pešaković, Dragan Miličević*
11.10 - 11.20 O1_13	Influence of plant growth regulators and LED lights on in vitro rooting and ex vitro acclimatization of lavander (*Lavandula angustifolia* L.) *Jelena Davidović Gidas, Sunčica Bodružić, Svjetlana Zeljković*
11.20 - 11.30 O1_14	The influence of planting site on tree architecture: A case study of *Acer platanoides* 'Crimson King' in green areas of Novi Sad *Olivera Kalozi, Vanja Vuksanović, Lazar Pavlović, Milica Kovač, Emina Mladenović*
11.30 - 11.40 O1_15	Kamenica park in Novi Sad – Natural and cultural heritage of Serbia *Mirjana Mlađenović*
11.40 - 11.50 O1_16	Antifungal potential of aqueous extract from *Nigella sativa* processing waste against phytopathogenic fungi *Jelena Mihić Salapura, Mihajlo Voruna, Nataša Pejaković, Duška Delić*
11.50 - 12.00 O1_17	Beekeepers' perceptions of pollination service management in Bosnia and Herzegovina: Survey data from the EU COST "Super B" Project and a review of EU and local subsidy policies *Violeta Santrač, Gordana Đurić, Dragana Rujević, Zora Čolović-Šarić*
12.00 - 12.10 O1_18	Investigation of pepper-infecting viruses and viroids in greenhouse cultivation in Albania *Orges Cara, Klevis Hoxhallari, Amani Ben Slimen, Jordan Merkuri, Magdalena Cara, Toufic Elbeaino*
12.10 - 12.30	Discussion
12.30 - 13.45	Poster Presentations: P1_01 – P1_60 | *Moderators: Jelena Davidović Gidas, Martin Penzel*
13.45 - 14.00	Discussion

Session 2 AGRICULTURAL ECONOMICS AND RURAL DEVELOPMENT

Leotar Hotel, Red Salon | *Moderators: Vesna Mrdalj, Sebastian Stępień, Ludovic Andres*

09.00 - 09.10 O2_01	Development of the National guidelines and action plan for climate change adaptation in agriculture in the Republic of Serbia *Dragana Vidojević, Dragana Drobnjak, Nenad Katanić, Darko Konjević*
09.10 - 09.20 O2_02	Standardisation of factor suitability assessment for different types of agricultural production in Slovenia *Lovro Sinkovič, Aleš Kolmanič, Branko Lukač, Matej Stopar, Klemen Lisjak, Klara Čevka, Janez Bergant*
09.20 - 09.30 O2_03	State and development trends of organic plant production in the Republic of Serbia *Jelena Lekić, Mihajlo Munćan*
09.30 - 09.40 O2_04	Strengthening Agricultural Knowledge and Innovation Systems (AKIS) to support the transition to organic beekeeping: a case study from Montenegro *Aleksandar Martinović, Mirsad Spahić, Dragana Šutović*

09.40 - 09.50 O2_05	Applying the value proposition canvas to farmers' markets: NCHU organic farmer market in Taichung, Taiwa *Ema Bahledova, Shang-Ho Yang, Ivo Zdrahal*
09.50 - 10.00 O2_06	Organic food as a path to sustainable and healthy living: Consumer behavior and market trends *Bojana Ostojić, Drago Cvijanović, Božo Ilić*
10.00 - 10.10 O2_07	Agro-ecotourism as a tool for sustainable rural development and economic diversification: Evidence from North Macedonia *Marija Gjosheva Kovachevikj, Despina Popovska Stojanov, Vesna Mrdalj, Lazo Dimitrov*
10.10 - 10.20 O2_08	Corporate valuation of agricultural enterprises for informed investment decision-making *Dragan Dokić, Vera Popović, Miroslav Nedeljković, Boris Ljubojević, Vesna Gantner*
10.20 - 10.30 O2_09	Green management as a tool supporting the sustainable development of the food value chain in agriculture *Arkadiusz Dyjakon, Stanislav Minta, Tomasy Noszczyk, Lukasz Sobol*
10.30 - 10.40 O2_10	Activation of youth in rural development processes *Petar Nikolić, Marija Ilić, Dejan Ilić*
10.40 - 10.50 O2_11	A comprehensive assessment of drought impacts on wetland ecosystems: Integration of economic, ecological, and socio-demographic perspectives *Senka Ždero, Zorica Srđević, Radoš Zemunac, Bojan Srđević*
10.50 - 11.00 O2_12	Managerial capabilities of crop producers in Central Banat *Sandra Pauljev, Dragan Ivanišević*
11.00 - 11.20	Coffee break
	| *Moderators: Nemanja Jalić, Karmen Pažek, Ivo Zdráhal*
11.20 - 11.30 O2_13	Agricultural value chain teaching in Poland: Limited offer, strong demand for practice *Bartłomiej Bajan, Karolina Pawlak, Natalia Genstwa-Namysł, Joanna Łukasiewicz, Ludovic Andres*
11.30 - 11.40 O2_14	Young consumers' engagement in short food supply chains - A Case study from Poland and Romania *Sebastian Stępień, Katarzyna Smędzik-Ambroży, Silvia Maican*
11.40 - 11.50 O2_15	Mapping higher education training modules related to the agricultural value chain in France *Sonia Gbebewoo, Daniel Kalnin, Ludovic Andres*
11.50 - 12.00 O2_16	The impact of storage capacity on the integration of local foods in school catering: Evidence from the Czech Republic *Ivo Zdrahal, Eliska Svobodova, Marika Tkacova, Nemanja Jalić, Nino Chkhartishvili, Sona Raszkova*
12.00 - 12.10 O2_17	Challenge of malting barley value chain in France *Ludovic Andres, Sonia Gbeblewoo*
12.10 - 12.20 O2_18	Structural changes and supply elasticity of potato production: The case of Slovenia *Črtomir Rozman, Karmen Pažek, Lazar Pavić, Tina Lešnik*
12.20 - 12.30 O2_19	Geographical indications of food products and their contribution to the economic development of rural areas: An empirical analysis in BiH *Dragan Brenjo, Sanin Tanković, Slobodan Dojčinović, Novo Pržulj*
12.30 - 13.00	Poster presentations: P2_01 – P2_28 | *Moderators: Željko Vaško, Dragana Vidojević, Lovro Sinkovič*
13.00 - 13.30	Discussion

17.30 - 18.30	**Presentation of book "*Dr. Luka Ćuk - A Life Story*"** *Dr Pavle Sklenar, moderator* *MSc. Zoran Vuković, reviewer* *Dr Branislav Dozet, author*	Leotar Hotel, Large Salon
20.00 - 21.00	**Concert by the City Choir "Tribunia"**	Trebinje Cultural Centre

Wednesday, 27 May 2026

Session 3	**CROP SCIENCE**
	Leotar Hotel, Large Salon | *Moderators: Sava Vrbničanin, Željko Dolijanović, Branimir Nježić*
09.00 - 09.10 O3_01	Frequence of the Fibonacci sequence of disc-florets in four genotypes of sunflower *Branislav Dozet, Kristof Poor, Gergo Makai*
09.10 - 09.20 O3_02	Plant microbiome for climate-smart agriculture: Integrating flipped learning and design thinking in higher education (Bioshield project) *Silva Grobelnik Mlakar, Manfred Jakop, Primož Titan, Danijel Davidović*
09.20 - 09.30 O3_03	Variation of weight of spike in wheat varieties *Dušan Urošević, Desimir Knežević, Vesna Kandić Raftery, Mirela Matković Stojšin, Danijela Kondić, Vesna Đurović, Veselinka Zečević*
09.30 - 09.40 O3_04	On- and off-site impacts of different land management practices related to soil health and flood control within small watersheds of Celinac in BiH *Jovana Aškrabić*
09.40 - 09.50 O3_05	Uncovering a sustainable system that enhances dietary fiber accumulation in grains *Milena Šenk, Milena Simić, Dušanka Milojković-Opsenica, Margarita Dodevska, Milan Brankov, Vesna Perić, Vesna Dragičević*
09.50 - 10.30	Poster presentations: P3_01 – P3_27
10.30 - 10.50	Discussion
10.50 - 11.20	Coffee break
	| *Moderators: Zoran Jovović, Branislav Dozet, Borislav Petković*
11.20 - 11.30 O3_06	Advantages and disadvantages of non-chemical weed management: Case study of medicinal and aromatic plants *Sava Vrbničanin, Dragana Božić, Teodora Tojić, Markola Saulić*
11.30 - 11.40 O3_07	Synergy of traditional and modern approaches in biotechnology and digital agriculture for sustainable food production and public health *Aleksandar Stevanović, Snežana Knežević, Markola Saulić*

11.40 - 11.50 O3_08	Integrating soil seed bank and aboveground vegetation for prediction of weed dynamics in soybean production *Markola Saulić, Aleksandar Stevanović, Marko Kovačević, Sava Vrbničanin, Ivica Đalović*
11.50 - 12.00 O3_09	Buckwheat response to abiotic stresses: effect of hail on different cultivars *Getalew Chana, Gabriela Alandia, Emanuele De Paoli, Alessandra Virili, Elisa Marraccini*
12.00 - 12.10 O3_10	Total phenolic content and antioxidant potential of the traditional wheat landrace *Duška Delić, Vojo Radić, Relja Suručić*
12.10 - 12.20 O3_11	Basic characteristics of the agricultural land in the Republic of Srpska *Tihomir Predic, Stefan Jovanovic, Tatjana Cvijanovic*
12.20 - 13.00	Poster presentations: P3_28 – P3_49
13.00 - 13.30	Discussion

Session 4 ANIMAL SCIENCE

Leotar Hotel, Large Salon | Moderators: Zlatan Sarić, Sara Popadić, Marinko Vekić

09.00 - 09.10 O4_01	Digital technologies in dairy farming: implications for efficiency, sustainability, and animal welfare in North Macedonia and Croatia *Gjoko Bunevski, Bratislav Pešić, Boris Ljubojević, Mirna Gavran, Aboubacarr Jallow, Vesna Gantner*
09.10 - 09.20 O4_02	Regional variability in milk production, milk urea nitrogen, and ammonia emissions in dairy cows in Croatia *Mirna Gavran, Dragan Solić, Vesna Gantner*
09.20 - 09.30 O4_03	Regional differences in milk production traits and mastitis prevalence in Holstein cows *Boris Ljubojević, Zvonimir Steiner, Dragan Solić, Maja Gregić, Dragan Dokić, Vesna Gantner*
09.30 - 09.40 O4_04	A comparative study of production performance of *Zophobas morio* and *Tenebrio molitor* as alternative protein sources in animal diets *Miroslava Polovinski Horvatović, Marko Vukadinović, Saša Krstović, Miloš Petrović, Nikola Laćarac, Igor Jajić, Dejan Beuković, Mirko Ivković*
09.40 - 09.50 O4_05	Effects of whey and highly digestible protein sources in starter feeds on growth performance and morphometric development of Holstein calves *Zvonimir Steiner, Stipo Benak, Boris Ljubojević, Vesna Gantner*
09.50 - 10.00 O4_06	Phenotypic description of the Lipizzan horses from the Republic of Srpska *Slađana Janković, Biljana Rogić, Milica Ćutković, Božo Važić*
10.00 - 10.10 O4_07	Evaluation of the body conformation of Arabian horses originating from Borike based on body indices *Milica Ćutković, Biljana Rogić, Nidal Korabi, Slađana Janković, Božo Važić*
10.10 - 10.20 O4_08	The impact of learning theory knowledge on improved horse welfare *Maja Gregić, Tina Bobić, Dragan Dokić, Boris Ljubojević, Vesna Gantner*
10.20 - 10.30 O4_09	Social network analysis in pigs: Insights into social organisation, behaviour, and welfare in pig production systems *Sara Popadić, Maja Prevolnik Povše, Janko Skok*

10.30 - 10.40 O4_10	Majevički dimljeni sir Zarac - Production and quality characteristics *Zlatan Sarić, Duška Mitrović, Željko Kerović, Naida Mahmić, Nevena Barać, Miroljub Barać, Dragan Brenjo*
10.40 – 10.50 O4_11	Agricultural resources and development opportunities in the Gambia *Vesna Gantner, Aboubacarr Jallow, Mbye Saine, Boris Ljubojević*
10.50 - 11.10	Discussion
11.10 - 11.30	Coffee break
11.30 - 11.50	Poster presentations: P4_01 – P4_09
11.50 - 12.10	Discussion

15.00 - 17.00	**Round Table: Best Practices in Developing Prosperous and Connected Rural Communities** *Predrag Ćurković – moderator* ** This part of the program is in Serbian.*	Leotar Hotel, Large Salon

20.00	**Gala Evening**	Leotar Hotel, Restaurant

Thursday, 28 May 2026

09.00 - 12.00	**Excursion** Visit to Grančarevo Dam

LIST OF THE POSTER PRESENTATIONS

Session 1: HORTICULTURE	
P1_01	Pomological characteristics and productivity of newly developed plum cultivars from the Fruit Research Institute, Čačak *Nebojša Milošević, Ivana Glišić, Milena Đorđević, Sanja Radičević, Slađana Marić*
P1_02	Characterization of sour cherry (*Prunus cerasus* L.) genetic diversity using microsatellite markers *Goran Barać, Davor Bajić*
P1_03	New flat peach cultivar 'Darinka' *Dragan Nikolić*
P1_04	Flowering phenology, tree vigor and yield of sour cherry cultivars grafted on Gisela 5 rootstock *Stefan Gligorić, Biserka Milić, Nenad Magazin, Maja Milovic, Jelena Kalajdžić, Gordana Barać, Željana Balać*
P1_05	Morphological variability of cherry plum (*Prunus cerasifera* L.) populations in the Doboj region *Ljubomir Radoš, Ermin Suljkanović, Tanja Krmpot, Borut Bosančić, Mirela Kajkut Zeljković*
P1_06	Branching induction in plum and sweet cherry nursery plants using bioregulators *Ivana Glišić, Jelena Savićević, Milena Đorđević, Slađana Marić, Nebojša Milošević, Sanja Radičević*
P1_07	Grafting of autochthonous apple cultivars on M9 and MM106 rootstock *Predrag Ilić, Zlatan Ristić, Sonja Umićević, Mirela Kajkut Zeljović, David Ducanović*
P1_08	Experiences with multi-axis training systems in stone fruit production *Miljan Cvetković*
P1_09	Impact of training system and cultivar on pruning efficiency in plum orchards *Jelisaveta Seka Cvijanović, Jelena Davidović Gidas, Milana Kočić, Miljan Cvetković*
P1_10	The influence of training systems on the vegetative and generative potential of the plum cultivar "Čačanska lepotica" *Danilo Vidović, Borut Bosančić, Miljan Cvetković, Boban Đorđević*
P1_11	Plant growth regulators improve vegetative growth and yield in 'Duke' highbush blueberry *Milana Kočić, Borut Bosančić, Miljan Cvetković, Jelisaveta Seka Cvijanović, Biserka Milić*
P1_12	Stomatal conductance responses of two blackcurrant cultivars under water stress *Nataša Čereković*
P1_13	Improving fruit set and quality of 'Williams' pear using biostimulants and plant growth regulators *Biserka Milic, Jelena Savićević, Nenad Magazin, Maja Milović, Stefan Gligorić, Gordana Barać*
P1_14	Morphological characteristics of one-year-old walnut (*Juglans regia* L.) shoots *Slađana Janković, Jelena Stanković, Zoran Jovanović, Ivana Jasnić, Dragan Janković*
P1_15	Color and antioxidant activity in light colored traditional autochtonous apple varieties *Zlatan Ristić, Boris Pašalić, Marina Antić, Mirjana Žabić, Predrag Ilić, Sonja Umićević, David Ducanović, Borut Bosančić*
P1_16	Post-harvest fruit handling processes: From placement to waste valorization *Srđan Lakić, Sanda Stanivuković, Boris Pašalić*

P1_17	Digital twins in strawberry cultivation: A systematic literature review *Effrosyni Bitakou, Nikola Kopilović, Maria Ntaliani, Konstantinos Demestichas, Constantina Costopoulou*
P1_18	Cultivar differences in apple fruit chemical quality as a basis for agrivoltaic orchard systems *Miroslav Lisjak, Jelena Ravlić, Marija Špoljarević, Josipa Jović, Anđelo Zdrilić, Marko Zorica, Šimun Kolega, Tomislav Kos*
P1_19	Measures that affect the functionality and efficiency of sprayer during application of protective agens *Zoran Maličević, Milan Jugović, Marko Kuzman*
P1_20	Natural strategies for pest control in agriculture *Dragana Šunjka, Sanja Lazić, Aleksandra Šušnjar, Jelena Ećimović*
P1_21	Detection of Plum pox virus in autochthonous stone fruit collections and orchards in the Republic of Srpska *Borut Bosančić, Sonja Umićević, Mirela Kajkut-Zeljković, Predrag Ilić, Stefani Tepić, Biljana Lolić*
P1_22	Flight dynamics of codling moth (*Cydia pomonella*) and performance of aged pheromone lures *Selma Hairić, Branimir Nježić*
P1_23	Incidence of root rot caused by *Phytophthora fragariae* var. *rubi* on blackberry in the Republic of Srpska *Biljana Lolić, Stefani Tepić, Sonja Umićević*
P1_24	Leaf spot symptoms of Loquat (*Eriobotrya japonica*) in Montenegro *Bogoljub Kandic, Jelena Latinović, Tatjana Popović Milovanović, Nedeljko Latinović*
P1_25	Establishing the "Slivovica Srpske" standard: A multidisciplinary framework for quality protection and cultural safeguarding *Branko Drljača, Branimir Nježić, Borut Bosančić*
P1_26	The influence of water stress on yield and berry composition of cv. Vranec (*Vitis vinifera* L.) *Klime Beleski, Dushko Nedelkovski, Viktor Rajchin, Riste Gjorgjiev*
P1_27	Technological characteristics of the newly introduced grapevine Souvignier gris cv. grown in the Telečka wine region *Nebojša Marković, Zoran Pržić, Andreja Preković*
P1_28	Factors for the limited distribution and possibilities for selection and revitalization of autochthonous table varieties of *Vitis vinifera* L. *Biljana Korunoska, Krum Boškov, Zlatko Prculovski*
P1_29	The quality of cold macerated Žilavka wines *Tatjana Jovanović-Cvetković, Rada Grbić, Nikolina Prodanović, Ljiljana Topalić-Trivunović, Ana Velemir, Aleksandar Savić*
P1_30	Effect of clonal variability of Chardonnay cultivar on phenological development, yield and quality of grapes and wine in agroecological conditions of Ćemovsko polje *Milena Mugosa, Sanja Radonjić, Biljana Knežević, Zorka Đapić, Milovan Mandić, Danilo Savović*
P1_31	Evaluation of UAV-based multispectral vegetation indices for disease and stress detection in vineyards *Irina Marina Stević, Biljana Bošković, Danijela Živojinović, Darko Jaramaz, Zorica Ranković Vasić, Jonel Subić, Miloš Pajić*
P1_32	Climate change and their impact on grape and wine quality cv. Riesling Italico and Sila on the terroir Fruška Gora *Olivera Šumenković, Milica Glišić, Danijela Živojinović, Andreja Preković, Saša Matijašević, Zoran Pržić, Zorica Ranković- Vasić*

P1_33	Survey of Flavescence Dorée phytoplasma in grapevine in Montenegro *Tamara Popović, Bojan Duduk*
P1_34	Characterizing Prokupac red wines: Consensus vocabulary development and descriptive sensory profiling *Federica Bonello, Darko Jaksic, Vasiliki Ragkousi, Maurizio Petrozziello, Stefana Urbancl, Sasa Savic, Ivan Bradic*
P1_35	Implementation of the HACCP system in the production, packaging and storage of wine at Jungić winery *Slobodan Jović, Sanda Stanivuković, Boris Pašalić, Tatjana Jovanović-Cvetković*
P1_36	Comparative in vitro study of essential oils against *Botrytis cinerea* *Jelena Ećimović, Aleksandra Šušnjar, Jozef Gašparovski, Sanja Lazić, Dragana Šunjka*
P1_37	Sensory evaluation of grape rakija: Expert vs. consumer panels *Viktor Rajchin, Marija Gjosheva Kovachevikj, Milena Taseska-Gjorgjijevski, Goran Milanov, Klime Beleski, Roze Djolevska Milenkovska, Dushko Nedelkovski*
P1_38	Topographic terroir modelling for evidence-based delineation of grape production zones for the future GI Armenian brandy *Darko Jaksic, Veljko Perovic, Tigran Hayrapetian, Ivan Bradic, Mikayel Mikayelyan, Aramayis Mkrtchyan, Stepan Davtyan*
P1_39	Morpho-numeric characterisation of Slovenian garlic varieties (*Allium sativum* L.) *Lovro Sinkovič, Mojca Škof, Barbara Pipan*
P1_40	Fruit characterization of local pepper landraces from the Republic of Serbia *Dario Danojević, Srđan Zec, Slađana Medić-Pap*
P1_41	Effect of biostimulants and colloid silver and copper on yield, sugar content and vitamin C content in sweet pepper (*Capsicum annuum* L.) *Milica N. Momirovic, Mihajlo V. Jakanovski, Đorđe Ž. Moravčević, Dušanka M. Milojković-Opsenica*
P1_42	Biocontrol agents for enhancing bioactivity of *Petroselinum crispum* in sustainable production and disease management *Snezana Dimitrijevic, Vladimir Filipović, Marija Milić, Vera Popović, Elmira Saljnikov, Svetolik Maksimović, Violeta Mickovski-Stefanović*
P1_43	Seed morphological variation in common bean germplasm form the Gene Bank of the Republic of Srpska *Sonja Umićević, David Ducanović, Stefani Tepić, Mirela Kajkut Zeljković, Biljana Lolić, Jelena Nikitović, Predrag Ilić, Zlatan Ristić, Sunčica Bodružić, Marina Antić*
P1_44	Climate adaptation in protected cultivation: Can modern plastic greenhouses match glasshouse productivity? *Đorđe Ž. Moravčević, Sofija Kilibarda, Sandra Vuković, Milica Momirović, Milica Stojanović, Ana Vujošević*
P1_45	Seedling preparation for hydroponic vegetable production – a case study *Olivera Nikolić, Zorana Srećkov, Zorica Mrkonjić*
P1_46	Cultivation of *Pleurotus ostreatus* on substrates containing municipal sewage sludge *Erik Mihelič, Katarina Zavrl, Vid Kolmanič Bučar, Marjana Simonič, Olivija Plohl*
P1_47	Pathogenicity of *Fusarium* species and their impact on pepper seed germination *Slađana Medić-Pap, Olivera Popov, Sonja Tančić Živanov, Dario Danojević*
P1_48	Results of seven-year survey of the presence of ´*Candidatus* Liberbacter solanacearum´ in Republic of Srpska *Vojislav Trkulja, Gordana Babić, Bojana Ćurković, Bojana Vukovic, Jovana Prijic, Bogdan Nedic, Aleksandra Dobričanin*

P1_49	Distribution of northern root-knot nematode *Meloidogyne hapla* in potato fields in Republic of Srpska *Andrija Vasilić, Radijana Đekanović, Nikola Grujić, Branimir Nježić*
P1_50	Effects of hydrogel and zeolite on growth and ornamental quality of *Salvia splendens* 'Vista Red' *Emina Mladenović, Lazar Pavlović, Vanja Vukasanović, Olivera Kalozi, Milica Kovač*
P1_51	The effect of two different fertilizers on the quality of *Begonia semperflorens* Link. et Otto. *Margarita Davitkovska, Vjekoslav Tanasković, Zvezda Bogevska, Svjetlana Zeljković, Boris Dorbić*
P1_52	Optimization of irrigation for improving seedling production of *Marrubium vulgare* L. *Stefan Gordanić, Miloš Rajković, Milan Lukić, Jelena Golijan Pantović, Brankica Babec*
P1_53	Optimization of irrigation regimes for high-quality seedling production of *Melissa officinalis* L. *Stefan Gordanić, Miloš Rajković, Milan Lukić, Jelena Golijan Pantović, Brankica Babec*
P1_54	Organic mulches as a conservation agriculture practice in organic turmeric (*Curcuma longa* L.) production *Dragan Žnidarčič, Irena Gril, Manca Grčar*
P1_55	Molecular characterization of sessile oak populations in National Park "Fruška Gora" *Vladislava Galović, Bratislav Matović, Sreten Vasić, Saša Orlović*
P1_56	Conceptual landscape design for the park complex of the protected area "University City" *Sunčica Bodružić, Jelena Davidović Gidas, Nikola Travar, Nataša Pašalić, Nataša Čereković*
P1_57	Autumn colour dynamics and visual identity of woody taxa along the quay in Novi Sad, Serbia *Sara Đorđević, Djurdja Petrov, Ivana Sentić, Lazar Pavlović, Mirjana Ocokoljić, Jelena Čukanović*
P1_58	PLA composites incorporating antioxidant compounds: Biodegradation behavior in different soil environments and functional property assessment *Grzegorz Świderski, Marek Jałbrzykowski, Monika Kalinowska, Grzegorz Markiewicz, Agnieszka Z. Wilczewska, Jolanta Magnuszewska, Emilia Bujnowska*
P1_59	PLA - Mineral fertilizer composites as sustainable materials for agricultural and horticultural applications *Monika Kalinowska, Grzegorz Świderski, Marek Jabłrzykowski, Grzegorz Markiewicz, Agnieszka Wilczewska, Jolanta Magnuszewska, Emilia Bujnowska*
P1_60	Continuation of monitoring the causes of olive decline and partial dieback in Bosnia and Herzegovina *Mladen Zovko, Ivan Ostojić, Slavica Matić, Dario Ivić, Ana Crnogorac*

Session 2: AGRICULTURAL ECONOMICS AND RURAL DEVELOPMENT

P2_01	Household food waste – Quantities, types, and reasons for food wasting in Bosnia and Herzegovina *Željko Vaško, Aleksandar Ostojić, Gordana Rokvić-Knežić*
P2_02	Bridging the sustainability data gap in the Western Balkans: The 'ESG-Admin' model applied to Bosnia and Herzegovina *Tamara Stojanović*
P2_03	The impact of subsidies on the productivity of agricultural production in EU countries for the period 2015-2024 *Mirna Kojic*
P2_04	Financial and strategic analysis of agricultural cooperatives in the Republic of Srpska: Transition from production to trade *Bogdan Stupar, Tamara Stojanović, Nemanja Jalić*
P2_05	Female entrepreneurship in the food processing sector in Republika Srpska: An analysis of socio-economic indicators and regional specifics *Ljiljana Drinić, Gordana Rokvić Knežić*
P2_06	Production, trade and competitiveness of Serbia in the meat market *Marija Nikolić, Dejana Vučković, Tamara Paunović, Ivana Vasić*
P2_07	Agricultural productivity in the Western Balkans: Structural transformation and the role of capital intensity *Vesna Mrdalj, Marija Gjosheva Kovachevikj, Despina Popovska Stojanov, Lazo Dimitrov, Đorđe Stojisavljević*
P2_08	Digital agriculture software systems: Global developments and the case of Slovenia with the LoginEKO platform *Monika Očko*
P2_09	Income and price elasticities of pork consumption: A two-part model evidence from the Republic of Srpska *Aleksandar Ostojić, Dragan Gligorić, Zoran Borović, Nemanja Jalić*
P2_10	Life cycle assessment of a fruit-based frozen dessert: Identifying environmental hotspots along the product life cycle *Tatjana Radovanović Vukajlović, Olga Agafonova, Petra Mesesnel, Špela Nusdorfer, Duygu Delican, Goran Ivetić, Abel Marc, Lorena Butinar, Branka Mozetič Vodopivec, Simon Muhič, Jelena Topić Božić*
P2_11	Purchasing habits and market preferences of young consumers regarding chicken meat in the Banja Luka region *Anastastija Grgić, Šešum Milana, Jalić Nemanja, Marinko Vekić, Aleksandar Ostojić*
P2_12	Comparative analysis of the competitiveness and sustainability of organic and conventional wheat production in Serbia *Bojan Dimitrijević, Jelena Golijan Pantović, Mladen Petrović, Vera Popović*
P2_13	Seed soybean production in Europe: An economic analysis *Bojan Dimitrijević, Jelena Golijan Pantović, Zoran Rajić, Vladimir Zdravković, Vera Popović*
P2_14	Assessing the implementation of environmental impact assessment for water infrastructure projects in the Republic of Srpska *Nataša Čereković, Milica Marić, Sunčica Bodružić*
P2_15	Extensive institutional coverage with a logistics-dominated AVC focus in the Czech Republic *Anna Tsenteradze, Pavel Kotyza, Tomáš Maier, Ludovic Andres*

P2_16	Fragmented and predominantly theoretical AVC teaching in Slovakia *Anna Tsenteradze, Pavel Kotyza, Tomáš Maier, Ludovic Andres*
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P2_18	Romania: Stronger explicit integration of agricultural value chain teaching *Mariam Japaridze, Téo Urushadze, Valérie Amiranashvili, Ana Kutubidze, Ludovic Andres*
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Plenary session

PL_01

Bridging science and practice: The role of applied research as interface between stakeholders in the fruit growing sector

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Abstract

The horticultural sector faces major challenges, primarily driven by political frameworks, market forces and climate change. Over the past decade, production costs have increased faster than market returns, forcing fruit growers to continuously increase the productivity of their orchards, replace unprofitable orchards and optimise operational processes. Adapting farm operations to changing conditions requires knowledge on best practices, cultivar performance and optimal management of various orchard systems. In addition to growers' experience, important sources of information include basic research, experimental orchards, breeders, nurseries, and other industry representatives, extension services, private consultants, growers' journals, social media and AI. In Germany, nine research stations conduct applied trials on sweet cherries in experimental orchards. These trials focused on cultivar and rootstock testing, optimisation of orchard systems, irrigation and orchard management. Additional activities include the organisation of field days and winter seminars, acting as a regional contact for growers, serving as a link between growers and the administration, and providing information to policymakers. Furthermore, the stations test basic research findings to integrate them into orchard systems. To plan new up-to-date trials, constant networking with all stakeholders in the fruit-growing sector is required. The overall goal is to make the latest developments from growers, the best practices from other countries and the results of basic research accessible to growers, policymakers and the public. However, due to the limited capacity of the few research stations to conduct trials, it is not possible to test all optimal cultivation systems, rootstocks and management practices for each new cultivar in different climates and soil conditions. Therefore, knowledge transfer systems must incorporate additional sources of information in order to develop site-specific solutions. This study presents an overview of the current knowledge transfer system in the German fruit-growing sector, with a particular focus on sweet cherries.

Key words: Prunus avium L., rootstocks, orchards systems, knowledge transfer, living labs

PL_02

Organic forms of microelements - New horizons in modern animal nutrition

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Abstract

As a consequence of piglets weaning, feed consumption usually decreases and the litters become malnourished with a reduced growth rate, entering an energy and protein deficit. Weaning process also causes both acute and chronic structural and functional changes in the small intestine, including shortening of the intestinal villi (villous atrophy) and an increase in the depth of the intestinal crypts. Atrophy of the villi and the accompanying hyperplasia of the crypts, in addition to the already weakened intestinal function, additionally impair the digestive and absorptive capacity, disrupting the balance between beneficial and harmful microflora in the intestine also. The main consequence is reduction of production performances in piglets. Due to the increasing demands of the global consumer lobby, and respecting the production priorities with the ultimate aim of increasing production and improving the quality of food of animal origin, in addition to the basic nutrients, a large number of additives with different purposes are added to the mixtures. For years, inorganic forms of microelements in the form of salts have been used as additives in mixtures for piglets: oxides, carbonates, chlorides and sulfates. The bioavailability of inorganic forms of microelements is limited and high doses are required to meet the needs of animals, often leading to nutrient imbalances and potential toxicity problems. As one of the proposed strategies are chelated forms of microelements, mostly copper, manganese and zinc. Aim of experiment was testing the effects of using chelated forms of microelements (Cu, Mn, Zn) in the diet on the health status, production performance of piglets, as well as the histological and microbiological characteristics of certain segments of the digestive tract of piglets. The use of chelated forms of microelements showed a beneficial effect on the resorptive surface of the intestine, microflora and consequently on the production results of piglets.

Key words: piglets, microelements, organic forms, production performances

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PL_03

Transforming research through immersive data analytics

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Abstract

The increasing volatility in global food markets necessitates a methodological transition from static observational models to dynamic, high-fidelity research environments. This study presents an integrated research framework that combines web-based 3D experimental interfaces with agent-based modelling (ABM) to analyse consumer decision-making within the agri-food sector. The proposed infrastructure utilises a specialised 3D virtual retail environment to conduct controlled behavioural experiments. By manipulating variables such as product placement, pricing strategies, and labelling, the system captures granular, real-time participant data. This approach bridges the gap between traditional laboratory settings and real-world ecological validity. The utility of this framework is demonstrated through an empirical application, in which the collected behavioural data were used to calibrate a predictive "Digital Twin" of the agri-food supply chain. This simulation engine utilises empirical rules to govern autonomous virtual agents, allowing for the "stress-testing" of food systems through multi-scenario Monte Carlo analyses. By simulating complex "what-if" scenarios, such as sudden inflation or supply chain bottlenecks, the model transforms micro-level behavioural data into macro-level insights regarding system resilience and innovation diffusion. This integrated approach offers a robust platform for agricultural economists to evaluate policy impacts and market transitions without the risks or costs associated with real-world experimentation. By synchronising empirical data collection with predictive simulation, the framework provides a comprehensive tool for understanding the complex interdependencies within modern food systems.

Key words: digital twins, consumer behaviour, agent-based modelling, agri-food supply chain, behavioral data infrastructure

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Session 1: Horticulture

Oral Presentations

O1_01

Knowledge transfer in hazelnut production: Networking is key for improving the sector

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Abstract

Hazelnut is a relatively new crop in Austria, Germany and Switzerland. Therefore, the countries have no traditional hazelnut-growing regions with existing value chains, extension services or industries that support growers with crop-specific technology, such as machinery for harvesting, cracking and roasting. Hazelnut growers are spread across the three countries and are often pioneers in their region, trying out this new crop without the benefit of an existing network. Since production costs in the three countries are high, growers mostly produce hazelnuts for direct marketing on their own farms or in their own online shops. To do this, they must process the nuts into marketable products, which requires additional skills and machinery. As in all agricultural sectors, technology transfer plays a crucial for introducing innovations such as efficient irrigation systems, plant protection strategies, and improved management methods. The Austrian-German-Swiss hazelnut network is an informal group of private and public fruit advisors, growers, and researchers. It aims to support farmers who are growing or planning to grow hazelnuts by testing cultivars, sharing knowledge, and offering a networking platform through organising field days and winter seminars. These activities may help growers to develop new ideas to improve the productivity of the orchards and the quality of their produce, as well as their marketing strategies. The paper aims to (1) provide an overview of the current hazelnut production situation in the three countries, (2) highlight knowledge gaps for optimised production and (3) outline the activities of the hazelnut network of the three countries.

Key words: brown stain disease, *Corylus avellana* L., *Corylus colurna* L., hazelnut weevil (*Curculio nucum* L.), nut quality, pruning trials, rootstock

O1_02

Rootstock effects on growth, fruit quality, and yield of ‘Gala’ apple clones

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Abstract

The establishment of modern high-density, highly productive orchards largely depends on the proper selection of vigor-controlling rootstock/cultivar combinations. The study was conducted over two years (2024–2025) using four ‘Gala’ clones (‘Dark Baron’, ‘Red Devil’, ‘Schnico Red’, and ‘Gala Val’) grafted onto two rootstocks, M.9 and B.9, planted at a planting distance of 4 × 0.8 m. Trunk circumference was measured from 2021 to 2026 to calculate trunk cross-sectional area (TCSA). The objective of this study was to evaluate rootstock effects on vegetative growth and fruit characteristics of the investigated ‘Gala’ clones. By the end of the observation period, the clone 'Schnico Red' showed the highest TCSA values on both rootstocks, while no statistically significant differences were observed among the other clones. Rootstock significantly affected crown volume, with trees grafted on M.9 exhibiting up to twofold higher values compared to those grafted on B.9. Fruit weight was greater on M.9 than on B.9 regardless of clone, while fruit diameter was unaffected by clone or rootstock. Fruit overcolor was most developed in ‘Red Devil’ gala grafted on B.9 rootstock. In both 2024 and 2025, trees on M.9 rootstock produced higher average yields per tree compared to B.9, with 'Gala Val' being the most productive in 2024 (9.4 kg tree-1) and 'Dark Baron' in 2025 (19.2 kg tree-1). The results highlight the importance of rootstock selection and annual variability in determining vegetative growth, fruit quality, and productivity in high-density ‘Gala’ orchards, with M.9 consistently promoting higher vigor and tree productivity, while 'Schnico Red' exhibited the strongest vegetative growth.

Key words: tree vigor, crown volume, productivity, fruit weight, overcolor

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O1_03

Root-associated beneficial microorganisms improve nutrient use efficiency and fruit functional quality in sustainable raspberry production

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Abstract

Enhancing nutrient use efficiency while preserving fruit functional quality represents a critical bottleneck in the transition toward sustainable raspberry production systems. Root-associated beneficial microorganisms are increasingly recognized as functional drivers of rhizosphere processes that enhance nutrient cycling and modulate plant metabolism. This study evaluated the field-level integration of a consortium of selected root-associated beneficial microorganisms, formulated as a microbial-enriched vermicompost extract developed at the Fruit Research Institute Čačak, Serbia, within contrasting fertilization strategies. The experiment compared conventional mineral fertilization with two biologically supported mineral systems — one supplemented with microbial-enriched vermicompost extract and zeolite and the other with humus-based fertilizer and zeolite, as well as a microbial treatment applied independently and an unfertilized control.The biologically supported mineral systems, particularly the microbial-enriched system, significantly increased the number of fruiting branches, fruit weight, and soluble solids content compared to mineral fertilization alone ($p < 0.05$). Treatments involving the microbial consortium, either alone or integrated with mineral fertilization, also enhanced total phenolic content, anthocyanins, and antioxidant activity (DPPH and ABTS assays), indicating improved modulation of secondary metabolism. The most pronounced effects were observed when microbial consortia were combined with mineral fertilization, suggesting synergistic interactions between microbial functionality and nutrient inputs. Collectively, the results clarify both the agronomic and mechanistic relevance of root-associated beneficial microorganisms in enhancing nutrient use efficiency and functional fruit quality, supporting their integration into sustainable raspberry production systems.

Key words: root-associated beneficial microorganisms, fertilization system, nutrient use efficiency, raspberry, fruit quality

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O1_04

Agrisolar - Application of photovoltaic technologies in agriculture

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Abstract

Agrivoltaic, or agrisolar, systems represent an integrated approach to the application of photovoltaic (PV) technologies in agriculture, enabling simultaneous electricity generation and agricultural production on the same land area. This paper reviews the main agrisolar technologies and design options, including elevated and interspace PV concepts, systems for permanent crops and pastures, greenhouse-integrated PV and rooftop PV on agricultural buildings. Agrisolar systems are highlighted for their benefits in supporting irrigation, modifying microclimates, reducing crop heat stress, and supplying energy for frost protection. The paper also discusses the main engineering trade-offs related to land use, structural design and maintenance on one hand as well as shading and supply reliability on the other. In addition to the general review, an illustrative sizing example is presented for a 20 ha apple orchard with annual electricity demand of about 120–128 MWh. Three supply concepts are compared: a 110 kWp on-grid PV system, a fully autonomous off-grid PV-battery system and a hybrid off-grid system combining PV, limited battery storage and diesel-generator support. For the analysed case, the 110 kWp on-grid system yields about 129.58 MWh/year of PV electricity with a simple payback of about 8.1 years, whereas the hybrid concept reduces the payback to about 5 years under similar agricultural assumptions. By contrast, the fully autonomous battery-based off-grid solution becomes economically unattractive, with an estimated simple payback of about 50 years. The results indicate that the on-grid concept is well suited for reducing electricity costs and maximizing daytime self-consumption, while the fully autonomous off-grid solution becomes economically unfavorable when rare but remarkably high frost-protection loads must be covered. Under such conditions, the hybrid concept provides the most balanced technical and economic solution, because it combines renewable energy use during normal operation with reliable backup for critical short-term peak loads. Agrisolar systems can therefore be regarded as a flexible and multifunctional framework linking energy efficiency, agricultural resilience and climate-adaptive farm infrastructure.

Key words: agrivoltaics, photovoltaics, agriculture, irrigation, frost protection

Acknowledgment

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O1_05

Application of bacteriophages and antimicrobial peptides for the control of *Xylella fastidiosa* in Italy

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Abstract

Xylella fastidiosa (Xf), a xylem-limited bacterial pathogen, represents a major threat to global agriculture, particularly in Mediterranean olive production, where it has caused severe economic and ecological losses. The absence of effective and sustainable control strategies has driven the exploration of innovative biocontrol approaches. This work integrates recent advances in phage-based and antimicrobial peptide-based strategies targeting Xf subsp. pauca in Italy. Bacteriophage research led to the isolation and characterization of three virulent phages (Phi1, Phi3, and MATE2) from environmental samples. Morphological and genomic analyses revealed that these phages belong to distinct taxa within *Caudoviricetes*, exhibiting genome sizes ranging from ~44 kb to ~64 kb and strictly lytic life cycles, with no detectable virulence, lysogeny, or antimicrobial resistance genes. Their strong host specificity and absence of off-target activity toward beneficial bacteria highlight their environmental safety. Functionally, these phages demonstrated efficient adsorption, replication, and bacterial lysis, significantly suppressing Xf populations in vitro and showing stability across a wide range of pH and temperature conditions. Complementarily, a nisin-based strategy using *Lactococcus lactis* and its bacteriocin nisin A demonstrated potent antibacterial activity against Xf. Nisin exhibited rapid membrane-disruptive action, achieving complete bacterial inactivation at a minimal lethal concentration of 0.6 mg/mL. Importantly, in planta experiments in *Nicotiana benthamiana* confirmed its ability to control infections, with treated plants remaining asymptomatic up to 74 days post-inoculation. Additionally, nisin showed systemic translocation and persistence within plant tissues, supporting its practical applicability. Together, these findings highlight the strong potential of integrating lytic bacteriophages and antimicrobial peptides as complementary, eco-friendly strategies for managing Xf. Such approaches provide a foundation for developing sustainable phytosanitary treatments aligned with current regulatory and environmental demands, although further validation under field conditions remains essential.

Key words: *Xylella fastidiosa*, bacteriophage therapy, antimicrobial peptides, nisin, plant pathogen control, sustainable agriculture

Acknowledgment

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O1_06

Fruit concentrates as functional ingredients for polyphenol-enriched frozen desserts: Chemical, antioxidant, and antimicrobial characterization

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Abstract

Ice cream is widely consumed but is often considered nutritionally less favorable due to its high sugar and fat content. In response to increasing demand for functional foods, reformulation using natural ingredients rich in bioactive compounds represents a promising strategy to improve its nutritional profile. Accordingly, the aim of this study was to evaluate fruit concentrates as functional ingredients for the development of polyphenol-enriched frozen desserts, with particular emphasis on their antimicrobial, antioxidant capacity, and chemical composition. Twenty fruit concentrates were analyzed for total phenolic content by Folin–Ciocalteu method, antioxidant capacity by ABTS, DPPH, FRAP, and tannin content by vanillin assay. Chemical composition, including sugars, organic acids, and hydroxycinnamic acids, was determined using HPLC-UV/RI. Antimicrobial activity was assessed against *Escherichia coli* and *Bacillus cereus*. The highest total polyphenol contents (8.2–29.0 g/L expressed as gallic acid equivalents) were observed in strawberry, pomegranate, aronia, cranberry, and elderberry concentrates. Elderberry exhibited the highest antioxidant capacity across all assays. Aronia concentrate exhibited a high sorbitol content (268 g/L), which may potentially contribute to a lower glycaemic impact due to its low glycaemic index. Elderberry and aronia also presented the highest tannin levels. Additionally, several concentrates demonstrated antimicrobial activity against both tested microorganisms. The inhibitory effects are likely associated with low pH and high total acidity, particularly in cranberry and orange juice concentrates. The incorporation of selected polyphenol-rich fruit concentrates, particularly aronia and elderberry, represents a promising approach for the development of reformulated frozen desserts with enhanced functional potential. The combination of high polyphenol content, organic acid composition, favorable sugar profiles, and antimicrobial potential supports the development of products with improved nutritional characteristics, while retaining desirable sensory properties.

Key words: polyphenols, fruit concentrates, functional foods, antioxidant activity

Acknowledgment

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O1_07

Modulation of aromatic, phenolic, and sensory attributes of pinela wines through different maceration approaches

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Abstract

Maceration is increasingly employed in white winemaking to enhance structural complexity and diversify stylistic expression. However, its influence on aroma, phenolic composition, and sensory characteristics remains insufficiently explored. This study investigates the effect of different maceration regimes and durations on the aromatic, phenolic, and sensory profile of wines produced from *Vitis vinifera* L. cv. Pinela (2025 vintage), a local variety from Vipava Valley, in Western Slovenia. Experimental vinifications were performed under controlled conditions, comparing four treatment groups: a control wine from direct pressing, cold maceration (18 h), and maceration during alcoholic fermentation for 24 h, 48 h, and 7 days using commercial yeast starter. Fermentation progress was monitored throughout. Wines were subjected to comprehensive analysis, including determination of basic physicochemical parameters, determination of total phenolic content by the Folin–Ciocalteu method, volatile compound profiling by HS-SPME-GC-MS, and descriptive sensory evaluation. Results indicated that different maceration regimes affected color, total phenolic content, aromatic expression, and structural perception. Shorter maceration treatments were associated with fresher varietal aromas, and lower phenolic extraction, while longer skin contact enhanced mouthfeel, total phenolic content, and fruit aromatic nuances. Overall, different maceration approaches can modulate the balance between freshness, structure, and phenolic contribution, shaping the sensory identity of Pinela wines. These findings underscore maceration as a versatile tool for steering aroma, phenolic content, and sensory profile, supporting stylistic diversity and quality optimization in this traditional variety.

Key words: pinela, maceration, total phenolic content, volatile compounds, GC-MS, wine aromatic profile

O1_08

Tracing the pathways of Zelen typicality: The role of maceration and fermentation strategies

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Abstract

The impact of fermentation strategy and maceration on fermentation dynamics and the temporal evolution of volatile phenols was investigated in wines from the autochthonous grape variety 'Zelen' (*Vitis vinifera* L.) from Vipava Valley (Slovenia). A microvinification experiment was performed using clarified juice and grape pomace, comparing commercial yeast inoculation (*Saccharomyces cerevisiae* Fermol Premier Cru, AEB) with spontaneous fermentation initiated by *pied de cuve* (PdC). Pomace treatments underwent 3-day maceration during fermentation. All fermentations were conducted in triplicate at 20 °C and monitored up to 21 days. Sugar consumption was determined by an in-house HPLC-RID method at four time points. Volatile phenols were quantified using HS-SPME-GC-MS. Yeasts were isolated from PdC ferments, identified by sequencing the D1/D2 26S rRNA domain, and selected isolates evaluated for *β*-glucosidase activity – important for releasing glycosidically bound aroma precursors, particularly methyl salicylate (MeSA), a key marker of Zelen wines. PdC juice fermentations showed the most rapid sugar depletion (from ~195 g/L to <3 g/L), while commercial and macerated treatments exhibited slower early-stage dynamics. Significant increases in 4-vinyl guaiacol (4-VG) and 4-vinylphenol (4-VP) occurred throughout, especially in macerated treatments, with final 4-VG exceeding 1200 µg/L – indicating intensive hydroxycinnamic acid decarboxylation and confirming its role as a varietal marker. Ethylphenols appeared at lower concentrations with variable, delayed formation. MeSA showed moderate increases, higher in pomace, indicating matrix-dependent release. PdC ferments were dominated by *S. cerevisiae*, with *Hanseniaspora uvarum* initially present. Yeast-dependent differences in *β*-glucosidase activity were significant, with *H. uvarum* showing higher linalool release than native or commercial *S. cerevisiae*; MeSA levels did not differ among treatments. These results demonstrate that matrix effects, microbial composition, and enzymatic activity collectively shape Zelen wines' chemical and sensory properties.

Key words: Vitis vinifera L. Zelen, fermentation dynamics, maceration, volatile phenols, β-glucosidase

O1_09

Variability of morphological and chemical traits in grapevine seedlings derived from the Blatina × Vranac cross

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Abstract

Blatina is an autochthonous grapevine cultivar widely grown in Herzegovina and characterized by a functionally female flower, which requires compatible pollinators. In order to obtain progeny with improved agronomic and technological characteristics, a cross between the cultivars Blatina and Vranac was performed. The aim of this study was to evaluate the variability of morphological and chemical traits in the obtained seedlings. During the 2025 growing season, sixteen seedlings were analyzed for cluster and berry characteristics as well as for basic chemical parameters of the must. The analyzed traits included cluster weight, number of berries per cluster, berry weight, number of seeds per berry, soluble solids content, total acidity, and must pH. The results showed pronounced variability among the studied seedlings. Cluster weight ranged from about 120 g to over 420 g, while the average berry weight varied between 1.85 and 4.16 g depending on genotype. The soluble solids content of the must showed substantial differences, ranging from 12.9 to 21.8 °Brix, indicating significant variability in ripening and potential technological quality. The obtained results confirm a high level of variability within the progeny derived from the Blatina × Vranac cross and indicate the possibility of selecting promising genotypes with improved production and quality traits for further breeding and evaluation.

Key words: grapevine, cluster and berry traits, must quality

O1_10

Quantifying resource use in Slovenian viticulture: A survey-based assessment

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Abstract

Viticulture is an important agricultural sector in Slovenia; however, quantitative data on resource use at the farm level remain scarce, limiting the development of evidence-based strategies to improve environmental performance. Collecting primary data at the farm level is crucial for producing reliable environmental indicators in agriculture. Life cycle assessment (LCA) is a standardized ISO methodology that uses such primary data to quantify potential environmental impacts across all stages of a product's life cycle from input production to farm gate and beyond. In viticulture, LCA provides a structured framework to link vineyard practices and resource use to multi-criteria impact indicators. The reliability depends on detailed, context-specific primary data from farms. This study focuses on vineyards in the Primorska and Vipava regions, where grape production plays an important economic and cultural role. The aim was to quantify water use, diesel consumption, pesticide and organic input use, and tillage practices per hectare and per kilogram of grapes, and to explore patterns that may drive differences in environmental load across vineyards. The work provides an empirical basis for a future life cycle assessment (LCA) of Slovenian viticulture by characterizing variability in resource use. A structured survey was conducted among vineyards in Primorska and Vipava, collecting data on annual yields, water application, diesel use for field operations, type and frequency of tillage, and the use of synthetic and organic plant protection products. Reported values were normalized to one kilogram of produced grapes. Preliminary analysis shows variations in diesel use and water application between farms. The results form an input dataset for subsequent LCA of Slovenian viticulture and can support more targeted advisory and policy measures aimed at reducing environmental pressures in key hotspots of the production system.

Key words: viticulture, Slovenia, life cycle assessment, resource use, sustainability

Acknowledgment

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O1_11

Organic vs. conventional viticulture: Implications for stilbene content in grapes

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Abstract

In contemporary plant protection, increasing attention is directed toward plants' natural defence mechanisms, particularly to reduce reliance on synthetic pesticides and promote sustainable production systems. Grapevine exhibits a highly developed secondary metabolism, within which stilbenes, most notably trans-resveratrol and its glycoside trans-polidatin, are recognised as key components of induced resistance. This study aimed to evaluate the content of these stilbenes in grapes of international grapevine varieties cultivated under organic and conventional production systems, and to examine the influence of cultivar and cultivation type on the plant's immune system. The 2023 growing season was characterised by alternating drought and rainy periods, conditions favourable for pathogen development and activation of plants' defence mechanisms. Healthy grape samples were collected at the harvest period in the same year, according to variety-specific Brix values, and analysed using a previously optimised and validated SPE-HPLC-DAD method. The results showed pronounced differences in stilbene content depending on the production system, with organically grown grapes generally exhibiting higher concentrations of both trans-resveratrol and trans-polydatin. Under organic production, trans-polydatin levels in grapes ranged from 0.24 µg/kg (Sauvignon blanc) to 12.49 µg/kg (Merlot), while trans-resveratrol concentrations varied from 0.30 µg/kg (Muscat Italia and Chardonnay) to 1.12 µg/kg (Sauvignon blanc). When cultivar type was considered, clear differences were observed between red and white grapevine varieties, with red ones generally showing higher stilbene concentrations, reflecting a more pronounced secondary metabolic response. An exception was Sauvignon blanc, with higher stilbene levels under conventional production, likely due to cultivar-specific response to chemical stress. These findings highlight the adaptive nature of stilbene biosynthesis and support their relevance within integrated and sustainable plant protection strategies.

Key words: grapes, stilbenes, resveratrol, organic production, conventional production

Acknowledgment

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O1_12

Integrating biocontrol and oenological functionality: The potential of indigenous yeasts in vineyard–winery systems

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Abstract

The growing emphasis on sustainable viticulture and the pursuit of regionally distinctive wines, often supported by spontaneous fermentation, has intensified interest in indigenous yeasts as multifunctional components of vineyard–winery systems. Accordingly, this study aimed to explore the functional diversity of indigenous *Saccharomyces* and non-*Saccharomyces* yeasts. Over 100 yeast strains from Slovenian vineyard-associated environments were screened for enzymatic activities linked to grapevine protection against fungal pathogens and aroma development, including chitinase, glycosidase, β-lyase, and sulfite reductase. Selected strains were further evaluated for quantitative enzymatic activity, antagonism against *Botrytis cinerea*, fungicide tolerance, niche overlap, and grapevine leaf disc infection model. The most promising candidate was validated under field conditions within an integrated disease management framework for Pinot cultivars, known for their susceptibility to *B. cinerea* infection. The results showed widely distributed, strain-dependent *β*-glucosidase and *β*-lyase activities, whereas chitinase and sulfite reductase activities were rare. In vitro antagonistic assays further highlighted seven non-*Saccharomyces* and two *Saccharomyces* strains as promising candidates. *Pichia guilliermondii* ZIM 624 stood out particularly, combining a favorable enzymatic profile with consistent antifungal performance. While in vitro and leaf disc assays suggested that ZIM 624 could effectively suppress *B. cinerea*, field experiments conducted under real vineyard conditions further supported its effectiveness within integrated disease management strategies. Notably, biocontrol-assisted treatments resulted in significant reductions in both disease incidence and severity in 'Pinot noir' compared with controls, whereas 'Pinot gris' showed similar but less pronounced trends. Although these findings are encouraging, they are based on a single (dry) vintage and require validation under higher disease pressure. In addition, the promising enzymatic outcomes call for further evaluation of oenological performance, including fermentation behavior and aroma development. Overall, this study establishes a structured basis for identifying indigenous yeasts with dual functionality in viticulture and winemaking, while also opening new avenues for research.

Key words: indigenous *Saccharomyces* and non-*Saccharomyces* yeasts, yeast enzymatic activity, biocontrol, *Botrytis cinerea*, sustainable viticulture

Acknowledgment

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O1_13

Influence of plant growth regulators and LED lights on *in vitro* rooting and *ex vitro* acclimatization of lavander (*Lavandula angustifolia* L.)

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Abstract

The successful transition from sterile culture to external environment remains a critical bottleneck in the micropropagation of lavander (*Lavandula angustifolia* L.). This study evaluated the combined impact of various light qualities and plant growth regulators (PGRs) on the induction of roots and subsequent plantlet establishment. Individual shoots were transferred to Murashige and Skoog (MS) rooting media supplemented with 0.1 mg/L 6-benzylaminopurine (BAP) or meta-Topolin (mT), and 0.1; 0.3; and 0.5 mg/L indole-3-butyric acid (IBA). These cultures were maintained under four distinct light treatments: fluorescent lamps (FL) and blue (BL), red (RL), and red-blue (1:1) (RBL) LED light spectra. Following the *in vitro* rooting phase, the survival and acclimatization rates of the resulting plantlets were monitored during their transfer to *ex vitro* conditions. The results revealed that the RL was the most effective for root development. When combined with 0.1 mg/L mT and 0.5 mg/L IBA treatment, RL produced the highest rooting success rate (57.75 ± 5.88%). Root morphology was also significantly improved under these conditions, achieving a maximum root count of 3.35 ± 0.23 and an average length of 63.16 ± 2.33 mm. Most importantly, the robust root systems developed under RL led to the highest successful establishment rate during the *ex vitro* phase (51.11 ± 5.88%), demonstrating superior physiological readiness compared to other light treatments. These results suggest that tailoring the light spectrum during the rooting phase significantly enhances the efficiency of the entire micropropagation process, providing a more reliable method for producing high-quality, acclimatized lavender plantlets than traditional lighting systems. However, despite the positive outcomes, *in vitro* rooting rates remained relatively low across all treatments, suggesting that the effect of higher IBA concentrations should be further investigated.

Key words: meta-Topolin, light emitting diodes, rhizogenesis, plantlet establishment rate

Acknowledgment

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O1_14

The influence of planting site on tree architecture: A case study of *Acer platanoides* 'Crimson King' in green areas of Novi Sad

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Abstract

The study aimed to evaluate the impact of planting site on the crown architecture, vitality, and ornamental value of *Acer platanoides* 'Crimson King' in urban green spaces of Novi Sad, Serbia. Research was conducted across three locations: Sunčani kej, Limanski Park, and Kineska četvrt. Morphometric measurements, including total tree height, height of the branch-free steam, diameter at breast height, crown projection area, crown volume, and slenderness coefficient were collected. Vital parameters were also assessed, covering trunk rotting, dead branches, mechanical, abiotic, entomological, and phytopathological damage. Crown architecture metrics were calculated from the collected data, and each tree was assigned a vitality and ornamental value score. Statistical analysis included one-way ANOVA for morphimetric data, Tukey's post-hoc test for significant differences, and chi-square tests for vital parameters. Results showed significant differences among sites for total tree height, crown height, diameter at breast height, and slenderness coefficient. Trees in Limanski Park displayed the highest values for most parameters, the best vitality and the highest ornamental score (5.00) indicating optimal growth conditions. In contrast, trees at Sunčani kej exhibited higher slenderness coefficients, suggesting lower stability, while individuals in the Kineska četvrt showed higher frequency of trunk rotting. Horizontal crown dimensions were less affected by site-specific factors, likely determined by internal growth patterns. Vitality and ornamental value were closely correlated, with healthier trees showing greater aesthetic quality. The study confirms that urban environment conditions significantly influence tree architecture, health, and visual appeal, emphasizing the importance of careful site selection and maintenance practices to maximize both ecological and aesthetic functions of urban trees.

Key words: *Acer platanoides* 'Crimson King', urban trees, crown architecture, vitality, ornamental value

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O1_15

Kamenica Park in Novi Sad – Natural and cultural heritage of Serbia

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Abstract

The purpose of the research of Kamenica Park in Novi Sad was to represent archival research and historical analysis based on relevant primary and secondary sources about period of designed, original concept and architecture, to represent unpublished results of site analysis of Park, especially qualitative and quantitative analysis of dendroflora and to find out the trees from original design.The hypothesis is that the original garden were formed in the English style of garden art. Archival material from relevant primary and secondary sources are found out are compared whith a existing situation in the current cadastre plan and in the field to find out original elements of garden.As a result 4512 woody plants (493 coniferous and 4019 deciduous) within 96 species and lower taxa was recorded.Park was designed in the first half of the 19th century, according to cadastral record of the originally designed garden of the Marcibanji and Karaconji family Kamenica Park which shows the spatial concept, the estate buildings of the manor from that time, garden-architectural objects such as the orangery, the bridge, the network of paths with rest areas, few hills, garden sculptures and the arrangement of groups of plants; acording to archival material the lakes are artificial elements of garden.Kamenica Park is a representative example of an English landscape park from the first half of the 19th century in Serbia, with significant dendrological diversity, in which the basic building element is plant. Together with the buildings, since its foundation it has represented an integral whole of expressed aesthetic values. Based on the analysis of the present conditions of the park, values, historical data and results in this paper, it will be possible to propose measurement of renewal.

Key words: Kamenica Park in Novi Sad, natural monument, dendroflora, historical analysis, site analysis

O1_16

Antifungal potential of aqueous extract from *Nigella sativa* processing waste against phytopathogenic fungi

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Abstract

The reuse of agro-industrial by-products as natural bioactive agents represents a sustainable approach in plant protection and food safety. This study aimed to evaluate the antifungal efficacy of an aqueous extract obtained from black cumin (*Nigella sativa* L.) processing waste left after oil cold press against selected food-associated phytopathogenic fungi. The extract was prepared using double-distilled water and applied *in vitro*. Antifungal activity was tested against *Fusarium oxysporum* and *Alternaria dauci*, obtained from a food microbiology collection. The food poisoning method was used to assess mycelial growth inhibition. Fungal growth was monitored under controlled laboratory conditions, and antifungal efficiency was expressed as percentage inhibition of radial mycelial growth compared to the untreated control. The aqueous extract demonstrated inhibitory activity against both tested fungi. The inhibition rate against *Fusarium oxysporum* was 36%, while *Alternaria dauci* showed 67% growth inhibition. The results indicate species-dependent sensitivity, with varying susceptibility to the applied extract. The findings suggest that aqueous extracts derived from black cumin processing waste possess measurable antifungal activity and may represent a promising, environmentally friendly alternative to synthetic fungicides. Further research should focus on optimizing extraction conditions, evaluating different concentrations, characterizing active compounds, and testing efficacy under *in vivo* or field conditions to confirm practical applicability.

Key words: *Nigella sativa* waste, antifungal activity, food poisoning method, *Fusarium oxysporum*, *Alternaria dauci*

O1_17

Beekeepers' perceptions of pollination service management in Bosnia and Herzegovina: Survey data from the EU COST "Super B" Project and a review of EU and local subsidy policies

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Abstract

Pollination by insects is a key contribution to many crops, with managed honeybees being "hired" to support pollination services in agricultural and natural habitats. The aim of this work was to contribute data to the scientific literature on Bosnia and Hercegovina that addresses an important aspect of local food sustainability through natural but managed pollination services that the European honeybee *Apis mellifera* provides, and to provide insights into existing agricultural subsidies. To our knowledge this is the first pollination management overview based on a standardized approach in Bosnia and Herzegovina. We analyzed results from Europe-wide online questionnaire, administered under COST Action project "Super B ", and compiled data from available sources on pollination service subsidies. The data on beekeeping practices and perceptions of pollination structure were collected using a questionnaire with 178 items grouped into twenty-seven thematic sections and were provided by 109 beekeepers. The study examines beekeeper perceptions and motivations for crop pollination in relation to their demographic characteristics and technological practices. Beekeepers' perception of mass flowering crops showed a lack of trust in intensive agriculture driven by perceived risks of pesticide contamination and bee mortality. Agri-environment management and subsidy systems at the global and EU level were compared with local policy frameworks, with the intention to promoting more visible and compensated pollination practices in the country. The findings highlight the need for locally adapted and structured recognition of pollination service as well as better options for constructive engagement in pollination services through adequate subsidies. The collected data can serve as a starting point for structuring pollination services and as a step toward improving the pollinator potential of bees, addressing pollination needs, and enhancing local practices in Bosnia and Herzegovina within the broader agricultural pollination service market.

Key words: questionnaire, pollination, *Apis mellifera*, beekeepers, subsidies

Acknowledgment

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O1_18

Investigation of pepper-infecting viruses and viroids in greenhouse cultivation in Albania

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Abstract

Pepper (*Capsicum annuum* L.) is among the most important vegetable crops cultivated under greenhouse conditions in Albania, where viral diseases constitute a major constraint to productivity, fruit quality, and marketability. Despite the economic importance of this crop, knowledge of the identity, distribution, and molecular diversity of pepper-infecting viruses and viroids in the country remains limited. This study was conducted to investigate the virome and viroidome of greenhouse-grown pepper in Albania through an integrated diagnostic approach combining qPCR and next-generation sequencing (NGS), with a focus on the major viruses and viroids affecting pepper. Plant samples were collected from the main pepper-producing regions and analysed using molecular assays targeting a broad range of economically important viral and viroid agents associated with this crop. NGS was further applied to broaden detection capacity, facilitate the identification of virus-like agents not captured by routine assays, and enhance the overall characterization of infections. Sequence-based analyses, including Sanger sequencing and phylogenetic reconstruction, were subsequently performed to assess the genetic relationships between the detected agents and homologous isolates reported worldwide. The survey showed that 158 samples (52.7%) were infected with at least one virus. Pepper mild mottle virus (PMMoV) was the most prevalent virus, followed by cucumber mosaic virus (CMV) and alfalfa mosaic virus (AMV). Mixed infections were frequently observed, particularly the CMV + PMMoV combination. In addition, NGS analysis enabled the detection of bell pepper endornavirus (BPEV), Caulimoviridae-like sequences, suggesting the presence of a putative novel virus infecting pepper. This study represents the first comprehensive molecular survey of pepper viruses in greenhouse cultivation in Albania and underlines the importance of continuous surveillance, accurate molecular diagnostics, and the implementation of integrated management strategies, including the use of certified planting material, resistant varieties, improved cultural practices, and effective vector control, to mitigate the impact of viral diseases on pepper production.

Key words: Capsicum annuum, viruses, detection, qPCR, NGS, phylogenetic analysis

Session 1: Horticulture

Poster Presentations

P1_01

Pomological characteristics and productivity of newly developed plum cultivars from the Fruit Research Institute, Čačak

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Abstract

Plum breeding programmes worldwide increasingly focus on improving fruit quality and productivity while also extending the harvest season. The long-term breeding programme at the Fruit Research Institute, Čačak, has resulted in the release of 18 plum cultivars, several of which are widely grown across Europe. Recently developed cultivars, including the early-ripening 'Lana' and the late-ripening 'Divna' and 'Petra', represent important advances in cultivar improvement. During 2023 and 2024, major pomological traits, fruit quality parameters, and yield performance of these new cultivars were evaluated and compared with the standard cultivars 'Čačanska Rana' and 'Stanley'. Fruit size characteristics (fruit and stone weight, height, width, and thickness), soluble solids content, sugar composition, total acids, vitamin C content, and ripening index were determined together with yield and yield efficiency. 'Lana' exhibited the largest fruit dimensions and the most vigorous tree growth, while 'Divna' produced the smallest fruits and the highest vitamin C content. 'Petra' achieved the highest soluble solids content and sugar levels, indicating superior fruit quality. The greatest yield and yield efficiency were recorded in 'Petra', whereas 'Lana' showed lower productivity. 'Stanley' exhibited the highest ripening index among the examined cultivars. Compared with 'Čačanska Rana', 'Lana' demonstrated improved fruit size and chemical traits with comparable yield performance. Both 'Divna' and 'Petra' exceeded 'Stanley' in chemical quality while maintaining similar fruit size and tree growth. Overall, the newly released plum cultivars from the Čačak breeding programme combine enhanced fruit quality with satisfactory productivity, confirming their potential for commercial production and further dissemination in modern plum production systems.

Key words: plum, new cultivars, pomological traits, fruit quality, yield efficiency

Acknowledgment

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P1_02

Characterization of sour cherry (*Prunus cerasus* L.) genetic diversity using microsatellite markers

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Abstract

The sour cherry (*Prunus cerasus* L.) belongs to the Rosaceae family, the *Amygdaloideae* subfamily, the genus *Prunus*, and the subgenus *Cerasus*. As a highly resilient fruit species, it has long been cultivated across various locations in Serbia, exhibiting substantial genetic variability that provides significant breeding potential. For this study, 18 varieties were collected from the Rimski Šančevi experimental field. Genetic diversity analysis was conducted using 14 microsatellite (SSR) markers. Successful amplification during the PCR reaction was achieved using 11 primer pairs, which detected 29 different alleles. Two of these markers were monomorphic, yielding only one allele each, and were excluded from further analysis. The genetic analysis revealed an average of 2.63 alleles per marker (*A*) and 2.29 alleles per individual per locus (*Ai*), while the average observed heterozygosity (*Ho* = 0.59) was found to be higher than the average expected heterozygosity (*He* = 0.49). Principal Coordinate Analysis (PCoA) explained 53.27% of the diversity among the examined varieties through the first three coordinates, categorizing them into three groups. A dendrogram constructed using the UPGMA method arranged the varieties into two clusters. This analysis of sour cherry diversity using SSR markers revealed significant differences between the tested varieties, providing a clearer insight into the state of genetic resources for this species that can be utilized in breeding programs.

Key words: diversity, breeding, genetic resources, microsatelllites

Acknowledgment

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P1_03

New flat peach cultivar ‘Darinka’

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Abstract

In this paper, the newly created flat peach cultivar ‘Darinka’ was studied. It was recognized as a new peach cultivar in 2023. It was created from the crossing combination ‘Goca’ ´ ‘Turtite 1 Baneasa’ at the Faculty of Agriculture, University of Belgrade. The ‘Turtite 1 Baneasa’ cultivar was used as the standard for the comparison. The study was conducted over a period of three years (2021-2023). The most important morphological traits, ripening time, yield, physical fruit characteristics, chemical composition of the fruit and sensory evaluation of fruit quality, were investigated. The ‘Darinka’ cultivar mostly had a medium red hue over a yellow skin ground color, and yellow flesh. In relation the stone adherence to flesh fruits of ‘Darinka’ cultivar are freestone. For the largest number of properties, the cultivar ‘Darinka’ showed better values than the standard. Statistically significant differences were found for ripening time, yield, fruit weight, fruit length fruit width, fruit thickness, soluble solids content and invert sugars content. The ripening time of the ‘Darinka’ cultivar was on average August 14, and the standard cultivar on August 18. The ‘Darinka’ cultivar had a yield of 7.16 kg/tree and a fruit weight of 80.03 g, while the ‘Turtite 1 Baneasa’ cultivar had a yield of 6.21 kg/tree and a fruit weight of 66.74 g. The soluble solids and total acid content of the ‘Darinka’ cultivar was 20.34% and 0.43%, respectively, compared to 17.86% and 0.57%, for the standard cultivar. The ‘Darinka’ cultivar also had a better fruit appearance, taste and aroma than the standard cultivar. The obtained results show that the 'Darinka' cultivar is an interesting quality flat peach cultivar for fresh consumption and spread in production orchards in Serbia.

Key words: flat peach, ripening time, yield, pomological characteristics, fruit quality

Acknowledgment

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P1_04

Flowering phenology, tree vigor and yield of sour cherry cultivars grafted on Gisela 5 rootstock

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Abstract

Sour cherry is an economically important fruit species in temperate climates, and the selection of suitable cultivars is essential for stable production and adaptation to specific agroecological conditions. The aim of this study was to evaluate the flowering phenology, tree vigor, and yield performance of sour cherry cultivars grown in a collection orchard. The study was conducted on an experimental collection comprising 18 sour cherry cultivars. All cultivars were grafted on Gisela 5 rootstock and planted at a spacing of 3.5 × 1.5 m. Over several years, flowering dynamics were monitored through the main phenological stages of flower development in order to determine differences in the timing of individual phenophases among cultivars and across years of observation. Tree vigor was assessed using trunk cross-sectional area (TCSA) as an indicator of vegetative growth, while the yield performance of the cultivars was evaluated by visual assessment using a scoring scale from 1 to 5. The collected data provide a basis for the comparative evaluation of flowering phenology, vegetative growth, and yield potential of the studied cultivars and contribute to their further assessment regarding their suitability for cultivation under specific agroecological conditions.

Key words: sour cherry, cultivars, flowering phenology, tree vigor, TCSA, yield performance, Gisela 5

Acknowledgment

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P1_05

Morphological variability of cherry plum (*Prunus cerasifera* L.) populations in the Doboj region

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Abstract

The development of varieties adapted to changing climatic conditions represents a new challenge in plant selection and breeding, primarily in terms of the selection and sources of new genes. Cherry plum (*Prunus cerasifera* L.) is one of the most widespread fruit species in the natural populations of the Balkans and is characterized by very wide genetic variability. The aim of this research was to identify genotypes from natural populations of cherry plum that are better adapted to unfavorable environmental conditions, primarily those that show greater tolerance to water deficit and extremely low temperatures. A total of ten genotypes were selected from two locations, and morphological analyses of leaves, fruits, and flowers were conducted. All selected trees were of generative origin, indicating that they represent a population of genetically diverse genotypes. By analyzing the studied fruit traits in combination among the selected populations from the locations Pridjel Gornji and Gornja Paklenica, a grouping of certain genotypes from these locations was observed, with genotypes 7 and 9 from the location Pridjel Gornji standing out. A distinct grouping of genotypes 2 and 3 from the location Gornja Paklenica was also observed. Morphological research and statistical analyses indicate the genotypic specificities of the selected cherry plum genotypes and represent valuable material for further work in the selection of generative and vegetative rootstocks for plum.

Key words: breeding, climate change, genotype, gene

P1_06

Branching induction in plum and sweet cherry nursery plants using bioregulators

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Abstract

The aim of this study was to evaluate the effectiveness of bioregulators [6-benzyladenine (BA) and gibberellic acid (GA_3)] in inducing lateral branching of plum ('Čačanska Lepotica' and 'Nada' grafted onto *Prunus cerasifera* Ehrh.) and sweet cherry ('Regina' grafted onto *Prunus avium* L. and *P. mahaleb* L.) nursery trees. Two commercial products, Opti Gold (BA 2% + free amino acids 8% + organic nitrogen 0.84%) and GibGro® PGR (GA_3 20%), were applied at 250 mL L^{-1} and 2.5 g L^{-1}, respectively. Four treatments were applied: I – Opti Gold (two applications); II – Opti Gold (four applications); III – Opti Gold (two applications) + GibGro® PGR (one application); IV – untreated control. The first application was performed when plants reached 60 cm above the graft union (mid-May), with apical buds treated directly. All lateral shoots were removed prior to the first treatment, and subsequent applications were repeated at 14-day intervals. Morphological parameters analysed included stem diameter, height of the first lateral branch, and number, length, and diameter of lateral branches. In plum nursery trees, the height of the first lateral branch was cultivar-specific, while other parameters depended on cultivar × treatment interaction. For 'Čačanska Lepotica', the best overall results were observed in treatment I, while the highest number of lateral branches occurred in treatment II. In contrast, for the 'Nada' cultivar, the highest number of lateral branches was recorded in treatment I, whereas the other parameters reached their maximum in treatment II. In 'Regina' sweet cherry, the number of lateral branches did not differ significantly between rootstocks or treatments, although the other parameters varied. Plants grafted onto *P. avium* performed best under treatment I, whereas those grafted on *P. mahaleb* responded best to treatment III.

Key words: plum nursery tree, sweet cherry nursery tree, BA, GA_3, apical bud treatment, lateral shoot development

Acknowledgment

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P1_07

Grafting of autochthonous apple cultivars on M9 and MM106 rootstock

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Abstract

As part of the Program for the Preservation of Plant Genetic Resources of the Republic of Srpska, in the nursery of the Institute for Genetic Resources of the University of Banja Luka, regular production of planting material of autochthonous cultivars of fruit trees is carried out with the aim of preserving them and returning them to their natural habitats.The aim of this study was to examine the growth and development of seedlings of nine autochthonous apple cultivars grafted on M9 and MM106 rootstocks during the first year of development. Grafting was performed in the spring of 2025 by grafting seedlings using the English grafting technique at a height of 30 cm. The following apple cultivars were measured: Vidovka, Đulabija, Ananas reneta, Batulinka, Crvenika, Krompiruša, Limunka, Petrovača and Slatka Šarenika, and the following parameters were observed: grafting reception (%), seedling height (cm), trunk diameter 10 cm above the grafting place (mm), number of branches, internode length (mm), leaf area (cm^2), leaf length (cm) and petiole length (mm).The results of this study showed significant differences between the observed cultivars in terms of seedling growth and development, which can be characterized as cultivar specificity. The differences that occurred within a cultivar depending on the rootstock were more or less pronounced depending on the observed parameter, with higher values, as expected, being recorded for seedlings grafted onto the MM106 rootstock. The graft acceptance ranged from 76.66% to 100%. All observed cultivars can be classified into three groups based on their growth on both observed rootstocks: vigorous cultivars (Vidovka, Krompiruša, and Limunka), medium-vigorous cultivars (Slatka Šarenika, Đulabija, and Crvenika), and weakly vigorous cultivars (Petrovača, Batulinka, and Ananas Areta). To obtain more significant data on the observed cultivars and their possible use in production plantations, further research is necessary.

Key words: nursery production, indigenous cultivars

P1_08

Experiences with multi-axis training systems in stone fruit production

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Abstract

Modern intensive fruit production increasingly requires training systems that enable efficient orchard management while maintaining stable productivity and fruit quality. Multi-axis training systems are increasingly being tested in stone fruit production as an alternative to traditional canopy architectures. This study presents practical experiences with the establishment and management of multi-axis training systems in sweet cherry and European plum under the agroecological conditions of northern Bosnia and Herzegovina.The study included sweet cherry trees with four cultivars and European plum trees with a larger number of cultivars of different ages, all trained using a multi-axis system with several vertical axes per tree. Observations focused on the specific aspects of canopy formation and the application of key pomotechnical practices, including pruning, renewal of fruiting wood, and canopy management. Particular attention was given to differences among species and cultivars in vigor expression, branching pattern, and response to pruning, which influenced the ease of training and long-term canopy stability. The results indicate that successful establishment of multi-axis systems requires careful formative pruning during the early years to ensure balanced development of individual axes and adequate light distribution within the canopy. Compared with conventional training systems, the multi-axis approach showed advantages in simplifying canopy management and improving the efficiency of orchard operations such as pruning, renewal of fruiting wood, and harvesting. Based on these experiences, multi-axis training systems can be considered a promising option for modern stone fruit orchards due to their potential to improve work efficiency and simplify the application of pomotechnical measures.

Key words: sweet cherry, European plum, canopy architecture, orchard management efficiency

P1_09

Impact of training system and cultivar on pruning efficiency in plum orchards

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Abstract

Pruning is one of the most important and labor-demanding operations in intensive plum production, strongly influenced by canopy architecture and cultivar growth characteristics. The aim of this study was to evaluate the effect of cultivar and training system on pruning intensity, expressed through pruning time and the amount of removed wood per tree. The research was conducted during two consecutive years (2023 – 2024) in a faculty experimental plum orchard including several European plum cultivars trained in different canopy systems. The results showed a significant influence of both cultivar and training system, as well as their interaction, on pruning intensity. The UFO training system generally required longer pruning time due to its more complex canopy architecture, while the Bi-axe system enabled a simpler canopy structure and lower amounts of removed wood. Among the studied cultivars, 'Empress' exhibited stronger vegetative growth and required more intensive pruning compared with cultivars such as 'Čačanska Lepotica' and 'Stanley'. It should be noted that these results refer to pruning intensity per tree; however, when expressed per hectare, the relative efficiency of training systems may change due to differences in tree density. The results indicate that the choice of training system plays a key role in optimizing pruning efficiency and labor requirements in intensive plum orchards.

Key words: plum, pruning, canopy architecture, labor efficiency

Acknowledgment

The research was supported through the implementation of the project: "Valorization of the Stone Seed of Domestic Plum (*Prunus domestica* L.)", funded by the Ministry of Scientific and Technological Development and Higher Education of the Republic of Srpska.

P1_10

The influence of training systems on the vegetative and generative potential of the plum cultivar "Čačanska lepotica"

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Abstract

Modern plum production requires the implementation of training systems that optimize the balance between vegetative growth and generative potential to ensure stable yields and efficient tree management. This study aimed to evaluate the influence of different training systems on the vegetative and generative potential of the plum cultivar "Čačanska lepotica". Research was conducted during 2025 in a orchard at the Experimental-Educational Center of the Faculty of Agriculture, University of Banja Luka, located in "Aleksandrovac" ("Laktaši" municipality). The orchard was established in 2019. Three training systems were included in the study: Spindel, UFO, and Bi-Baum. Measurements were performed on five trees per training system in three vertical zones: base (0–1 m), middle (1–2 m), and top (above 2 m). In each zone, five fruit-bearing branches were selected, categorized as short (up to 10 cm) or long (over 10 cm). On each fruit-bearing branches, vegetative and generative buds and flowers were counted, and trunk diameter was measured between the rootstock and the first branching. Vegetative and generative potential were calculated as the number of buds and flowers per unit of trunk cross-sectional area (TCSA). Statistical analysis was conducted using general linear models with a significance threshold of $p < 0.05$. Results showed that the Spindel training system consistently produced the highest number of vegetative and generative buds and flowers across all zones and on both fruit-bearing branches types. Bi-Baum exhibited a slightly higher number of vegetative buds than Spindel at the top on long fruit-bearing branches. The UFO system had the lowest bud and flower counts, but displayed a relatively uniform distribution across all zones. Research results indicate that training system significantly influences both vegetative and generative potential in cv. "Čačanska lepotica".

Key words: plum, Čačanska lepotica, training systems, vegetative potential, generative potential

P1_11

Plant growth regulators improve vegetative growth and yield in 'Duke' highbush blueberry

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Abstract

In modern production of northern highbush blueberry (*Vaccinium corymbosum* L.), plant growth regulators (PGRs) are applied to influence the vegetative development of plants, increase yield and improve fruit quality. The aim of this study was to examine the effect of foliar application of PGRs on shoot growth and yield of blueberry cultivar '*Duke*'. The research was conducted during 2024 in a blueberry plantation located in Romanovci, the city of Gradiška (45°08′43″ N, 17°15′04″ E), which was established in 2019. The PGRs treatments were applied once during the period from full flowering to the end of folwering (BBCH 54–59) by using a hand sprayer to 14 bushes each, with a water volume equivalent to 500 L ha^{-1}. The treatments were as follows: Globaryll (a.i. 6-benzyladenine 10%) 0.5 L ha^{-1}; Globaryll 1 L ha^{-1}; Obsthormon (a.i. naphthaleneacetic acid 7.5%) 0.13 L ha^{-1}; Obsthormon 0.26 L ha^{-1}; Globaryll 0.5 L ha^{-1} + Obsthormon 0.13 L ha^{-1}; Globaryll 1 L ha^{-1} + Obsthormon 0.26 L ha^{-1}; Orogib (a.i. GA_3 1.6% + BA 1.6% + B) 3.125 L ha^{-1}; Perlan (a.i. GA_{4+7} 1.8% + 6BA 1.8%) 2.75 L ha^{-1}; untreated control. Measurements of vegetative growth were carried out at the end of the growing season, when leaf samples were also collected to determine leaf area. All applied treatments increased the length and basal diameter of one-year shoots, as well as the number of leaves per shoot compared to the control, with Globaryll 1 L ha-1 + Ormoroc 0.26 L ha-1 and Orogib 3.125 L ha-1 being the most effective. The leaf area was the highest in Obsthormon 0.13 L ha^{-1} and Orogib 3.125 L ha^{-1}. Considering the strongest promotion of shoot and leaf development, the treatment with Orogib resulted was 2.6 times higher yield compared to the control.

Key words: 6-benzyladenine, naphthylacetic acid, gibberellins, shoot length, leaf area

P1_12

Stomatal conductance responses of two blackcurrant cultivars under water stress

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Abstract

Water stress significantly affects blackcurrant productivity, particularly during sensitive phenological stages such as flowering. This study evaluated stomatal conductance (gs) as a physiological indicator of drought response in two blackcurrant cultivars, Ben Gairn and Narve Viking, grown under greenhouse conditions. One-year-old plants cultivated in 3 L pots were subjected to two water regimes: fully irrigated (FI) and non-irrigated (NI) for 0, 3, 5, 7, 10, and 12 days. Stomatal conductance measurements were taken in the morning and afternoon to capture diurnal variation during the flowering period. Data were analyzed using the R programming language, applying four-way ANOVA with logarithmic transformation and Tukey post-hoc comparisons to assess the effects of cultivar, irrigation treatment, measurement time, and duration of drought stress. Results indicated significant interactions among factors, with 'Ben Gairn' maintaining higher stomatal conductance under water deficit and showing slower stomatal closure compared with 'Narve Viking', suggesting greater drought tolerance. The R-based analytical workflow enabled robust handling of repeated measurements and complex factor interactions in plant physiological datasets. These findings contribute to improved understanding of drought response mechanisms in blackcurrant and provide a quantitative framework for evaluating cultivar performance and supporting the selection of drought-adaptive genotypes under water-limited conditions.

Key words: blackcurrant (*Ribes nigrum* L.), stomatal conductance, drought stress, cultivar response, irrigation

P1_13

Improving fruit set and quality of 'Williams' pear using biostimulants and plant growth regulators

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Abstract

Plant growth regulators are applied to increase fruit set and yield in pear cultivars prone to poor fruit set, as well as to mitigate frost damage. This study aimed to apply different combinations of a biostimulant and plant growth regulators at two flowering stages to the pear cultivar '*Williams'* to improve fruit set and maintain good quality.The following treatments were applied at phonological stages BBCH 62 and BBCH 65: Vellset (a.i. B, Mo, N, amino acids) 2 mL L^{-1} + Perlan (a.i. GA4+7 1.8% + 6BA 1.8%) 0.25 mL L^{-1}; Vellset 2 mL L^{-1} + GranPera (a.i. GA_3 2%) 1.0 mL L^{-1}; Vellset 2 mL L^{-1} + Orogib (a.i. GA_3 1.6% + BA 1.6% + B) 0.25 mL L^{-1}; FrutaFija (a.i. NAA 3%) 0.15 mL L^{-1} + Perlan 0.25 mL L^{-1}; FrutaFija 0.15 mL L^{-1} + GranPera (a.i. GA_3 2%) 1.0 mL L^{-1}; FrutaFija 0.15 mL L^{-1} + Orogib 0.25 mL L^{-1}; Orogib 0.25 mL L^{-1} + Perlan 0.25 mL L^{-1}; Perlan 0.25 mL L^{-1} + Orogib 0.25 mL L^{-1}; and an untreated control.Fruit set was very low in the untreated control (1.1%), due to frost damage and poor weather conditions during flowering. All treatments applied increased fruit set compared with the untreated control. The highest fruit set (5.4%) was recorded in the treatment FrutaFija 0.15 mL L^{-1} + Orogib 0.25 mL L^{-1}, in which fruit size was not affected, while the proportion of deformed fruits (25%) was higher compared with the control. Fruit set was also increased in the Vellset 2 mL L^{-1} + Perlan 0.25 mL L^{-1} treatment, with fruit weight increasing by 10.1% compared with the control. In addition, no deformed fruits were observed, indicating that this treatment could be used for improving fruit set and quality in '*Williams*' pear.

Key words: fruit set, plant growth regulators, 6-benzyladenine, gibberellins, naphthaleneacetic acid

Acknowledgment

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P1_14

Morphological characteristics of one-year-old walnut (*Juglans regia* L.) shoots

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Abstract

The objective of this research was to determine the influence of genotype (three spontaneous seedlings: L16, L6 and L45), environmental factors over two years (2020–2021), shoot length (<6 cm, 8–18 cm, and >20 cm), and shoot type (shoots developed from vegetative buds versus those from mixed buds) on the morphological characteristics of one-year-old shoots (diameter, node number, and length-to-diameter ratio). Furthermore, the study examined the representation of different bud categories (vegetative, dormant catkins, and mixed buds) on the three terminal nodes and across the entire one-year-old walnut shoots, as well as the representation of different shoot types within the overall structure of the one-year-old wood. The results showed that, in most cases, genotype, shoot length, and shoot type exerted a significant influence on the investigated parameters, whereas the effect of the year was not significant.

Key words: genotype, vegetative shoots, fruiting shoots, mixed buds, dormant catkins

P1_15

Color and antioxidant activity in light colored traditional autochtonous apple varieties

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Abstract

As a part of the Gene Bank of the Republic of Srpska, within the Institute of Genetic Resources, University of Banja Luka, field collections of autochhthonous fruit and grape varieties serve as a valuable resource for diverse scientific research, experimental studies, measurements, and long-term monitoring. In ripening season of 2024, we counducted research on traditional autochthonous apple varieties. From field collections, we selected 3 apple accsessions with good yield potential, for sampling. The apple varieties included in this study were Bjeličnik, Vidovka žuta and Kanada Švabica. After color analyses was done, we concucted analyses of antioxidant potential in samples. Methods used for color were the LAB digital color positioning system and for antioxidant potential, it was determined using the DPPH free radical sequencing method. Results showed that EC50 value of 18.60 mg/mL places 'Vidovka žuta' at the top of the studied varieties for antioxidant potential. 'Bjeličnik' is interesting variety in the pomology of Republika Srpska, named for its characteristic pale, almost white skin (EC50 =24.19 mg/mL). Kanada švabica showed EC50 of 31.87 mg/mL, and suggests a lower relative antioxidant potency compared to 'Vidovka žuta' and 'Bjeličnik'. Color showed that Bjeličnik is also significantly lighter than the others, confirming its phenotype as the "white" apple of the collection. Yellowness (b*) indicated that Vidovka žuta and Kanada švabica are statistically similar in their yellow intensity, while Bjeličnik is significantly less yellow. Traditional apples are a rich source of dietary antioxidants. The high uniformity in 'Bjeličnik' and the superior potency of 'Vidovka žuta' justify their use in breeding programs targeting increased functional value in modern apple cultivars.

Key words: apples, color, antioxidant potential

Acknowledgment

This research was supported by the Ministry of Scientific and Technological Development and Higher Education of Republic of Srpska, through the project: "Examination of antioxidant activity in fruits from plantations of field collections of autochtonous apple and pear varieties"

P1_16

Post-harvest fruit handling processes: From placement to waste valorization

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Abstract

The paper includes an analysis of the post-harvest fruit handling process, with a special emphasis on critical points in the supply chain, from primary selection to waste valorization. Post-harvest fruit handling is defined as an integral system of processes necessary to preserve the nutritional value and quality of the fruit, as a living organism that continues its metabolic functions even after separation from the parent plant. The paper presents the basic stages of harvesting, transport and primary processing in order to emphasize that inadequate logistics and hygiene are the main causes of mechanical damage and microbiological contamination, which leads to losses of between 40-50% of the total volume at the global level. Attention is also paid to modern packaging technologies. Innovative packaging solutions, such as smart and active packaging, incorporating nanocomposites and real-time monitoring sensors, was analyzed to extend the shelf life of fruits. The focus also was to the treatment of agricultural waste in retail. Economic and environmental causes of fruit waste are identified, such as the insistence on "aesthetic perfection" and inefficient inventory management. The waste of edible fruits not only causes an economic cost, but also an environmental disaster caused by ethane emissions in landfills. Finally, the paper affirms the concept of fruit waste valorization in a circular economy system. Inedible parts of fruits, such as peel and seeds, are seen as exceptional sources of bioactive compounds and fibers for the production of functional foods. The conclusion is that the implementation of advanced post-harvest technologies and efficient processing of fruit waste serves as the only path towards reducing the ecological footprint and improving the economic profitability of the food industry.

Key words: modern packaging methods, fruit waste, valorization of fruit waste, sustainable development

Acknowledgment

This paper was supported by Ministry of Scientific and Technological Development, Higher Education and Information Society of Republic of Srpska trough the project "The Importance and Application of The Bioactive Potential of Fruits and Vegetables in The Development of the Food Industry" in support of COST action CA 24111 "European Network for Valorizing Food Processing Waste into Sustainable Fibers (ENFiber)", (Contract number: 19.032-966-49 /25).

P1_17

Digital twins in strawberry cultivation: A systematic literature review

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Abstract

Strawberry (*Fragaria × ananassa*) is a very popular fruit among consumers due to its appealing appearance, flavor, and health benefits. It holds significant economic value worldwide and is cultivated both for fresh consumption and food processing. However, strawberry cultivation faces challenges regarding soil quality, growing conditions, and disease management. Because strawberry is a highly perishable and labor-intensive crop, its cultivation can greatly benefit from precision agriculture approaches. Digital twins are an emerging technology used to develop virtual models of real systems. In agriculture, this technology has been applied to simulate and monitor different aspects of crop production, such as crop growth models. In bibliography, while theoretical interest in digital twins in agriculture is substantial, practical implementation remains limited. Therefore, a systematic literature review was conducted to synthesize current knowledge on the application of digital twins in strawberry cultivation for the last decade. The research focuses on models for soil, crop growth, and insect population, which are considered major parameters affecting cultivation. Based on PRISMA 2020 guidelines for Systematic Reviews and Meta-Analyses, two databases, namely Google Scholar and ScienceDirect, were searched in March 2025, including research articles and reviews published in English. The findings show that digital twins applied in precision agriculture mainly regard real-time monitoring crop growth in greenhouses using IoT and enable 3D visualization for optimized irrigation and fertilization. This work highlights challenges from different aspects of strawberry cultivation, such as technical (e.g., improving real-time performance due to computational load, scalability to larger farms/uncontrolled environments), methodological (e.g., mismatch between virtual and real crop structures, collection of intrusive and destructive data), and economic (e.g., costs for full automation and deployment). Therefore, the findings could be valuable to researchers, farmers, and businesses, providing insights that can guide scientific studies, improve agricultural practices, and support decision-making in the strawberry cultivation.

Key words: digital twins, strawberry, crop growth, soil model, insect population

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P1_18

Cultivar differences in apple fruit chemical quality as a basis for agrivoltaic orchard systems

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Abstract

Agrivoltaic systems, which combine agricultural production with photovoltaic energy generation on the same land area, are increasingly being explored as a strategy to enhance land-use efficiency and climate resilience. In orchards, these systems can modify microclimatic conditions such as light intensity, temperature, and water availability thereby influencing tree physiology, fruit quality, and overall productivity. As part of the project "Development of Innovative Products within the Priority Niche Smart Agriculture – Agriculture Next Generation (ANG)", an agrivoltaic system will be installed above the apple orchard at the beginning of the 2026 growing season at the Tenja experimental field of the Faculty of Agrobiotechnical Sciences Osijek. The system will be set up in three different configurations: semi-transparent, dark, and rotating solar panels. The aim of this preliminary study was to determine the chemical properties of apple fruits during the 2025 growing season in order to identify differences among cultivars prior to the installation of the agrivoltaic system. Cultivar had a significant effect on all examined properties: pH value, acid content and vitamin C content in the juice, as well as dry matter and starch content in the apple fruit. The highest total acid content, and consequently the lowest juice pH value, was recorded in the cultivars Granny Smith and Red Topaz. The lowest total acid content and the highest juice pH value were found in the cultivar Golden Delicious. The cultivars Braeburn Aporo Mariri Red, Braeburn Lochbuie, Sirius, and Red Topaz showed a significantly higher vitamin C content in the juice, which was positively correlated with starch content and dry matter percentage. In the upcoming growing seasons, climatic indicators and the agroecological response of apple leaves and fruits to shading will be monitored, in order to identify cultivars suitable for cultivation in agrivoltaic systems.

Key words: agrivoltaics, apples, shading, quality, cultivars

P1_19

Measures that affect the functionality and efficiency of sprayer during application of protective agens

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Abstract

Chemical protection of orchards is one of the most important protective measures that ensure high and quality production. Goal of research is to, based on potential capabilities of device through adaptation (calibration model) to the geometry of the plantation, achieve the same or similar quality of protection, that is, to indicate the possibility of saving energy and increasing the productivity of work during applying pesticides on apple orchard. Research was conducted in order to determine the influence of important treatment parameters (working speed, working pressure, device capacity, treatment rate) on leaf surface coverage, size and number of drops per cm^2. It were used spreyers that during research achieve working angle of 80°, Lechler TR 80 - 04, red coded, TR 80 - 02, yellow coded and TR 80 - 015, green coded. Results of research confirmed the assumption that with the classical concept sprayer that has passed measures of technical control, adjustment and calibration, under suitable weather conditions, with small norms it can be achieved a high-quality application of pesticides. By reducing the standard of treatment, the calibration of sprayer comes to the fore, and so well better results are achieved in terms of coverage of treated surface, as well as the number of drops per cm^2. Correcting the norm, that is by applying a significantly lower standard through a calibrated sprayer, similar results were achieved in terms of quality of application, with a significant reduction of losses.

Key words: sprayer, efficiency, treatment standard, plant protection, losses

P1_20

Natural strategies for pest control in agriculture

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Abstract

Identifying new sources of pesticidal compounds represents a significant challenge in contemporary plant protection. Accordingly, plant-derived natural products play an important role in the development of novel biopesticides. They comprise various types of secondary metabolites, produced by plants as a defensive response to pests and pathogens, offering a renewable source of bioactive agents with unique modes of action. Furthermore, certain compounds play a key role in the plant immune response. Previous studies have confirmed the efficacy of essential oil-based bioinsecticides in controlling the invasive insect species *Drosophila suzukii*. Renewable biopesticide sources are increasingly recognized as a promising approach in overcoming resource limitations and environmental pollution. Thus, phenolic and polyphenolic compounds in olive mill wastewater, particularly oleuropein, have demonstrated insecticidal activity and efficacy against the invasive Mediterranean fruit fly, *Ceratitis capitata*. Optimizing the fermentation process could enable the use of agroindustrial waste, such as rice husk, as a substrate for fungal-based biocontrol agents production, such as *Beauveria* and *Trichoderma*, which represent promising alternatives to chemical pesticides. Grape pomace, a valuable agricultural by-product, contains bioactive stilbenes which show considerable potential as biopesticidal agents. Recent studies have confirmed the efficacy of resveratrol in controlling *Botrytis cinerea* by inhibiting mycelial growth and conidia germination. Benefits of these compounds include their rapid degradation, low risk of residue accumulation in food, and chemically complex bioactive profiles that limit the development of pest resistance, even within a single extract. Their selectivity towards non-target and beneficial organisms also enhances safety for humans, animals, and the environment. Overall, their properties highlight the potential of plant-derived products as a new generation of biopesticides in sustainable agriculture.

Key words: natural sources, biopesticides, pests, agriculture

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P1_21

Detection of Plum pox virus in autochthonous stone fruit collections and orchards in the Republic of Srpska

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Abstract

Plum pox virus (PPV) belongs to Potyvirus genus, is one of the most devastating viral disease of stone fruit worldwide. PPV affects stone fruit in the Prunus genus, which includes plums, apricots, cherries, sour cherry, peaches, and almonds. Transmission of PPV in short-distance spread by aphids in a non-persistent manner, but in long distance spread through human activity, such as grafting and movement of infected plant material. During 2025, a survey was performed to detect the presence of Plum pox virus (PPV) in stone fruits collection orchards in Aleksandrovac and at the site of Botanical Garden of the University of Banjaluka and orchards surround Banjaluka which include both commercial and autochthonous varieties. Leaves plant tissues were collected and analyzed serologically by DAS-ELISA method with commercial antisera according to recommended protocol (Bioreba, Switzerland). A total of 72 accessions were analyzed where every sample include at least 2 trees. Plum, cherry, sour cherry, apricot and peach samples were collected, but all positive samples were plum trees. In total, 36 of symptom and symptomless plum accessions resulted as positive. Observing the presence of Plum Pox Virus (PPV) in a collection of autochthonous stone fruit accessions is a critical step for preservation, propagation, and recovery procedures.

Key words: Prunus genus, PPV, serological analyzes

Acknowledgment

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P1_22

Flight dynamics of codling moth (*Cydia pomonella*) and performance of aged pheromone lures

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Abstract

Apple production is significantly affected by pest pressure, among which the codling moth (*Cydia pomonella*) represents a key insect pest. Larval feeding inside the fruit causes direct damage, leading to yield losses of 30–50% in the absence of control measures, and up to 90% under severe infestations. Monitoring adult flight activity is the cornerstone for determining the optimal timing for treatments, with the goal of reducing insecticide use and ensuring economic sustainability and environmental protection. The study was conducted in 2025 in an orchard in Rizvanovići (Prijedor) on the *Petrovka* cultivar. The objective was to assess pest flight dynamics and evaluate the effectiveness of pheromones of different ages. Two types of delta traps were used: a larger white trap and a smaller transparent one. Traps were installed in the first half of April at a height of 1.5–2 m. Two pheromones manufactured by Biobest were tested: one within the recommended usage period and another three years past its expiration date. The results revealed a highly dynamic flight pattern with two primary peaks in population density. Following the initial April emergence, the first significant peak was recorded in mid-June. The second, more pronounced peak occurred in August, reaching the seasonal maximum population level at the end of the month. The larger white trap consistently recorded higher daily catches. The short distance between the traps likely influenced the distribution of the catch. Findings demonstrate that pheromone lures remain highly effective three years after expiration. Differences in catch numbers were primarily due to trap design rather than lure performance. *C. pomonella* flight dynamics in this study indicate an intensive and prolonged presence. The extended functionality of pheromone lures offers an opportunity for more cost-effective monitoring. Despite numerical differences in catch, both trap types proved reliable for tracking seasonal population dynamics.

Key words: Cydia pomonella, monitoring, flight dynamics, pheromones, apple

P1_23

Incidence of root rot caused by *Phytophthora fragariae* var. *rubi* on blackberry in the Republic of Srpska

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Abstract

Phytophthora fragariae var. *rubi* Wilcox and Duncan is the primary problem of raspberry root rot and is included in the EPPO A2 quarantine list of harmful organisms. In addition to raspberry (*Rubus ideus* L.), blackberry (*Rubus fructicosus* L.) is also listed as a host plant. The fastest spread of the pathogen is through the use of infected nursery plant material. Once the pathogen enters the production area, it can survive in the soil for many years, even in the absence of host plants. Through the national Program for Plant Protection, nursery and commercial production of berry fruit, as well as imported plant material from border crossings, were examined for the presence of the pathogen. Although there were no confirmed infected blackberry samples in previous surveys, last year in 2025 the presence of the pathogen was confirmed on blackberries within one commercial plantation. This year in 2026, the presence of the pathogen was confirmed in one blackberry sample from the border crossing. Laboratory work was done through DNA extraction directly from the sampled roots using extraction buffer and amplified by nested PCR. Results indicate that nested PCR (ITS 4/DC 6 for first round, DC 1/DC 5 for second round) for detection of *P. fragariae* var. *rubi* are less time-consuming and therefore recommended for use as it allows a fast reaction.

Key words: Phytophthora fragariae var. *rubi*, raspberry root rot, blackberry (*Rubus fruticosus*), nested PCR detection, quarantine plant pathogen

P1_24

Leaf spot symptoms of Loquat (*Eriobotrya japonica*) in Montenegro

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Abstract

Loquat (*Eriobotrya japonica*), also known as Japanese medlar, is sporadically distributed in Montenegro, primarily as an ornamental plant in home gardens and urban green spaces. During regular monitoring of the health status of planting material in Montenegrin nurseries in 2024 and 2025, characteristic leaf spot symptoms were observed on plants aged 3 to 8 years. Symptoms appeared as brown to black spots of round or irregular shape, varying in size, with a lighter central area and darker margins. Over time, spots coalesced, leading to tissue necrosis and premature leaf drop. Symptomatic leaves were sampled and incubated in a moist chamber (25 °C, 60–70 % relative humidity) for 3 days. On the underside of the leaf, within necrotic spots, gray mycelium and a thin black layer were observed. Microscopic examination of these layers revealed numerous spores, whose morphological features indicated *Entomosporium* spp. and *Venturia* (*Fusicladium*) spp. as the causal agents. *Entomosporium* conidia were multicellular (3–5 cells) with characteristic segmented appearance, averaging 23–29 µm in length, 3–5 µm in width at the apical end, and 4–7 µm at the basal end (n=100). *Venturia* spp. conidia were fusiform to oval with a narrowed apex, averaging 13–21 µm in length and 4–7 µm in width (n=100). These results indicate that regular chemical treatments are necessary for the control of *Entomosporium* spp. and *Venturia* spp. in the production of *E. japonica* in Motnenegro, as humid conditions favor their sporulation and spread, while timely fungicide application can significantly reduce leaf damage.

Key words: loquat, symptoms, *Entomosporium* spp., *Venturia* spp.

Acknowledgment

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P1_25

Establishing the "Slivovica Srpske" standard: A multidisciplinary framework for quality protection and cultural safeguarding

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Abstract

The production of plum and plum brandy (rakija sljivovica) is deeply embedded in the cultural and agricultural identity of the Republic of Srpska. However, the lack of a unified standard has historically led to market fragmentation and inconsistent quality. This paper presents the newly developed "Slivovica Srpske" Standard, a comprehensive regulatory framework designed to protect the origin, culture, traditional production methods, and sensory authenticity of plum spirits. A core hypothesis of this work is the "Unified Stakeholder Model." Unlike traditional top-down regulations, this framework was developed to ensure that agricultural producers, master distillers, and scientific experts operate as a single team with equal protection. For the farmer, the standard preserves genetic resources and traditional orchard management; for the distiller, it provides a technical roadmap for excellence; and for the expert, it creates a transparent system for certification and traceability. The research and results rely on deep study of well-established benchmarks such as Calvados, Cognac, Tequila, Mezcal and Armagnac standards. "Slivovica Srpske" standard establishes a rigorous plum production, distillation and aging system. It encompasses novel four-tier classification system: Bistri (Clear), Originalni (Original), Veliki (Grand/Old), and Vrhunski (Premium/Archive) distillates. Each level defines specific requirements for raw materials emphasizing autochthonous varieties like Požegača or Crvena Ranka, fermentation parameters, copper-still distillation limits, and aging durations in oak or mulberry casks. By integrating modern oenological practices with ancestral knowledge, the standard moves beyond a simple set of rules to become an efficient tool forscientific, cultural and economic development. It ensures that the value added during the aging process is protected through strict labelling and certification protocols. Ultimately, the "Slivovica Srpske" standard serves as a model for how Balkan traditional products can achieve global prestige while remaining rooted in local biodiversity and community cooperation.

Key words: plum, rakija, standardization, autochthonous varieties, distillation, terroir, quality control

P1_26

The influence of water stress on yield and berry composition of cv. Vranec (*Vitis vinifera* L.)

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Abstract

The influence of water stress on the agrobiological and technological properties of grapevine is a critical area of study, especially given climate change and increasing drought conditions in many grape-growing regions. The impact of water stress was examined by measuring the midday stem water potential in non-irrigated and irrigated plantations of the Vranec variety, during 2021, in the Tikvesh grape – growing region. According to midday stem water potential values, non-irrigated plantations were exposed to severe water stress and the following parameters were measured: yield per vine, skin-to-pulp ratio, total soluble solids, total acid in the grape juice and pH of the grape juice. The results showed that water stress affected grapevines by reducing berry size, with lower water availability leading to smaller berries, which reduced the skin-to-pulp ratio. Lower cluster weight led to an overall reduction in yield under prolonged or severe water stress. Water stress also negatively affected berry composition. Moderate water stress increased sugar levels due to reduced berry size and concentration effects. Tartaric and malic acid concentrations were reduced, potentially affecting the freshness and balance of the wine, and pH was increased due to reduced acid content. Water stress, when carefully managed, can enhance certain technological properties of grapes beneficial for winemaking, particularly in red varieties. However, excessive stress risks yield loss and quality degradation. Sustainable irrigation management is crucial in balancing berry composition performance with enological quality.

Key words: water stress, midday stem water potential, yield, berry composition, Vranec

P1_27

Technological characteristics of the newly introduced grapevine Souvignier gris cv. grown in the Telečka wine region

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Abstract

The study aimed to determine the technological potential of Souvignier gris, a variety introduced to Serbian viticulture in 2021, which is currently cultivated in the Telečka wine region. The research was conducted in a commercial vineyard in this region during the 2023-2025 period. Sample analysis was carried out in the laboratory of the Department of Viticulture, University of Belgrade Faculty of Agriculture. The study includes an analysis of the region's agroclimatic conditions, the mechanical composition of grapes and berries, and the quality chemical parameters of grape juice-must. In the period 2001-2020, the average annual temperature was 12.1°C, and the average vegetation temperature was 13.3°C. Annual precipitation averaged 592 mm. Mechanical composition analysis showed that the average bunch mass ranged from 156.1 to 187.9 g. The highest number of berries per bunch (185.3) was recorded in 2024. In 2023, samples had the highest average mass of 100 berries (150.0 g), the largest berry dimensions (12.5±0.7 × 11.6±1.0 mm), and the greatest skin mass of 100 berries (9.2 g). The proportion of skins in bunches ranged from 6.4% to 7.4%, while the proportion of mesocarp in bunches varied between 82.5% and 87.6%. Regarding the quality parameters of grape must, sugar content ranged from 24.0% to 26.4%, and total acidity from 8.1 to 8.7 g/L. The glycoacidometric index, expressed as the ratio of sugar to acid concentration, ranged from 2.8 to 3.1. According to these results, the examined variety meets the standards for quality white wine production in the Telečka wine region.

Key words: Souvignier gris, grape juice, mechanical composition, sugar content, total acidity

Acknowledgment

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P1_28

Factors for the limited distribution and possibilities for selection and revitalization of autochthonous table varieties of *Vitis vinifera* L.

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Abstract

Our research presented in the abstract refers to the autochthonous table grape varieties in the Republic of North Macedonia and their insufficient representation in modern viticulture, with an emphasis on fertilization, fertility, yield and quality of the bunches. The research was conducted in the context of hybridization and the application of positive and negative clonal selection over the years, especially in the recent period, in order to identify the reasons for their insufficient distribution (represented on limited areas) and the possibilities for their revitalization. The main limiting factors are the variability in fertilization, which leads to unstable fertility, sensitivity to freezing and unpredictable yield, which reduces the reliability of production. However, some of the varieties show late ripening, which is an advantage for extending the harvest period, and others stand out with resistance to diseases, viruses and pests and good adaptability to different types of soils. The quality of the grapes in the selected clones is confirmed as a significant factor for their competitiveness, enabling a stable yield and a market-attractive product. The conclusion is that the analyses carried out in our country, such as systematic clonal selection, planned hybridization, genetic analysis and ampelographic testing according to O.I.V., are necessary to overcome the weaknesses and exploit the positive properties, in order for the autochthonous table varieties to gain a deserved place in modern viticulture.

Key words: autochthonous varieties, clonal selection, hybridization, fertility, adaptability

Acknowledgment

Thanks to the private individual producers where the autochthonous table varieties are represented and where our tests were carried out.

P1_29

The quality of cold macerated Žilavka wines

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Abstract

In this paper, the influence of cold maceration on the quality of Žilavka wines was investigated. Six samples were prepared: five samples were subjected to maceration and fermentation at a temperature of 10°C, lasting from 24 h to 240 h, and the sixth sample was a control sample (must), which was fermented at 10°C. The content of total phenolics, flavonoids and non-flavonoids was determined in the wines, and the FRAP, DPPH and ABTS tests were used to test the antioxidant activity. The agar dilution method was used to test the antimicrobial activity of wine, and four pathogenic and conditionally pathogenic bacteria were selected: *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Bacillus cereus*, the pathogenic yeast *Candida albicans* and the probiotic culture *Saccharomyces boulardii*. The highest ethanol content was measured in the control sample (12.39% vol), and a significantly higher methanol content was measured in the macerated samples (5 to 6 times higher). The macerated samples showed a significantly stronger antioxidant effect (2.5 to 5 times higher) compared to the control sample, and with the increase in the duration of the maceration, the antioxidant properties also increased. The macerated samples showed a stronger antimicrobial effect than the control sample, and the strongest effect was shown against the bacteria *P. aeruginosa* and *S. aureus*.

Key words: Žilavka, maceration, physicochemical properties, antioxidant and antimicrobial activity

Acknowledgment

This research was funded by the Ministry for Scientific and Technological Development and Higher Education through the project "Improvement of the Biological Properties of White Wines and Blackberry Wines by Adjusting Maceration Parameters" (Contract No. 19.032/961-28/24, December 30, 2024).

P1_30

Effect of clonal variability of Chardonnay cultivar on phenological development, yield and quality of grapes and wine in agroecological conditions of Ćemovsko polje

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Abstract

The study aimed to evaluate the impact of clonal variability of Chardonnay on the phenological development, yield, and quality of grapes and wine under the agroecological conditions of the Ćemovsko Polje locality. During 2025, seven Chardonnay clones (R8, VCR11, 95, ISV4, 96, and SMA130) were analyzed in experimental vineyards of the company "13. jul Plantaže." Phenological stages, yield parameters, and basic chemical quality indicators of the grapes were monitored. After vinification, basic physicochemical parameters of the wines were analyzed, and sensory evaluation was performed using the OIV methodology and RATA approach. The obtained data were statistically processed using analysis of variance (ANOVA) and the LSD test to determine the significance of differences among clones. The results revealed differences among clones in ripening dynamics, yield, and technological maturity. Clone ISV4 achieved the highest yield (7.54 kg/vine) and the largest cluster weight (250 g), while clone 96 had the highest number of clusters per vine (21) with an average cluster weight of approximately 195 g. Clones 95 and SMA130 showed balanced yields of 2.0–2.9 kg/vine. Due to its more neutral aromatic profile and weaker structure, clone ISV4, together with clones 96 and SMA130, is recommended for commercial wine production. Clones 95, R8, and VCR11 exhibited grape sugar content of 22.0–22.8% with balanced acidity, making them most suitable for premium wine production. These results confirm the importance of clonal selection as a key measure for adapting cultivars to variable agroecological and climatic conditions.

Key words: Chardonnay, clonal variability, phenological development, yield, climate change

P1_31

Evaluation of UAV-based multispectral vegetation indices for disease and stress detection in vineyards

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Abstract

In areas with a long-standing tradition of wine production, vineyard management increasingly requires the application of precise and data driven agricultural practices. The adoption of advanced technologies in viticulture has enabled the collection of large amounts of data, supporting early detection of potential problems and providing valuable insights into crop condition and overall vineyard status. The objective of this paper is to analyze the potential of multispectral imaging for vineyard monitoring and to examine its role in improving decision making in modern viticulture. The paper provides an overview of the principles of multispectral sensing and the use of vegetation indices, particularly NDVI and NDRE, for assessing grapevine condition. Based on the reviewed literature, multispectral imaging enables precise monitoring of grapevine status, including the detection of stress, diseases, and pests, as well as the assessment of vine growth, development, and spatial variability within vineyards. Furthermore, its integration with UAV systems allows for efficient data acquisition and high-resolution analysis at the field level. Although certain limitations related to environmental conditions, data interpretation, and sensor calibration remain, multispectral technologies have significant potential to optimize grape production and support more sustainable and resource efficient vineyard management.

Key words: canopy monitoring, NDVI, NDRE, crop health assessment, site-specific management, UAV technology

Acknowledgment

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P1_32

Climate change and their impact on grape and wine quality cv. Riesling Italico and Sila on the terroir Fruška Gora

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Abstract

In recent years, climate change and conditions of the locality has an increasing impact on production and qualitative traits of grapes and wines. The Fruška Gora, as the only vineyard area in the Srem wine-growing region of the Serbia, represents a unique *terroir* with specific climatic characteristics. This study examined the influence of climatic factors on the quality parameters of grapes and wines of the Riesling Italico and Sila varieties over two years (2023-2024). The newly created domestic Sila variety is predominantly cultivated on Fruška Gora vineyard area (93.52%), compared to Riesling Italico, which occupies 12.77%. The climatic factors on the Fruška Gora during the study years deviated from the long-term reference period (1991-2020). The experimental years were warmer with lower total precipitation and uneven monthly distribution (19.2% deviation in 2024). The average annual air temperature in the last 30 years was 11.94°C. In 2023, it was higher by almost 2°C (13.89°C), while in 2024 it was even higher and amounted to 14.82°C. The mean vegetation temperature for the multi-year reference period was 17.81°C, while in both examined years were higher than average (2023-19.36°C; 2024-20.86°C). The year 2024 had a record number of tropical days (88), while in the reference period there were 38.4. The changed climatic conditions and Winkler index (2024-change B to C1 viticultural climate zone) significantly contributed to the quality of grapes and wines of the tested varieties. Riesling Italico had a higher sugar content in the must and higher alcohol content in the wine (22.63%; 13.2 vol.%). In both varieties, a lower content of total acids in the must was determined, conditioned by meteorological conditions during the grape ripening period (5.41 g/l Sila; 5.94 g/l Riesling Italico). These results indicate the need to plan adaptation in order to better utilize the *terroir* potential.

Key words: grapevine, climate, terroir, grape quality, wine

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P1_33

Survey of Flavescence Dorée Phytoplasma in grapevine in Montenegro

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Abstract

Grapevine (*Vitis vinifera* L.) is an economically and culturally important crop in Montenegro. However, its production is frequently affected by phytoplasmas associated with grapevine yellows. Grapevine flavescence dorée phytoplasma (FDp) is considered one of the most destructive grapevine pathogens worldwide. The aim of this study was to assess the current presence and distribution of FDp in Montenegro.FDp was first detected in Montenegro in a single sample in 2021 (Godinje, Bar), leading to the establishment of a demarcated area, which was expanded in 2023 following additional detection in two samples (Gluhi Do, Bar). Based on the results of official surveys conducted over two consecutive years without further detections, the demarcated area was lifted at the end of 2025. Nevertheless, a new single-sample detection in 2024 (Mataguži, Zeta) resulted in the establishment of a new demarcated area, accompanied by eradication of infected plants and the implementation of phytosanitary measures. During 2025, surveys were conducted in demarcated areas and major grapevine-growing regions in central Montenegro. Sampling was performed from July to September, targeting typical grapevine yellows symptoms. As these symptoms are not specific to FDp and may be associated with '*Candidatus* Phytoplasma solani' (Bois noir), molecular analyses were performed. A total of 220 grapevine samples were analyzed for FDp. DNA was extracted from leaf midrib, followed by direct PCR with P1/P7 primers and nested PCR with R16(V)F1/R1 primers. All samples tested negative for FDp. Additionally, from the same batch 20 samples were analyzed for the presence of '*Ca.* P. solani', using Tuf1-f1/r1-fTufAy/rTufAy nested PCR system followed by RFLP analyses. In two samples '*Ca.* P. solani' tuf-b was detected. The results indicate that FDp is currently not widespread in Montenegro and does not pose a significant threat to grapevine production.

Key words: Grapevine flavescence dorée phytoplasma, Bois noir, grapevine, symptomatology, identification

Acknowledgment

This study was supported by Administration of Food Safety, Veterinary and Phytosanitary Affairs, Montenegro, partly funded by Ministry of Science and Technological Development, Montenegro.

P1_34

Characterizing Prokupac red wines: Consensus vocabulary development and descriptive sensory profiling

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Abstract

Prokupac is an autochthonous Serbian red wine variety traditionally cultivated in Serbia and increasingly valued for quality-oriented winemaking. Building on recent work highlighting Prokupac's stable performance and oenological potential, this study aimed to define a sensory profile for Prokupac wines and to identify the main sensory attributes that differentiate wines obtained through diverse vinification trials. Ten Prokupac wines produced in distinct winemaking trials were evaluated by a panel of twelve trained assessors (CREA-VE, Asti, Italy). Descriptor generation was conducted in a guided session using the Noble aroma wheel adapted to product-specific traits, followed by consensus to establish a shared vocabulary. Descriptors mentioned by at least 50% of assessors were retained as core terms, while those mentioned by at least 25% were retained as secondary terms. Descriptive sensory profiling was then performed for all wines, with assessors rating attribute intensity using structured numerical scales. Mean intensity values were used to generate radar plots as sensory "fingerprints" for each sample. Across wines, a consistent Prokupac profile emerged, characterized by deep ruby-red colour with violet highlights, predominant red fruit notes (raspberry, pomegranate, plum), violet floral nuances, and pronounced acidity, with generally low bitterness and persistence. Despite this shared signature, clear differences were observed among trials: some wines expressed greater fruit and floral intensity, others exhibited higher structure, persistence and tactile sensations, while several were distinguished by fresher, herbaceous notes and lighter body. These findings confirm a recognizable sensory identity for Prokupac while demonstrating that vinification choices substantially modulate its expression. The results provide a basis for tailoring winemaking strategies to enhance varietal typicity and diversify stylistic outcomes for Prokupac wines.

Key words: Prokupac, sensory profiling, descriptive analysis, varietal typicity

P1_35

Implementation of the HACCP system in the production, packaging and storage of wine at Jungić winery

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Abstract

The purpose of the HACCP system is to identify potential microbiological, chemical, and physical hazards in all stages of the wine production chain, from production, processing, packaging, and storage to sale and consumption. At the beginning of 2021, the implementation of the HACCP system started at Jungić winery (Municipality of Čelinac). During this process, the entire implementation procedure was thoroughly analyzed, including the activities carried out, preparation of documentation, identification of Critical Control Points (CCPs), and the way the system was adapted to the real operating conditions in the production facility. At the winery level, a HACCP team was established consisting of a technologist/winemaker, the person responsible for quality control, a representative of the management (owner or manager), and cellar workers who participated in key operational activities. Training for personnel responsible for applying HACCP in the winery included both theoretical and practical components. The theoretical part covered the basic HACCP principles (hazard analysis, determination of CCPs, establishment of critical limits, monitoring procedures, corrective measures, verification, and documentation) in the context of wine production. The practical component included equipment demonstrations, workshops on developing process flow diagrams, exercises in identifying CCPs, and the implementation of sampling procedures and sanitary inspection practices. The results of introducing the HACCP system at Jungić winery showed that the system is functional, that key risks in wine production have been identified and controlled, and that operational procedures enabling monitoring and verification have been established. The implementation led to concrete improvements in hygiene practices, reliability of production parameters, and the winery's readiness for external quality assessment. It is recommended that the winery continue with periodic internal and external audits, invest in digital monitoring systems, and expand the verification protocol in order to ensure the long-term sustainability and competitiveness of its products.

Key words: food safety, quality wine, storage

P1_36

Comparative in vitro study of essential oils against *Botrytis cinerea*

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Abstract

Intensive food production requires an enormous application of pesticides to maintain high-quality food, sufficient to feed the growing population. Phytopathogenic fungi are one of the limiting factors in agricultural production. The control of these pathogens is primarily carried out by the use of chemical fungicides. However, their intensive and often irrational use, in addition to increasing costs, leads to the development of resistance in harmful organisms, as well as to the accumulation of these substances in the environment. The control of post-harvest diseases is a significant challenge, given the limited number of pesticides due to strict pre-harvest interval. A common cause of rot is *Botrytis cinerea*, the responsible agent of pre- and post-harvest grey mold. In addition to the wide host range, a major problem for agricultural producers is the ability to develop resistance to existing conventional pesticides, which requires the discovery of new strategies for plant protection. In line with the strategy of sustainable agriculture, essential oils (EOs) are recognized for their antifungal effects. This study was conducted *in vitro*, using a fumigation bioassay, and the effect of EOs on the growth of *B. cinerea* mycelium was monitored. The results showed that dill weed EO achieved complete inhibition (100%), while cardamom inhibited fungal growth until the 7th day of the experiment. Allspice, lemon, orange and bergamot EOs slowed down the development of mycelium, with the inhibition being pronounced during the first days of incubation. The black kumin and patchouli EOs didn`t have significant effects, compared to the control. The obtained results indicate that essential oils have a significant antifungal effect, which makes them potential candidates for an integrated plant protection strategy.

Key words: Botrytis cinerea, essential oils, integrated plant protection, biocontrol

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P1_37

Sensory evaluation of grape rakija: Expert vs. consumer panels

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Abstract

The sensory quality of rakija from grapes is a key factor for its market value and competitiveness, especially in regions with diverse production scales and styles. This study determined the sensory profiles of 30 samples from three different types of producers: industrial, small family-owned, and traditional distilleries. Visual, smell, taste, and overall harmony characteristics were evaluated using the standard International Organisation of Vine (OIV) methodology for spirits made from grapes (100 points total). Furthermore, a comparative analysis was conducted between a professional panel (n=6) and regular consumers (n=9) to identify quality perception differences. The results show a significant difference in scoring behavior between the two panels. Higher scores were consistently given by the consumer panel, with average scores of 89.81 for industrial, 86.38 for small family, and 70.86 for traditional producers, as they focused primarily on pleasant aromas. In contrast, the expert panel showed a more rigorous analytical approach by assigning lower scores of 85.01, 80.48, and 62.22, respectively, after detecting subtle defects in the samples. In conclusion, the results demonstrate a clear hierarchy in quality, which led by industrial producers who exhibited with low variability (CV <10%) while traditional distillers showed high variability (up to 41%). The expert panel serves as a benchmark for technical precision, identifying subtle defects, and verifying chemical purity, the consumer panel gives a broader market-oriented preferences for these spirits. New protocols are required in traditional distillation is needed to improving overall production quality, minimizing variability among traditional producers, and aligning the quality of rakija with market expectations.

Key words: rakija, sensory evaluation, OIV methodology, expert panel, consumer panel, grape brandy

P1_38

Topographic terroir modelling for evidence-based delineation of grape production zones for the future GI Armenian brandy

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Abstract

Armenian Brandy is a prestigious and time-honored spirit, recognized for its exceptional quality and serving as a flagship export that strengthens Armenia's rural value chains and enhances international visibility. To establish a transparent, science-based foundation for defining grape production zones for the future Geographical Indication (GI) Armenian Brandy, an innovative GIS modeling workflow was developed within the EU project "Technical Assistance for the Development of the GI 'Armenian Brandy'," implemented by Expertise France in collaboration with DMI.A DEM (30 m) was utilized to analyze five key topographic indicators: elevation, slope, aspect, the length-slope (LS) factor, and the Wind Exposure Index (WEI). The indicator values were standardized into a common suitability scale using Standard Scoring Functions (SSF), employing methodologies such as "more-is-better," "less-is-better," and "midpoint-optimal."To reduce subjectivity in indicator weighting, inter-indicator dependencies were modeled using network analysis (NA), where the network structure was estimated as a sparse Gaussian graphical model via graphical LASSO (gLASSO) with Extended Bayesian Information Criterion (EBIC) model selection. Node strength centrality was then applied to derive data-driven indicator weights, identifying elevation and WEI as the dominant topographic factors influencing grape production. A newly formulated index, the Topographic Quality Index (TQI), was created specifically for this purpose. This index, defined as a network-weighted composite of SSF-standardized indicators, ranges from 0.038 to 0.923. Nationally, the prevailing TQI categories were 0.2–0.4 (45.60%) and 0.4–0.6 (24.59%), with high suitability (TQI > 0.6) accounting for 20.12% of the territory. High-TQI terrain is primarily located in the four defined zones, forming a coherent topographic core that supports GI-compliant sourcing, traceability, and risk-based control planning. This integrative *terroir* modeling approach, which is being applied for the first time in the spirit-drinks sector, combines topographic with other factors, representing a systematic methodology to enhance GI-oriented spatial suitability assessment and zoning.

Key words: topographic terroir factors, geographical indication, Armenian Brandy, topographic quality index

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P1_39

Morpho-numeric characterisation of Slovenian garlic varieties (*Allium sativum* L.)

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Abstract

Garlic is a widely consumed bulbous crop primarily used as a culinary spice and in pharmaceutical applications. Slovenia has a long tradition of garlic cultivation, as evidenced by traditional varieties originating from the north-eastern region. Over the past four decades, seven garlic varieties have been developed and registered on the Slovenian National List of Varieties: Ptujski jesenski, Ptujski spomladanski, Jesenski Anka, Štrigon, Haloški, Primorski and Markovski. These varieties were characterised and evaluated using prescribed *Allium sativum* descriptors, morphometric and photographic documentation. Field trials were conducted using vegetative propagation in an unheated tunnel at the Agricultural Institute of Slovenia during the 2023/2024 growing season. Plant and leaf traits were assessed at defined developmental stages. Garlic was harvested at technological bulb maturity, dried, and morphologically characterised after three months of storage using six bulbs or ten representative cloves per variety. Eight quantitative and 27 qualitative traits were evaluated for each variety, covering plant, leaf, bulb, and clove characteristics. Significant varietal differences were observed for both quantitative and qualitative traits. Leaf length ranged from 36 to 64 cm and leaf width from 21 to 31 mm. The number of cloves per bulb ranged from 6 to 18, bulb weight from 23 to 57 g and clove weight from 2.3 to 4.6 g. Varieties differed in foliage density and attitude, leaf colour, waxiness and cross-sectional shape. Ptujski jesenski and Ptujski spomladanski did not develop a flowering stem and were classified as softneck types. Bulb ground colour of dry outer scales and clove scale colour were variety-dependent. The data provide a comprehensive morpho-numeric characterisation and detailed description of Slovenian garlic varieties developed over the last four decades.

Key words: Allium sativum, descriptors, garlic variety, plant grnrtic resources, morpho-numeric traits, UPOV

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P1_40

Fruit characterization of local pepper landraces from the Republic of Serbia

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Abstract

Pepper (*Capsicum annuum* L.) is one of the most important vegetables in Southeastern Europe. Serbia is particularly rich in local pepper landraces, which represent an important source of genetic diversity and adaptation to specific agroecological conditions. This study evaluated 13 local pepper landraces from Serbia. The main objective was to assess fruit variability based on key quantitative and qualitative traits. The experiment was conducted in 2025 in Novi Sad, Serbia, using a randomized design with three replications and ten plants per replication. The evaluated fruit traits were weight, length, width, index, number of locules, pericarp thickness, and total soluble solids content (TSS). Twenty fruits were analyzed, except for TSS, where 10 fruits were used. Three qualitative traits were used: fruit position, pungency, and immature fruit colour. Descriptive statistics revealed high variability for fruit weight (CV 53.71%). Pericarp thickness ranged from 1.6 to 9.5 mm. Index had the highest CV (72.91%), while the lowest CV was noted for TSS (21.03%). The principal component analysis clearly discriminated pepper landraces, highlighting phenotypic differences. Novosadska bela babura, Gložanska babura, Paradajz paprika, and Somborka were associated with higher fruit weight, greater fruit width, and thicker pericarp, indicating large, fleshy fruit types. Lokošnička, Horgoška slatka, Vrtka, and Venčarka showed stronger associations with higher TSS, immature colour and position. Elongated and pungent fruit types (Džinka and Puckavka) were characterized by greater length and higher index. Trait vectors indicated strong positive correlations among weight, pericarp thickness, width, and number of locules. In contrast, length and index were negatively associated with weight-related traits. The obtained results reveal considerable morphological diversity among the analyzed Serbian pepper landraces, indicating their potential use in breeding programs for the improvement of specific fruit traits and consumer-oriented characteristics.

Key words: Capsicum, genotype, phenotypic, diversity

Acknowledgment

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P1_41

Effect of biostimulants and colloid silver and copper on yield, sugar content and vitamin C content in sweet pepper (*Capsicum annuum* L.)

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Abstract

Sweet pepper (*Capsicum annuum* L.) is one of the most economically important vegetable crops worldwide due to its high nutritional value and rich content of bioactive compounds. Under conditions of ongoing climate change and increasingly restrictive use of conventional pesticides, the application of biostimulants and innovative cultivation technologies has become essential for maintaining yield stability and improving fruit quality. The aim of this study was to evaluate the effects of biostimulants (Agriful and Tecamin Brix), nano-formulated colloidal silver, and a combination of silver and copper, as well as their combined application, applied weekly by drip irrigation, on yield and quality parameters of sweet pepper cultivated in a heated greenhouse under soilless production conditions using a peat-based substrate. Soluble solids concentration (°Brix values) was measured using Hanna Instruments refractometer (Inc. HI96801), vitamin C content was determined using HPLC/UV, whereas HPAEC/PAD was utilized for sugar profile determination in water extracts of peppers. The experiment included individual and combined treatments compared with an untreated control. The combined application of biostimulants with both nano-formulated products resulted in the highest total yield and the greatest proportion of premium-grade fruits. Chemical analyses showed that colloidal silver treatment and treatment containing colloid silver and copper increased vitamin C content, while combined treatments modified carbohydrate composition by increasing glucose and fructose levels, which corresponded to higher °Brix values and enhanced sensory sweetness. Overall, the application of biostimulants alone or in combination with nano-formulated silver and copper significantly improved the nutritional and functional quality of pepper fruits under controlled production conditions. The study demonstrates an integrated technological approach combining biostimulants and nanotechnology as a novel strategy for achieving premium fruit quality in climate-resilient greenhouse production systems.

Key words: sweet pepper, greenhouse production, soilless cultivation, biostimulants, fruit quality

P1_42

Biocontrol agents for enhancing bioactivity of *Petroselinum crispum* in sustainable production and disease management

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Abstract

This study evaluated the effects of applying the biocontrol agent *Pythium oligandrum*, particularly its influence on plant physiological responses, on the content of bioactive compounds and the antioxidant activity of parsley (*Petroselinum crispum*) fruit essential oil under production conditions. In addition, its efficacy in suppressing infections caused by the phytopathogenic fungi *Alternaria dauci* and *Septoria petroselini* on parsley leaves and fruits was assessed, together with its impact on fruit yield. *P. oligandrum* is an oomycete (Oomycota) recognized for its biocontrol potential and its capacity to induce plant defense responses. It has been shown to protect plants against fungal pathogens. Parsley (*P. crispum*) is a widely cultivated aromatic and culinary plant of considerable importance in the food and pharmaceutical industries, primarily due to the characteristic composition and bioactive properties of its essential oil. The commercial formulation Polyversum®, containing *P. oligandrum*, was applied at specific plant growth stages. Essential oil from parsley fruits was obtained by hydrodistillation. Antioxidant activity was determined using the FRAP (Ferric Reducing Antioxidant Power) assay, while the content of bioactive compounds was quantified by spectrophotometric methods. Disease severity on leaves and fruits was confirmed by microscopic pathogen identification. Fruit yield was determined at the end of the growing season. Application of the biopreparation significantly increased total polyphenols content (by approximately 9%) and flavonoid content in the fruit essential oil, as well as overall antioxidant capacity (by approximately 5%) compared with the untreated control. Moreover, treatment reduced the incidence and severity of foliar diseases caused by *Alternaria* and *Septoria* spp. by approximately 30% and resulted in a 12% increase in fruit yield. These findings demonstrate the potential of *P. oligandrum* as an effective biocontrol agent for enhancing parsley fruit essential oil quality and promoting sustainable disease management strategies in aromatic crop production.

Key words: Pythium oligandrum, parsley, essential oil, antioxidant activity, *Alternaria, Septoria*

Acknowledgment

This research was funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, grants number: (451-03-136/2025-03/200053, 451-03-65/2025-03/200135, 451-03-136/2025-03/200032, 451-03-136/2025-03/200054)

P1_43

Seed morphological variation in common bean germplasm from the Gene bank of the Republic of Srpska

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Abstract

A total of 161 common bean (*Phaseolus vulgaris* L.) accessions conserved in the Gene Bank of the Republic of Srpska were evaluated to characterize seed morphological diversity within the collection. The study was conducted using standardized descriptors proposed by IPGRI (1982) and UPOV (2005). In total, four quantitative traits (seed length, width, thickness, and 100-seed weight) and six qualitative traits (number of seed colors, primary and secondary seed color, distribution of secondary color, seed coat pattern, and seed shape) were assessed. The average seed length, thickness, and width were 13.90 mm, 5.98 mm, and 7.88 mm, respectively, while the mean 100-seed weight was 41.48 g. Seed length ranged from 9.50 to 18.06 mm, thickness from 4.17 to 8.13 mm, and width from 5.31 to 10.92 mm. The highest variability was observed for 100-seed weight (CV = 26.04%), indicating substantial diversity in seed size among accessions. Regarding qualitative traits, most accessions (115) had seeds with a single color, while 46 exhibited two-color patterns. The most frequent primary seed color was brown (47), followed by white (32), green (30), beige (30), black (10), yellow (7), purple (4) and gray (1). Secondary color was predominantly violet (33), followed by beige (6), brown (3), black (3) and grey (1). In most cases, the secondary color was distributed across the entire seed surface, while only 3 accessions had distribution on half of the seed. Striped seed coat patterns were the most common, while dotted and bicolor patterns were less frequent. The predominant seed shape was cuboid (101 accessions), followed by an oval (32), truncate (18) and kidney-shaped form (10). Overall, the results revealed considerable morphological variability within the bean collection form the Gene Bank of the Republic of Srpska, highlighting its potential value for breeding programs, conservation strategies, and further genetic studies.

Key words: Phaseolus vulgaris L., genetic resources, collection, characterization, variability

P1_44

Climate adaptation in protected cultivation: Can modern plastic greenhouses match glasshouse productivity?

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Abstract

Adapting protected vegetable production systems to increasing climate variability represents a major challenge for achieving stable and sustainable high-yield production. This study compared hydroponic production performance of grafted tomato cultivated in two modern protected structures differing in construction and climate-buffering capacity: a glass greenhouse with a gutter height of 7 m and a modern plastic greenhouse with a height of 5 m. The experiment was conducted in Bogatić (Serbia), a continental climate region characterized by pronounced seasonal temperature variability. Tomato plants were grown in a soilless system using coconut substrate during a long production cycle spanning December 2024 to November 2025, with an eight-month harvesting period. Both structures were equipped with heating systems providing a temperature differential (ΔT) of 35°C. Fertigation was based on mineral fertilizers, while plant protection relied exclusively on biological control agents and biopesticides. Both structures were shaded during summer months to mitigate heat stress. Both systems achieved very high productivity, with total yields of 535 t ha^{-1} in the glass greenhouse and 510 t ha^{-1} in the plastic greenhouse equipped with double-inflated polyethylene covering. The glass greenhouse showed slightly higher early-season yields during spring, whereas during summer periods with external temperatures exceeding 35 °C, more favorable thermal conditions were observed in the plastic greenhouse. The relatively small difference in total yield indicates that modern plastic greenhouse technology can provide production conditions comparable to glass greenhouses when appropriate climate management strategies are applied. These findings demonstrate that appropriately designed plastic greenhouse systems can serve as climate-adaptive production solutions capable of maintaining high productivity under increasingly variable environmental conditions.

Key words: grafted tomato, greenhouse production, soilless cultivation, climate adaptation, yield performance

P1_45

Seedling preparation for hydroponic vegetable production – A case study

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Abstract

This paper presents conclusions on the critical points in the process of seedling preparation for hydroponic vegetable production, based on a small pilot project conducted at Educons University in Sremska Kamenica, during 2025. Efficient management of hydroponic systems requires particular attention to seed quality, purity, and germination rate. Considering that production takes place in facilities with limited vertical space, it is essential to understand the morphological characteristics of the plant species. If plants outgrow the system and develop excessive leaf mass, plant spacing is reduced and air circulation is hindered, which may slow down growth and increase the risk of pathogen development. Seeds can also be germinated in soil, that is inconvenient, time-consuming, and stressful for the root system. Inert rock wool placed in plastic containers expressed better performances. The advantages of this substrate include excellent moisture retention, efficient heat transfer from the heating base, and easy transplanting into hydroponic pots. However, a disadvantage is that the cells in the plastic trays, containing rock wool cubes, are very closely spaced, so roots may grow through drainage openings and become entangled with those of neighboring plants. During transplanting, this may cause difficulties and lead to damage to the root system of the seedlings. To avoid this, it is recommended to transplant seedlings when they reach approximately 15 cm in height or earlier. Early transplanting does not cause problems, as the substrate remains unchanged, and root stress is minimized. Seed disinfection is essential to ensure the health status of the seedlings. In this study, soaking seeds for 30 minutes in a 3% hydrogen peroxide solution, followed by rinsing with clean water, proved effective, as no issues with germination or seedling development were observed. The germination rate was approximately 95%, and nearly all seedlings (50) were healthy and ready for transplanting.

Key words: hydroponic, seedlings, substrate, vegetables

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P1_46

Cultivation of *Pleurotus ostreatus* on substrates containing municipal sewage sludge

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Abstract

This study investigates the cultivation of *Pleurotus ostreatus* on lignocellulosic substrates supplemented with municipal sewage sludge (MSS) as a strategy for biomass valorization. *Pleurotus ostreatus* is a fast-colonizing saprotrophic white-rot fungus widely recognized for its strong extracellular enzymatic system and adaptability to diverse waste-based substrates. The objective was to evaluate the growth performance and fruiting yield of *P. ostreatus* on substrates containing different mass fractions of MSS (15-70%), using gravimetric methods and qualitative assessment of fruiting body production. Substrates were prepared from oak sawdust supplemented with wheat bran and gypsum, with MSS added at 15-70 wt.%. After pasteurization and inoculation, cultivation was conducted at 24°C and 90% relative humidity in 700 mL glass containers. Growth performance was evaluated by monitoring fruiting body formation and determining yield gravimetrically. The results demonstrated that MSS additions of 15-30 wt.% not only supported successful growth but also enhanced mushroom yield compared to the control substrate without MSS. A key practical observation was the complete elimination of the persistent sludge odor following fungal colonization, indicating significant substrate biotransformation. At higher MSS contents (50 wt.% and 70 wt.%), substrate colonization occurred successfully; however, no fruiting bodies were produced under the tested conditions. These findings indicate that moderate incorporation of MSS (up to 30 wt.%) into lignocellulosic substrates can promote *P. ostreatus* productivity while simultaneously improving substrate properties. Although higher sludge fractions inhibited fruiting, the successful colonization suggests potential for alternative non-food applications. The study contributes to the emerging field of sludge-based substrate valorization and provides a basis for further optimization of cultivation parameters and biomass utilization pathways.

Key words: Pleurotus ostreatus, municipal sewage sludge, lignocellulosic substrates, circular bioeconomy

Acknowledgment

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P1_47

Pathogenicity of *Fusarium* species and their impact on pepper seed germination

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Abstract

Pepper (*Capsicum annuum* L.) is an economically important vegetable crop, where seed quality strongly influences production. Pepper seeds may serve as a primary source of inoculum for several fungal pathogens. Among seed and soil-borne fungi, *Fusarium* species are the most frequently detected and are often associated with seed decay and early-stage infections. This study aimed to evaluate the pathogenicity of different *Fusarium* strains of the NS Vatrena seeds, a hot pepper variety developed at the Institute of Field and Vegetable Crops. Five *Fusarium* strains belonging to three different species (*Fusarium solani*, *F. oxysporum*, and *F. proliferatum*) were included in the pathogenicity assay. Seed pathogenicity test was assessed by soaking seeds in a conidial suspension for 3 hours. For each strain, four replicates consisting of 25 seeds were evaluated. Control seeds were soaked in sterile distilled water. Inoculated seeds were placed on sterile filter paper in Petri dishes and incubated at 25 °C. Germination energy was evaluated after 7 days, and final germination after 14 days. Data were analyzed using Statistica 13.2 software by analysis of variance (ANOVA) and Duncan's multiple range test. *Fusarium* species significantly affected pepper seed germination and early seedling development, with clear differences in pathogenicity among tested species/strains. *F. oxysporum* caused a strong reduction in both germination energy and final germination, whereas *F. proliferatum* strains did not reduce germination energy but significantly decreased final germination, indicating a negative effect at later stages of seedling growth. *F. solani* exhibited a less pronounced, yet still significant, negative effect compared with the non-inoculated control. Overall, the results demonstrate that seed-associated *Fusarium* species can substantially impair seed viability and negatively influence the establishment of healthy pepper seedlings. These findings highlight the importance of using pathogen-free seed and suitable, well-managed nursery substrates, given that *Fusarium* species are frequently soil-borne.

Key words: Capsicum, *Fusarium*, seedborne diseases, energy, germination

Acknowledgment

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P1_48

Results of seven-year survey of the presence of ´*Candidatus* Liberbacter solanacearum´ in Republic of Srpska

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Abstract

A comprehensive survey program was approved and funded by the Ministry of Agriculture, Forestry, and Water Management of RS from 2019, in order to support early detection, assess pathogen distribution, and strengthen national surveillance efforts for monitoring the occurrence of ´*Candidatus* Liberibacter solanacearum´ (CLso). Targeting host plants (potato, tomato, aubergine, pepper, carrot, etc.), sampling was carried out in a number of registered production sites, farms, and gardens, as well as from consignments of host plants on border crossing during their import. A total of 678 samples were analysed for seven year period (2019-2025). Laboratory analysis were carried out in accordance with the EPPO diagnostic protocols PM 7/143 (1). Protocols included the molecular detection with a conventional PCR method according to Li *et al*. (2009) and Jagoueix *et al*. (1996) which amplifies a region of 16S rRNA, using LsoF (sequence 5′ -GTC GAG CGC TTA TTT TTA ATA GGA-3′ / OI2c (sequence 5′-GCC TCG CGA CTT CGC AAC CCA T-3′) primer pair. Extraction from plant material was performed by CTAB method. Further steps in identification includes haplotype determination, and in this case up to three conventional PCR may be needed respectively. Number of analysed samples for 2019 was 120, in 2020 – 103, for 2021– 105, in 2022 – 65, in 2023 – 70, in 2024 – 120, and in 2025 – 95. From 2019 until 2022 every sampling were mapped, recorded and digitized using FITO GIS software, while in 2023, for mapping, recording and digitizing, IT web platform in real time @Farm FITO GIS was used. Based on the conducted laboratory analysis during 2019-2025, all tested samples were negative for the presence of CLso. However, considering the epidemiology, genetic diversity, and host interactions of CLso, a continuously revised and defined surveillance program becomes necessary, and thus it is continued in 2026.

Key words: Candidatus Liberibacter solanacearum, Republic of Srpska, survey

P1_49

Distribution of Northern Root-Knot Nematode *Meloidogyne hapla* in potato fields in Republic of Srpska

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Abstract

Potato is one of the staple food crops in Europe and is associated with a high phytosanitary risk due to the large number of pests affecting its production. Among them, several plant-parasitic nematode species are known to cause significant damage. The northern root-knot nematode, Meloidogyne hapla, develops well on potato and, on certain varieties, can induce tuber symptoms similar to those caused by quarantine species such as *Meloidogyne chitwoodi* and *Meloidogyne fallax*. In this study, soil sampling from ware potato fields was conducted in the Republic of Srpska during three consecutive years (2023-2025). Each year, 36 soil samples were collected after harvest and processed in the laboratory for the presence of plant-parasitic nematodes. Detection to the genus level (Meloidogyne) was performed using a dissecting microscope, followed by species identification using conventional PCR with species-specific primers. *M. hapla* was detected in 14 samples in 2023, 12 samples in 2024, and 11 samples in 2025. The findings confirm its widespread occurrence in potato-growing regions of the Republic of Srpska. The study also examines the relationship between its distribution, potato cultivation practices, and altitude of the sampled fields.

Key words: potato, Northern Root-Knot nematode, pest distribution

P1_50

Effects of hydrogel and zeolite on growth and ornamental quality of *Salvia splendens* 'Vista Red'

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Abstract

Ornamental sage (*Salvia splendens* Sellow ex J.A. Schultes) is an annual flowering species of high decorative value. It represents one of the most important flowering species used in the design of flower beds and ornamental green areas. This study examined the effect of hydrogel and zeolite on the growth and development of ornamental sage during 2025. Hydrogel improves moisture retention, while zeolite enhances the availability of nutrients. The variety used in the experiment was Vista, red in color. The experiment was established on March 30, 2025, and lasted until July 1 of the same year. The control group included 20 plants, while three treatments were applied, each consisting of 20 plants. The first treatment included a mixture of substrate and hydrogel, the second a mixture of substrate and zeolite, and the third treatment examined the effect of the combination of zeolite and hydrogel. The parameters measured were: plant height, flower stalk length, root length, number of leaves, and number of flowers. The qualitative characteristics evaluated were plant vitality and decorative value. Based on the results obtained after three months of monitoring and measuring quantitative and qualitative characteristics, the findings showed a positive effect of both hydrogel and zeolite. All three treatments produced better values and ratings compared to the control treatment. Although it was expected that the combination of hydrogel and zeolite would yield the best results, the study showed otherwise. Among the three treatments, hydrogel had the most favorable effect on both qualitative and quantitative characteristics. The plants were the most compact and received the highest ratings for decorative value and vitality. Future research will focus on determining the optimal concentration of hydrogel in the substrate.

Key words: Salvia splendens, hydrogel, zeolite

The research funds were provided by the Ministry of Science, Technological Development and Innovation under Contract No. 451-03-34/2026-03/200117 dated 05 February 2026.

P1_51

The effect of two different fertilizers on the quality of *Begonia semperflorens* Link. et Otto.

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Abstract

This research was conducted to evaluate the effects of various fertilizer formulations and concentrations on the morphological characteristics of *Begonia semperflorens* Link et Otto. The primary objective was to determine the most effective fertilizer formulation and concentration for optimizing plant quality. In this experiment were applied two fertilizers – Agrosal with NPK 4-6-6 + microelements (0,2%; 0,3%; 0,4%) and Agrosal with NPK 6-3-6 + microelements (0,2%; 0,3%; 0,4%). For measurement, 30 plants were used per treatment, four months after planting into plastic containers. Plant quality was assessed through parameters including plant height (mm), leaf number, branch number, and inflorescence number. Measurements of biometric parameters showed that the liquid mineral fertilizer Agrosal (NPK 6–3–6 + microelements) at a concentration of 0.3% resulted in the highest average plant height and the highest average number of branches. In contrast, Agrosal (NPK 4–6–6 + microelements) at a concentration of 0.4% produced the highest average number of leaves and inflorescences. Based on these findings, Agrosal NPK 6-3-6 at 0.3% and Agrosal NPK 4-6-6 at 0.4% are recommended in practice.

Key words: branches, inflorescences, leaves, plant height

P1_52

Optimization of irrigation for improving seedling production of *Marrubium vulgare* L.

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Abstract

Marrubium vulgare L. is a perennial medicinal plant belonging to the Lamiaceae family, widely used in the pharmaceutical and herbal industries due to its expectorant, anti-inflammatory, and antioxidant properties. The production of high-quality seedlings represents a key prerequisite for successful cultivation and establishment of this species. The aim of this study was to evaluate the effect of different irrigation regimes on seedling emergence, stand formation, and morphological characteristics of *M. vulgare* L. seedlings under open-field nursery conditions. The experiment was conducted in 2025 at the Institute for Medicinal Plant Research "Dr Josif Pančić" in Pančevo, Serbia. Seeds were sown on 28 July at a sowing rate of 10 g m^{-2}, and transplanting was performed on 30 November. Three irrigation treatments were applied: no irrigation (T0), moderate irrigation (T1: 6 l m^{-2} day^{-1}), and intensive irrigation (T2: 10 l m^{-2} day^{-1}). The results showed that irrigation significantly affected emergence and seedling morphology. Intensive irrigation provided the highest emergence (99.0%), but resulted in reduced seedling quality due to high plant density and competition. In contrast, the non-irrigated treatment produced the largest individual seedlings but had insufficient emergence (34.0%). Moderate irrigation ensured optimal seedling emergence (62.0%) and the best overall seedling quality, characterized by balanced shoot and root development. Based on the obtained results, moderate irrigation can be recommended as the optimal regime for the production of high-quality *M. vulgare* L. seedlings.

Key words: white horehound, seedlings, irrigation, emergence, seedling quality, medicinal plants

Acknowledgment

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P1_53

Optimization of irrigation regimes for high-quality seedling production of *Melissa officinalis* L.

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Abstract

Melissa officinalis L. is a perennial aromatic and medicinal plant belonging to the Lamiaceae family, widely used in the pharmaceutical, food, and cosmetic industries due to the presence of biologically active compounds with sedative, antioxidant, antimicrobial, and antiviral properties. The production of high-quality seedlings represents a key prerequisite for successful crop establishment and commercial cultivation of this species. The experiment was conducted during the 2025 growing season at the Institute for Medicinal Plant Research "Dr Josif Pančić" in Pančevo, Serbia, on slightly acidic silty clay loam soil with moderate fertility and favorable water properties. Sowing was performed in mid-July in open nursery beds at a sowing rate of 8 g m^{-2}, while transplanting was carried out in mid-October, resulting in a seedling production period of approximately 90 days. Three irrigation regimes were applied: no irrigation (T0), moderate irrigation (T1: 6 l m^{-2} day^{-1}), and intensive irrigation (T2: 10 l m^{-2} day^{-1}). Irrigation was performed during nighttime using micro-sprinklers (type 7110) in order to ensure uniform water distribution and reduce evaporative losses. During the experimental period, the total precipitation amounted to only 82 mm, indicating pronounced water deficit conditions. The results showed that irrigation regimes significantly affected seedling development and quality. Moderate irrigation enabled the production of uniform and compact seedlings with well-developed root systems and optimal morphological characteristics, while intensive irrigation increased seedling density but reduced seedling quality. Based on the obtained results, moderate irrigation can be recommended as the optimal regime for the production of high-quality *M. officinalis* L. seedlings under open field nursery conditions.

Key words: seedling production, transplant trays, irrigation, seedling weight

Acknowledgment

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P1_54

Organic mulches as a conservation agriculture practice in organic turmeric (*Curcuma longa* L.) production

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Abstract

The introduction of turmeric (*Curcuma longa* L.) into temperate-continental environments requires the development of sustainable soil management practices adapted to organic production systems. This pilot study evaluated the effects of three soil management treatments - bare soil, straw mulch, and sheep wool mulch - on growth parameters, soil conditions, and rhizome yield of turmeric cultivated in an organic greenhouse at the Biotechnical Centre Naklo (Slovenia) during the 2025 growing season. Organic mulching significantly improved plant growth compared to bare soil. Plants grown under straw and sheep wool mulch exhibited greater height, larger leaf area, and thicker stems. Sheep wool provided the most stable soil moisture conditions (31.5%) and the lowest weed infestation (16.1 plants m^{-2}), resulting in the highest total fresh rhizome yield (7.7 kg m^{-2}) and dry matter content (26.8%). Bare soil treatments showed significantly lower soil moisture, higher weed pressure, and the lowest yield (4.4 kg m^{-2}). The results confirm that organic mulches are an effective conservation agriculture practice for turmeric production under temperate greenhouse conditions. Sheep wool, as a locally available and biodegradable material with high water retention capacity, proved particularly suitable for enhancing soil stability, reducing weed pressure, and increasing yield. These findings provide a basis for developing sustainable production technologies for high-value specialty crops in non-tropical environments and support the diversification of organic greenhouse systems.

Key words: *Curcuma longa*, organic mulching, weed suppression, rhizome yield, conservation agriculture

Acknowledgment

The project "System of conservation agriculture in organic production without the use of herbicides" is supported by European Union funds and is being implemented within the framework of the Strategic Plan for the Slovenian 2023-2027 Common Agricultural Policy (CAP) Strategic Plan (SN SKP 2023–2027).

P1_55

Molecular characterization of sessile oak populations in National Park "Fruška Gora"

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Abstract

Sessile oak (*Quercus petraea* (Matt.) Liebl.) is one of the most ecologically and genetically significant forest tree species in Europe, and the populations in Fruška Gora National Park form an important part of its genetic diversity. During the Last Glacial Maximum, the Balkan Peninsula served as a major refugium, allowing the preservation of ancient haplotypes and high levels of genetic variability that persist in contemporary oak populations. Due to geographic isolation, habitat fragmentation, and the pronounced climatic extremes characteristic of the Pannonian region, many oak stands in Fruška Gora have a marginal or semi-marginal character. These populations show strong local adaptation to environmental stress factors such as drought, high temperatures, and poor soil conditions, making them a valuable genetic resource for future adaptive processes. This study aimed to evaluate genetic variability and differentiation between typical and marginal sessile oak populations within the Fruška Gora area. Seven nuclear microsatellite markers (SSR) were used to analyze population genetic structure and variability. Genomic DNA was isolated from sampled individuals and amplified using polymerase chain reaction (PCR). Fragment analysis was performed using a next-generation microchip electrophoresis system (MultiNA, Shimadzu) with the DNA1000 kit. The results revealed clear genetic differences between the studied populations. The typical population exhibited higher allelic richness and greater overall genetic variability, whereas marginal populations showed reduced allelic frequencies and lower levels of genetic diversity, likely due to stronger geographic isolation and limited gene flow. These findings highlight the importance of incorporating population genetic data into forest management and conservation strategies, particularly in the context of ongoing climate change. Preserving marginal Balkan oak populations is essential for maintaining the adaptive potential, resilience, and long-term stability of European forest ecosystems.

Key words: Quercus petraea (Matt.) Liebl., genetic diversity, SSR markers, MultiNA electrophoresis

Acknowledgment

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P1_56

Conceptual landscape design for the park complex of the protected area "University City"

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Abstract

The protected area – park architecture monument "University City" represents a Category VI protected area located in the City of Banja Luka. It was initially designated in 2012, and its protection status was confirmed in 2016 in accordance with the new legal regulations. The managing institution is the Institute of Genetic Resources, University of Banja Luka. The protected area includes a park complex, which represents a significant natural heritage, and a botanical garden. The landscape of the park complex was originally established during the Austro-Hungarian administration, and its spatial and visual identity has evolved through several phases of land use, the longest of which was its military use. This paper presents a conceptual landscape design proposal for the important segments of the park complex of the protected area "University City", primarily the central alley, the pedestrian paths and the surrounding spaces of several buildings. The main objective is the selection of plant material that meets both functional and aesthetic requirements of the space, the reconstruction and adaptation of existing green areas, and the introduction of new landscape elements within the pedestrian zone. The research methodology included the analysis of natural and anthropogenic characteristics of the site, a review of planned architectural and construction interventions, as well as the application of examples of good practice from international case studies. The proposed landscape solution is based on the preservation of existing vegetation and the inherited historical landscape, complemented by the introduction of new plant species in order to achieve compositional coherence and a high level of aesthetic value. The proposed intervention enables improved spatial connectivity and enhances the visual identity of the complex in accordance with the principles of sustainable development and contemporary ecological approaches.

Key words: nature protection, sustainable development, genetic resources

P1_57

Autumn colour dynamics and visual identity of woody taxa along the quay in Novi Sad, Serbia

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Abstract

Colour, as one of the most distinctive visual elements in the landscape, plays an important role in shaping the aesthetic, emotional, and psychological perception of space. Its significance in urban greenery is particularly evident in autumn, when changes in leaf colour enhance the visual attractiveness of plant taxa. This study aimed to analyse the occurrence, duration and intensity of autumn colouration in woody taxa of different life forms along the Quay in Novi Sad. The analysis was conducted within three segments differing in species and cultivar composition: 1) *Carpinus betulus* 'Frans Fontaine', 2) *Fraxinus ornus* 'Globosa', *Parthenocissus quinquefolia* L., *Populus alba* L. and 3) *Prunus fruticosa* 'Globosa', *Betula alba* L., *Parthenocissus quinquefolia* L. and *Spiraea* × *vanhouttei* (Briot.) Zabel. Leaf colour dynamics were monitored from 17 August to 26 November 2025, or until complete leaf fall in certain taxa. For each taxa, five leaves were sampled, while both leaves and whole plants were photographed under standardised conditions and analysed using the Image Color Picker tool to obtain RGB and HSL values. The results revealed clearly differentiated patterns of autumn colouration in onset, intensity, and duration. *Parthenocissus quinquefolia* L. showed the most intense and visually attractive autumn aspect, characterised by deep red, burgundy, and purple tones. *Carpinus betulus* 'Frans Fontaine' and *Betula alba* L. displayed distinct yellow to golden-yellow tones, while *Fraxinus ornus* 'Globosa' and *Prunus fruticosa* 'Globosa' remained predominantly green most of the study period indicating a later onset of autumn colour change. *Populus alba* L. showed yellow-brown to rust-coloured shades, whereas *Spiraea* × *vanhouttei* (Briot.) Zabel displayed yellow-brown to dark brown tones. The findings contribute to a better understanding of the seasonal dynamics and decorative potential of woody taxa and may support the design of waterfronts with a distinctive autumn identity.

Key words: urban greenery, RGB and HSL analysis, colourimetric analysis, seasonal colour change, landscape aesthetics

P1_58

PLA composites incorporating antioxidant compounds: Biodegradation behavior in different soil environments and functional property assessment

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Abstract

This study focuses on polylactide (PLA) composites containing 10 wt.% starch and 0.2 wt.% natural antioxidant additives: quercetin, caffeic acid, and gallic acid. These compounds are well-known phenolic substances exhibiting strong antioxidant and antimicrobial properties, which may influence the degradation behavior of biodegradable polymer systems. Their presence in PLA-based materials could potentially modify both the rate and mechanism of biodegradation by affecting microbial activity and oxidative processes in the environment. The primary objective of this work was to evaluate the influence of these bioactive additives on the physicochemical properties and biodegradation behavior of PLA–starch composites. Biodegradation studies were carried out under controlled conditions in compost, field soil, and horticultural soil. The degradation process was monitored by assessing mass loss and changes in material structure. Mechanical properties of the obtained composites were determined through tensile strength testing to evaluate the effect of the incorporated antioxidants on material performance. Thermal properties were investigated using thermogravimetric analysis (TG) and differential scanning calorimetry (DSC) to assess thermal stability and phase transitions. In addition, spectroscopic analyses were performed to examine potential changes in the chemical structure of polylactide resulting from the incorporation of the phenolic additives. The comprehensive characterization allowed for the assessment of how natural antioxidant compounds influence the functional properties and environmental degradation behavior of PLA-based composites intended for sustainable applications.

Key words: polylactide, PLA, antioxidant compunds, thermal analysis, biodegradation

Acknowledgment

The research leading to these results has received funding from the „Mikrogrant RID – budowanie interdyscyplinarnych zespołów badawczych": „Project financially supported by the Ministry of Science under the program entitled „Regional Initiative of Excellence" for the years 2024-2027.

P1_59

PLA - Mineral fertilizer composites as sustainable materials for agricultural and horticultural applications

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Abstract

Polylactide (PLA) - based composites containing 10 wt.% starch and 2 wt.% selected mineral fertilizers ($MgSO_4$, KNO_3, $Ca(NO_3)_2$, and $Ca_3(PO_4)_2$) were developed and systematically characterized. The mechanical performance of the materials was evaluated through tensile strength measurements. Structural analysis was carried out using Fourier-transform infrared (FTIR) and Raman spectroscopy to determine whether the incorporation of mineral salts affected the chemical structure of the PLA matrix. Thermal stability and phase transitions were examined using thermogravimetric analysis (TG/DTG) and differential scanning calorimetry (DSC). The biodegradation behavior of the prepared composites was investigated in field soil, horticultural soil, and compost. Degradation progress was monitored by measuring mass loss, conducting spectroscopic analyses, and visually assessing surface and structural changes in the materials. The results indicate that the incorporation of mineral fertilizers into the PLA-starch matrix enhances the mechanical properties of the composites. Spectroscopic studies confirmed that the addition of mineral salts did not alter the chemical structure of polylactide. Furthermore, thermal analysis demonstrated that the presence of the mineral additives had no significant influence on the thermal properties of the PLA-based materials.

Key words: polylactide, PLA, fertilisers, thermal analysis, biodegradation

Acknowledgment

The research leading to these results has received funding from the „Mikrogrant RID – budowanie interdyscyplinarnych zespołów badawczych": „Project financially supported by the Ministry of Science under the program entitled „Regional Initiative of Excellence" for the years 2024-2027.

P1_60

Continuation of monitoring the causes of olive decline and partial dieback in Bosnia and Herzegovina

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Abstract

The agroecological conditions of Herzegovina, characterized by drought and karst soils, are favorable for the cultivation of olive *Olea europaea* L.), but also for the development of phytopathogenic fungi. Previous studies conducted in the Herzegovina region identified *Fusarium* spp., *Diplodia seriata*, *Neocosmospora solani*, *Phoma* sp., and *Pythium* sp. as causal agents of olive decline.During the period 2023–2026, symptoms of progressive decline in young olive trees of various cultivars were observed at several locations in western Herzegovina, including the Crnići Stolac area. These symptoms included dried leaves, branch necrosis, and plant dieback.Samples of symptomatic plant material were isolated on PDA medium following surface sterilization. Incubation at 25–28 °C resulted in the development of fast-growing, darkly pigmented colonies. Pure cultures were obtained using the hyphal tip transfer method. Based on macroscopic and microscopic characteristics, including septate mycelium and the formation of microsclerotia, the pathogen was identified as *Macrophomina phaseolina* (Tassi) Goid. (1947). Pathogenicity tests confirmed the ability of the isolates to induce chlorosis, necrosis, and wilting in olive seedlings, while control plants remained healthy. The pathogen was successfully re-isolated from infected tissues. Based on these findings, *M. phaseolina* is confirmed as an additional and significant causal agent of olive decline in Herzegovina, alongside previously identified phytopathogenic species.

Key words: olive, Herzegovina, *Macrophomina phaseolina*, olive decline, disease monitoring

Session 2: Agricultural Economics and Rural Development

Oral Presentations

O2_01

Development of the National guidelines and action plan for climate change adaptation in agriculture in the Republic of Serbia

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Abstract

Climate change poses a significant and complex challenge for agriculture in the Republic of Serbia, affecting ecosystems, food security, and rural livelihoods. The *Guidelines for Climate Change Adaptation in Agriculture* (Guidelines), jointly with the Action plan are being developed to provide a strategic framework for addressing these challenges while also tackling interconnected environmental and socio-economic issues, including biodiversity loss, water scarcity, land degradation, food insecurity and rural depopulation. The Guidelines and the Action plan are being developed within the framework of the Green Agenda for the WB through a regional cooperation process led by the Regional Rural Development Standing Working Group in South East Europe (SWG). Although embedded in this regional framework, the development process is primarily focused on addressing the national priorities of the Republic of Serbia. The process involves collaboration among a wide range of stakeholders and is led by the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia. The Guidelines aim to integrate the latest scientific knowledge and global best practices in climate change adaptation in agriculture. Particular attention is given to identifying adaptation options that address multiple dimensions of agricultural production, including crop and livestock systems, as well as the management of key natural resources such as water and soil. The Guidelines and the Action plan are expected to support the development of strategic and planning documents at the national and local levels. Three main goals guide the process: strengthening the resilience of agricultural production and promoting sustainable natural resource management; enhancing the sustainability of rural areas through diversification, infrastructure development, landscape conservation, and environmental protection; and raising awareness and improving knowledge of climate change and its impacts. By promoting science-based solutions and strong partnerships, the Guidelines aim to strengthen the resilience of Serbia's agricultural sector to climate change.

Key words: guidelines, action plan, agriculture, climate change, adaptation, cooperation

O2_02

Standardisation of factor suitability assessment for different types of agricultural production in Slovenia

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Abstract

Efficient and sustainable agricultural land use in Slovenia requires a harmonized, spatially explicit evaluation of natural conditions that determine production potential and risk. Slovenia's pronounced heterogeneity in soils, relief and climate makes agricultural regionalization particularly challenging and motivates the development of transparent and standardized suitability rules. Here we present a unified framework for standardizing natural factors in four major agricultural production systems: general arable land, permanent grassland, intensive orchards and viticulture. The RajonSI workflow integrates harmonized national raster datasets representing soil properties, climate variables (including baseline clime data and RCP-based projections), topographic parameters and environmental constraints. Factor suitability was standardized to a common 0–100 scale using expert elicitation supported by documented transformation rules, implemented as class-based reclassification for categorical factors and continuous standardization functions (including fuzzy-membership-type curves) for continuous factors. The accompanying factor maps and standardization-curve plots provide an explicit audit trail of how expert knowledge was translated into spatially continuous suitability surfaces. The resulting standardized layers are designed for subsequent aggregation within a GIS-based multi-criteria evaluation framework (e.g., Weighted Linear Combination) and for scenario-based assessments of future suitability. The framework enables consistent, reproducible suitability assessment and supports agricultural regionalization, land-use planning and climate-adaptation decision support.

Key words: agro-ecological zoning, factor standardisation, multi-criteria decision analysis, weighted linear combination, production system suitability, Slovenia agriculture

Acknowledgment

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O2_03

State and development trends of organic plant production in the Republic of Serbia

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Abstract

This paper examines the state and development trends of organic plant production in the Republic of Serbia over the period 2015–2024, with the aim of assessing growth dynamics, structural changes, and future development prospects. The analysis is based on official statistical data and international databases, applying comparative and trend analysis, including the use of base indices, growth rates, and linear regression for projection purposes. The results indicate a continuous expansion of organic production, as total areas under the organic farming system increased by 80.1% during the observed period, rising from 15,298 ha to 27,549 ha, with an average annual growth rate of 6.8% and a peak reached in 2023 (29,002 ha). Crop production dominates the structure of organic plant production, accounting for 53%, followed by fruit production (41.9%), while vegetables and other crops have a considerably smaller share. A decline in areas under cereals (26.7%) and industrial crops (53%) was recorded, in contrast to the significant growth of fodder crops, fruits, and especially medicinal and aromatic plants, which increased by more than 400%. Despite these positive developments, the share of organic agricultural land in total utilized agricultural land remains low, reaching only 0.83% in 2024. Comparative analysis shows that Serbia significantly lags behind the European Union and neighboring countries, while projection results indicate that this share may reach only about 1.16% by 2030, remaining far below both the EU target and current levels observed in surrounding EU member states. The results suggest that, although organic production demonstrates stable growth and favorable structural changes, its current level remains insufficient. Further development requires not only stronger institutional support and more efficient policy measures, but also improved market conditions, more stable demand and price incentives, better access to inputs such as organic seeds and fertilizers, and enhanced knowledge transfer and advisory support for producers.

Key words: organic plant production, Serbia, growth trends, rural development, sustainability

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O2_04

Strengthening Agricultural Knowledge and Innovation Systems (AKIS) to support the transition to organic beekeeping: A case study from Montenegro

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Abstract

The transition to organic beekeeping represents an opportunity for improving sustainability, product quality, and market competitiveness in Montenegro's beekeeping sector. The aim of this project was to facilitate this transition by strengthening the Agricultural Knowledge and Innovation System through coordinated education, practical training, and institutional cooperation, thereby enhancing beekeepers readiness for organic production. To establish a baseline understanding of the sector, an initial survey was conducted among 69 conventional beekeepers from Montenegro. The survey collected data on demographic characteristics, scale of production, beekeeping practices, product types, market orientation, awareness of organic principles, perceived benefits, and anticipated challenges related to the transition to organic beekeeping. Based on the survey findings, targeted capacity-building activities were designed and implemented. These included a peer-to-peer field training session hosted at a certified organic apiary, where participants received hands-on instruction in organic colony management, with particular emphasis on Varroa mite control using biological methods. In addition, an educational workshop was organized to provide theoretical and regulatory knowledge, covering topics relevant for AKIS implementation. The results revealed a high general awareness of organic beekeeping concepts (96%) of respondents, but limited understanding of their concrete economic and environmental benefits, with nearly half of respondents uncertain about potential advantages. Major barriers included certification complexity, investment costs, market uncertainty, and insufficient advisory support. Capacity-building activities led to a substantial improvement in practical knowledge, particularly in organic disease control. More than 90% of participants expressed willingness to adopt organic practices and engage in further training.In conclusion, the project confirmed that an integrated AKIS-based approach combining baseline assessment, practical demonstrations, and targeted education is effective in supporting the transition to organic beekeeping. Strengthening advisory services, promoting group certification models, and expanding peer-learning and demonstration farms are key recommendations for ensuring long-term adoption and sustainable development of the sector.

Key words: Agricultural Knowledge and Innovation System (AKIS), organic beekeeping, knowledge transfer

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O2_05

Applying the value proposition canvas to farmers' markets: NCHU organic farmer market in Taichung, Taiwan

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Abstract

As global awareness of the environmental and social impacts of mass food production grows, consumers are increasingly seeking transparent, local alternatives. Short Food Supply Chains (SFSCs) have therefore re-emerged as important mechanisms for sustainable agriculture and more direct producer–consumer relationships. In Taiwan, farmers' markets represent a deeply embedded model of SFSCs, functioning as stable community hubs rather than occasional experiences. Yet the specific factors that ensure their long-term resilience remain insufficiently explored. This article identifies drivers of customer engagement at farmers' markets. The Value Proposition Canvas (VPC) principles were applied to categorise the most important jobs the consumers seek to accomplish, the pains or obstacles they encounter, and the gains or positive outcomes they desire. Primary data were acquired through an in-person survey of 250 respondents from the NCHU farmer market in Taichung, Taiwan, in 2025. The results indicate that trust, organic certification, and community engagement play a central role in shaping customer loyalty and market stability. These results contribute to an understanding of factors important for the economic viability of farmers and the sustainable functioning of SFSCs.

Keywords: short food supply chains, VPC, consumer behaviour, sustainability,

O2_06

Organic food as a path to sustainable and healthy living: Consumer behavior and market trends

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Abstract

Organic food consumption has emerged as a global phenomenon, reflecting both increasing health consciousness and heightened concern for environmental sustainability. This paper investigates the key drivers of organic food consumption, with particular emphasis on health motivations, food safety concerns, and environmental awareness. The existing body of literature indicates that consumers perceive organic products as safer and more nutritious, primarily due to their production methods that exclude synthetic pesticides, fertilizers, and genetic modification. Health consciousness consistently appears as a central determinant of purchase intention, with consumers motivated not only by personal well-being but also by broader concerns related to diet-associated illnesses such as obesity. Simultaneously, awareness of food safety risks and ecological impacts further strengthens the preference for organic alternatives. By synthesizing market data and consumer behavior research, this paper highlights the relevance of organic food as both an economic opportunity and a public health intervention. The findings suggest that fostering organic consumption can contribute to healthier lifestyles while promoting sustainable agricultural practices.

Key words: consumer behavior, sustainable agriculture, organic food consumption, health consciousness

O2_07

Agro-ecotourism as a tool for sustainable rural development and economic diversification: Evidence from North Macedonia

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Abstract

Agro-ecotourism has emerged as an integrated development approach linking agriculture, ecology, and tourism within sustainable rural systems. As a multifunctional model, it connects food production, environmental conservation, and experiential tourism, creating opportunities for economic diversification in rural regions undergoing structural transformation. This study explores agro-ecotourism as a strategic instrument for improving rural sustainability in the Republic of North Macedonia. The research analyzes the structural condition of the national agricultural sector, characterized by declining economic relevance despite its continued strategic importance. Agriculture contributed approximately 6–11% of national GDP during the period 2010 - 2023, considerably above the European Union average; however, its relative share has steadily decreased due to faster growth in services and industry. The sector faces significant structural constraints, including a 31% decline in agricultural employment between 2012 and 2023, strong regional economic disparities, and pronounced farm fragmentation. Small family farms dominate the rural economy, representing 99.8% of all agricultural holdings, with an average farm size of approximately 1.8 hectares, which limits productivity and competitiveness in conventional agri-food markets. Findings indicate that these structural limitations increase vulnerability of rural households while simultaneously creating favorable conditions for diversification through agro-ecotourism. By valorizing local agricultural products, traditional knowledge, rural landscapes, and extensive farming practices, agro-ecotourism enables income generation beyond primary production. Global agritourism expansion, from USD 45.4 billion in 2021 to a projected USD 141 billion by 2030, further supports integration of emerging destinations such as North Macedonia into sustainable tourism markets. The study concludes that agro-ecotourism represents a viable pathway for strengthening farm viability, reducing regional disparities and revitalizing rural areas through environmentally sustainable and economically diversified development.

Key words: agro-ecotourism, rural development, economic diversification, sustainable tourism, rural economy

O2_08

Corporate valuation of agricultural enterprises for informed investment decision-making

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Abstract

The study evaluated the financial performance and valuation indicators of selected agricultural corporations listed on the Croatian capital market during the period 2021–2025. The analysis includes Kutjevo p.l.c., Koka Varaždin p.l.c., Croatian Sugar Industry p.l.c., Žito Group p.l.c., and Podravka p.l.c. The research applied a quantitative approach based on secondary financial data obtained from annual reports, the Zagreb Stock Exchange, and the Financial Agency (FINA). The valuation framework is based on three standard financial models: discounted cash flow (DCF), Capital Asset Pricing Model (CAPM), and Economic Value Added (EVA). Comparative and descriptive analyses were used to examine differences in asset values, expected returns on equity, and value creation among companies. The results indicate significant differences in financial scale and performance indicators across the analyzed corporations. Larger companies, particularly Podravka p.l.c. and Žito Group p.l.c., recorded higher total asset values and EVA results, while smaller companies demonstrated lower but relatively stable financial performance. CAPM-based estimates of expected returns show moderate variation across firms, reflecting differences in systematic risk and market positioning. The findings suggest that valuation indicators provide useful comparative information for assessing financial performance in capital-intensive agricultural sectors. However, the results should be interpreted as descriptive evidence rather than causal relationships due to methodological limitations related to secondary data analysis and model assumptions.

Key words: agricultural companies, company valuation, CAPM, EVA, financial performance

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O2_09

Green management as a tool supporting the sustainable development of the food value chain in agriculture

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Abstract

The sustainable development of the agri-food sector, particularly within the food value chain, faces increasing pressure due to significant levels of food loss and waste, as well as rising environmental and climate-related challenges. Current estimates indicate that food waste constitutes a substantial economic burden and contributes notably to greenhouse gas emissions, highlighting the urgency of implementing more efficient and sustainable management practices across all stages of the supply chain. This paper examines the role of green management as a tool supporting the transition toward a more sustainable and resource-efficient agri-food system. It identifies the main drivers of food loss and waste, grouping them into technical, technological, environmental, economic, and social categories. Importantly, these factors are closely linked to human behaviour, decision-making processes, and the level of individual competencies. In this context, the concept of green soft skills is introduced as a critical component enabling sustainable transformation. These skills encompass environmental awareness, responsible attitudes, analytical thinking, and the ability to apply sustainable practices in everyday professional activities. They also include competencies related to resource efficiency, climate change mitigation, and the use of environmentally friendly technologies. The study highlights the growing demand for green skills in the labor market, particularly in sectors with high environmental impact, such as agriculture and food processing. It also emphasizes the key role of education in equipping current and future professionals with the necessary competencies to support the green transition. The findings suggest that strengthening green soft skills can significantly contribute to reducing food waste, improving resource efficiency, and minimizing the environmental footprint of the food value chain. Ultimately, integrating these competencies into management practices is essential for achieving long-term sustainability goals (SDG8, SDG9, SDG15) and supporting the transition toward a low-carbon and circular economy (SDG7, SDG12, SDG13).

Key words: sustainable development, green competences, food value chain

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O2_10

Activation of youth in rural development processes

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Abstract

Rural development is most sustainable when it originates from within the community itself. Strong social relationships, shared responsibility, and collective engagement are essential drivers of progress in rural areas. Among all social groups, young people play the most significant role in initiating activities and mobilizing communities. Community-based activities such as sports events, cultural and spiritual gatherings, and the development of shared local infrastructure significantly contribute to strengthening social cohesion. These activities create opportunities for interaction, cooperation, and mutual support among residents, which improves the social atmosphere and encourages broader community participation. When young people are given the opportunity to organize and implement such initiatives, they become active actors in developing their own communities. Recognizing this potential, agricultural clusters in the Republic of Srpska developed the concept of "small rural development projects." Through this pilot programme, support was provided to informal groups of young people living in rural areas, encouraging them to organize themselves and implement local initiatives aimed at improving community life. The objective was not only to support individual activities but also to stimulate long-term collective action and responsibility for local development. The research conducted among project participants included 33 individual respondents who were involved in these initiatives. Results indicate that the concept strongly encourages youth engagement. Approximately 88% of respondents stated that the supported activity was the first project they had implemented together, demonstrating the program's ability to initiate new forms of community cooperation. In addition, the majority of participants expressed a high willingness to continue volunteering for the development of their villages, indicating strong motivation for future engagement. These findings suggest that small-scale, community-driven initiatives can serve as an effective mechanism for activating rural youth, strengthening social cohesion, and creating a positive environment for long-term rural development.

Key words: youth, rural development, agricultural clusters, the Republic of Srpska

O2_11

A comprehensive assessment of drought impacts on wetland ecosystems: Integration of economic, ecological, and socio-demographic perspectives

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Abstract

In the broadest sense, wetlands are among the most productive and biologically valuable ecosystems, providing numerous functions that benefit both nature and society. They regulate biodiversity, climate, water, hydrological cycles, soil and sediments, and pollution levels. In recent years, the effects of climate change have intensified and become more destructive, while the loss of inland wetlands has accelerated. Focusing on the Serbian wetland Special Nature Reserve Koviljsko-petrovaradinski rit, this research examines water availability over 15 years, specifically targeting the impact of prolonged dry periods. Understanding the multidimensional impacts of drought requires selecting indicators that accurately reflect the state of the natural system and allow comprehensive evaluation of environmental and socio-economic factors. Using the Driver-Pressure-State-Impact-Response (DPSIR) methodology, this paper identifies 11 socio-climatic indicators, enabling a structured categorization of complex interactions within social and environmental factors. Following this selection, a statistical analysis of the grouped indicators was performed to quantify the specific impact of each group on systemic wetland changes. The analysis showed that social characteristics of local communities directly affect vulnerability and adaptability wetland ecosystems during dry periods, impacting resource availability and ecosystem stability. Furthermore, evaluating drought vulnerability from an economic perspective illustrated the costs of water scarcity, comparing reference values with biophysical parameters measured during dry periods. By integrating social, economic, and environmental perspectives, policymakers and stakeholders can develop strategies that strengthen both community resilience and ecological stability of KPR wetland. The presented approach provides a balanced pathway toward sustainable development while protecting essential ecosystem services and resources for future generations in the subject area (wetland and its surrounding). Timely consideration of aforementioned indicators and the implementation of appropriate measures can significantly reduce economic losses. Deploying proactive management strategies will help preserving essential resources and ensure the stability of local economies that depend on the health of wetland ecosystems.

Key words: wetland ecosystem, drought, vulnerability assessment, adaptive capacity

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O2_12

Managerial capabilities of crop producers in Central Banat

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Abstract

This study examines the managerial capabilities of crop producers in Central Banat (Vojvodina, Serbia). A total of 64 crop producers participated in the survey. The questionnaire consisted of 31 closed-ended questions. The section addressing producers' objectives, risk-reduction strategies, and strategies for achieving established goals was structured using a five-point Likert scale. Responses were evaluated using a 5-point Likert scale. The Kruskal-Wallis test was employed to examine the effect of farm size on the perception of established objectives and the evaluation of risk reduction strategies. The survey results indicate that crop production is predominantly managed by men of middle and older age groups (41-50 years). Most respondents have completed a four-year secondary education (39.06%). Family farms ranging from 1 to 10 hectares are the most common (40.6%). The most common form of knowledge improvement is "exchange of experiences with other producers" (56.25% of respondents). Approximately 83% of participants have a production plan, while 42% make decisions based on their personal knowledge and experience. The objectives of crop producers are primarily focused on "improving production" (mean score 4.23). Producers demonstrate a developed managerial awareness, with around 89% of respondents monitoring and analyzing production results. The application of the Kruskal-Wallis test revealed statistically significant differences for the objectives "expanding production capacity" and "being self - employed", as well as for the strategies "contracting the sale of finished products", and "consulting with experts", across farms of different sizes. In conclusion, the surveyed crop producers demonstrate a solid level of managerial capabilities and a strong awareness of the importance of planning, organizing, and marketing their production.

Key words: crop producers, Central Banat, managerial capabilities

O2_13

Agricultural value chain teaching in Poland: Limited offer, strong demand for practice

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Abstract

The Polish screening reveals a relatively limited but identifiable presence of agricultural value-chain content in higher education. Across 32 universities, 186 study programmes, and 8,270 scanned courses, only 11 courses were identified as relevant to agricultural value chains. Among these, logistics-based and agri-food-oriented courses clearly predominated, while only one course was primarily focused on food safety. Most identified cases were at the Bachelor's level, with much less visibility at the Master's level. Lecturer interviews suggest that the current offer aligns substantively with labour-market needs but also shows clear pedagogical weaknesses. Reported scores for value-chain analysis and fieldwork were modest, and lecturers consistently pointed to the need for more practical classes, field or study visits, and direct interaction with professionals. The competency analysis among barley-chain actors reinforced this diagnosis: respondents highlighted a lack of practical knowledge and insufficient familiarity with working tools among graduates. The Polish case, therefore, illustrates a recurring pattern within TeachAVC: relevant teaching exists, but it remains too sparse, too logistics-centred, and too weakly connected to experiential learning. Expanding applied training would significantly improve the relevance of AVC education in Poland.

Key words: Poland, agricultural value chains, logistics, fieldwork, higher education, practical training

O2_14

Young consumers' engagement in short food supply chains - A case study from Poland and Romania

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Abstract

The main aim of this study is to examine buyers' attitudes towards food purchases and to determine their willingness to participate in short supply chains. In particular, it aims to determine the extent to which convenience-seeking consumers are willing to participate in SFSCs and whether digital and logistics innovations can increase this group's participation in short-selling systems. An additional goal is to answer the question of whether short food supply chains can be designed to accommodate so-called "mainstream" consumers, not just "niche, green" consumers. To achieve this goal and identify the demand side of SFSCs, a survey was conducted on a group of young consumers – students – who are considered to be more knowledgeable and aware of issues related to the food market and make purchasing decisions based on these criteria. The study was conducted using the CAWI method between November 2025 and January 2026 among 410 individuals – 190 in Poland and 220 in Romania. The results were interpreted using descriptive statistics, interdependence testing (Chi-square test and Kendall's Tau-b test), and significance testing for differences between convenience-oriented and value-driven consumers (Kruskal-Wallis test and Dunn test). Theories of willingness to pay and willingness to accept were also applied. The study verified the following hypotheses: 1) Young consumers are more likely to be convenience-oriented, and when shopping for food, convenience and time savings are paramount for them; 2) Young consumers' participation in SFSCs is limited primarily by a lack of knowledge on the subject and difficulties accessing such sales channels; 3) Young consumers would be willing to pay more for food from short supply chains due to freshness and health benefits; 4) Knowledge of innovative short-selling solutions is low, but the willingness to use such solutions in the future is high.

Key words: food market, short supply chains, young consumers, Poland, Romania

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O2_15

Mapping higher education training modules related to the agricultural value chain in France

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Abstract

This communication, prepared within the Erasmus+ TeachAVC project, examines how agricultural value-chain approaches are currently integrated into French higher education, using the malting barley chain as a reference case. The methodological framework combines curriculum mapping with a competency-based approach. The screening covered 796 BTSA institutions, 108 IUTs, 19 agronomy and veterinary schools, and selected specialised Master's programmes, with data collection based on information saturation. The analysis was complemented by interviews with 20 professionals from the malting barley value chain in order to identify current and emerging skills needs. Results show that the diversity of French higher education programmes creates multiple entry points for value-chain teaching. Across institutions, teaching methods tend to combine lectures, tutorials, laboratory work, case studies, professional seminars, field visits, and internships. In practice, value-chain learning is strongly supported by internships, which provide applied analysis of specific chain components. However, most curricula address value-chain issues implicitly through modules on technology, quality, marketing, logistics, economics, and work-based learning rather than through dedicated value chain ("filière in French") courses. More explicit teaching on "filières" is mainly found in long-established agronomy schools. Overall, the findings suggest that many programmes cover only part of what a filière entails and would benefit from a more territorial and systemic approach, with stronger attention to regulation, coordination, and interdependence among stakeholders.

Key words: France, agricultural value chain, higher education, curriculum mapping, competencies, internships

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O2_16

The impact of storage capacity on the integration of local foods in school catering: Evidence from the Czech Republic

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Abstract

This paper aims to assess how storage capacity affects the integration of regional foods into school catering, drawing on empirical evidence from the South Moravian Region of the Czech Republic. The analysis is based on 216 valid responses (41.5% of the targeted population) gathered via a questionnaire distributed electronically to representatives of school canteens in the region. The analysis examines two key variables: perception of sufficiency of storage facilities in school kitchens and the willingness of school canteens to increase the share of local food in students' meals in the future. The relationship between these variables was evaluated using the chi-square test of independence. The strength of the association was assessed using Cramér's V coefficient. The calculated test criterion reached 7.386, which exceeds the critical values for both the 5% and 1% significance levels. This allows for the rejection of the null hypothesis of independence, demonstrating that adequate storage capacity influences the willingness of school canteens to integrate local foods into their operations. The strength of this association was quantified by Cramér's V coefficient, which is recorded at 0.185. These results suggest that while physical infrastructure and storage facilities are important factors for shortening food supply chains in the South Moravian Region, they are not the sole determinants; however, modernising and expanding storage capacities appear to be an important step toward the successful implementation of local foods in school catering in the South Moravian Region.

Key words: short food supply chains, farms, farm-to-school, barriers, infrastructure, storage facility

Acknowledgment

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O2_17

Challenge of malting barley value chain in France

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Abstract

This article seeks to outline the various challenges facing the malting barley sector in France. The methodology combines secondary data and literature reviews with 20 semi-structured interviews targeting all stakeholders in the sector. The malting barley sector in France is structured around malt production and export. Most of the land area under barley is dedicated to feed barley production. The analysis identifies two main types of malters: large malting plants owned by international companies and small malting plants attempting to integrate into an existing ecosystem. Despite an increase in the number of small and medium-sized breweries, rising costs, declining consumption, and the poor performance of certain products are preventing optimal growth at present. However, this sector demonstrates potential both in terms of its local dynamism and its ability to orient its market toward exports. The downgrading of batches of malting barley is also an important factor to consider.

Key words: malting barley, value chain analysis, France

Acknowledgment

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O2_18

Structural changes and supply elasticity of potato production: The case of Slovenia

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Abstract

Potato production in Slovenia has undergone profound structural change over the past six decades, characterised by a sharp and persistent decline in cultivated area alongside gradual technological improvements. Using official statistical data covering 1961–2024, this study examines long-term trends in area, yields, price developments, and the evolving spatial distribution of production. Over the observed period, potato area contracted by more than 90%, while yield improvements reflect technological progress and partial consolidation among the remaining commercial farms. Spatial analysis of GERK parcel data confirms a highly fragmented structure, with most holdings cultivating less than one hectare and only a limited number engaging in economically significant production. To assess supply responsiveness, we estimated a log–log model and a Nerlovian partial-adjustment model. Results reveal very low short-run price elasticity and strong path dependence, with lagged area exerting the strongest influence on current production decisions. Long-run elasticity remains weak, indicating limited capacity of Slovenian producers to adjust to market signals due to structural constraints such as small farm size, perishability of the product, and modest integration into commercial value chains. Overall, the findings point to a sector marked by ongoing contraction, low supply responsiveness, and increasing spatial concentration. These insights contribute to understanding supply behaviour in structurally constrained agricultural systems and provide a basis for future research and policy measures aimed at improving farm structure, market integration, and regional production potential.

Key words: potato production, structural change, supply elasticity, Nerlove model, farm structure, spatial analysis, Slovenia

O2_19

Geographical indications of food products and their contribution to the economic development of rural areas: An empirical analysis in B&H

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Abstract

The system of geographical indications (GIs) is an important instrument for the valorisation of traditional food products, enhancing their market competitiveness, and supporting rural development. In Bosnia and Herzegovina, the GI system has been established in accordance with the European model of food quality protection, enabling the registration of products under several quality label categories and contributing to the preservation of traditional production practices and local identity. The study aims to analyse the role of the GI system in the economic and market positioning of food products and its contribution to rural development in Bosnia and Herzegovina. The research is based on the analysis of existing registered geographical indication products in Bosnia and Herzegovina and the results of a survey conducted among producers and consumers, with data collected through an online survey (Google Forms) on a sample of 123 respondents. The producer survey covered motivations for registration, product quality assessment, and expected economic and market effects. The consumer survey examined purchase frequency, perception of product quality, and willingness to pay a premium price. The data were processed using descriptive statistics and a comparative analysis of respondents' attitudes, based on quantitative data. The results indicate that the GI system has considerable potential to strengthen the local economy, increase the market value of traditional products, and support sustainable rural development. Producers highlight the preservation of traditional production, improved product recognition, and economic benefits as key motivations for registration. Consumers perceive GI products as authentic and high-quality and show a strong willingness to pay higher prices. In addition, GI products contribute to preserving traditional production and strengthening links with rural and gastronomic tourism.

Key words: geographical indications, rural development, economic effects

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Poster Presentations

P2_01

Household food waste – Quantities, types, and reasons for food wasting in Bosnia and Herzegovina

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Abstract

According to UNEP, 19% of food in the world is wasted at the retail, food service and household level. In order to measure the achievement of SDG number 12.3 to halve the food waste by 2030, national food waste measurement systems are being established. Bosnia and Herzegovina (BiH) is one of the countries where there is still no regular food waste monitoring system. As part of the development of a methodology for monitoring food waste, a survey questionnaire was designed and tested during 2025 through its random distribution. The survey was completed by 134 randomly selected households, of which 132 responses were valid. The results of the conducted research are: (1) 90.8 kg of food is wasted annually per household member in BiH, of which 83.2 kg is edible food; (2) the most commonly wasted food is vegetables (19.2%), fruit (17.5%), bread (15.9%) and other types of food (15.5%), while meat and meat products (12.3%), oils and fats (10%) and milk and milk products (9.5%) are thrown away to a lesser extent; (3) the most common reasons for wasting food are preparing larger meals than necessary (16.8%), throwing away leftovers (16.3%) and purchasing more food than necessary (16.2%); (4) 70% of food waste is disposed of by municipal waste and similar companies, and 30% of food waste is disposed of by consumers themselves; (5) 27% of households donate food, most often doing so independently. 75% of surveyed households share concerns about food waste, and 47% feel embarrassed about wasting food. Recommendations based on the research conducted are to establish a food waste monitoring system in BiH based on representative samples at all levels of the food value chain, to increase the practice of food donation and to take preventive action to reduce food waste at the source of origin.

Key words: household food waste, food waste monitoring, Bosnia and Herzegovina

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P2_02

Bridging the sustainability data gap in the Western Balkans: The 'ESG-Admin' model applied to Bosnia and Herzegovina

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Abstract

The integration of the Western Balkans into the European market imposes strict sustainability reporting requirements (CSRD), creating a challenge for local producers operating without a fully established Farm Sustainability Data Network (FSDN). This paper proposes a cost-neutral "ESG-Admin-BiH" model that operationalizes the FAO "Proxy Approach" to bridge this information gap. While developed and validated within the regulatory framework of Bosnia and Herzegovina, the model's reliance on standardized financial reporting makes it scalable to the wider Western Balkans region, which shares similar accounting legacies and EU accession challenges. By synthesizing mandatory financial data (Income Statement AOP codes) with administrative governance records, we construct a matrix of 10 Key Performance Indicators. The model employs a hybrid scoring mechanism: scalar scoring for financial-ecological proxies (e.g., input intensity) and deductive binary scoring for regulatory compliance. While organic audits currently provide the "Golden Standard" for data verification, the study demonstrates a stratified application for conventional producers by substituting audit reports with Cross-Compliance records from the Farm Registry (RPG). The results indicate that existing bureaucratic infrastructures can be transformed into robust sustainability metrics. We conclude that Entity Ministries of Agriculture can automate this scoring by integrating the proposed algorithm into existing RPG software, thereby facilitating immediate ESG benchmarking for both organic and conventional sectors.

Key words: proxy approach, ESG Reporting, organic farms audits, Cross-Compliance, sustainable agriculture

P2_03

The impact of subsidies on the productivity of agricultural production in EU countries for the period 2015-2024

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Abstract

The agricultural sector plays an important role in the European Union, and agricultural subsidies represent one of the key instruments of the Common Agricultural Policy aimed primarily at stabilizing farmers' income. However, their impact on agricultural productivity remains an open and widely debated issue. The purpose of this paper is to examine the existence, direction and strength of the relationship between subsidies and agricultural productivity in European Union countries over the period from 2015 to 2024. The analysis is based on secondary data obtained from the EUROSTAT database and includes a sample of 21 EU Member States. The methodological approach includes descriptive statistical analysis, correlation analysis and simple linear regression analysis. The results of the descriptive analysis indicate substantial heterogeneity among EU countries in terms of both subsidy levels and productivity. The correlation analysis reveals a weak but statistically significant negative relationship between subsidies and agricultural productivity. Regression results confirm this finding, showing that higher levels of subsidies are, on average, associated with a slight decrease in productivity, while subsidies explain only a small share of productivity variation. These findings suggest that subsidies, when observed at an aggregate level and without distinguishing their specific forms and purposes, do not automatically contribute to higher agricultural productivity. The results indicate that agricultural productivity is influenced by a range of structural and economic factors, and that the effects of subsidies should be considered within a broader analytical framework.

Key words: subsidies, agricultural productivity, European Union, Common Agricultural Policy

P2_04

Financial and strategic analysis of agricultural cooperatives in the Republic of Srpska: Transition from production to trade

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Abstract

This paper analyzes the financial and strategic sustainability of agricultural cooperatives in the Republic of Srpska through a comparative analysis of two periods: 2014–2018 and 2022–2023. Based on financial reports from 54 active cooperatives and utilizing ratio, PESTLE, and SWOT analyses, the research identifies a significant structural shift in the business model. Unlike the earlier period characterized by a focus on primary production, the 2022–2023 data reveal a sharp decline in revenue from the sale of own output (−40%) alongside a surge in revenue from the sale of goods (+67%), signaling a decisive pivot toward a trading orientation. This transition is accompanied by severe human capital erosion: the total workforce has been halved compared to the 2014–2018 average, with 21 cooperatives currently operating with zero employees. The study concludes that cooperatives are undergoing a structural transformation where trading has become the dominant strategy for maintaining liquidity and financial viability, albeit at the cost of long-term production capacity and their developmental role in rural areas.

Key words: agricultural cooperatives, financial analysis, sustainability, structural transformation, Republic of Srpska

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This research is derived from the Master's thesis of candidate Bogdan Stupar, defended at the University of Banja Luka, Faculty of Agriculture.

P2_05

Female entrepreneurship in the food processing sector in Republic Srpska: An analysis of socio-economic indicators and regional specifics

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Abstract

Female entrepreneurship in the food processing sector of the Republic of Srpska represents a key factor in rural development and economic diversification. The subject of this research encompasses an analysis of the interdependence between the socio-economic status of female entrepreneurs, structural barriers, and technological readiness within the manufacturing sector. The methodology is based on the application of descriptive-analytical methods and comparative regional analysis across three key economic regions: Krajina, Semberia, and Herzegovina. The research utilizes secondary data sources from official reports of the Intermediary, IT and Financial Services Agency (APIF), the Gender Center of the Republic of Srpska, the Republic Srpska Institute of Statistics, and relevant ministries for the period 2022–2024. Key research results indicate a pronounced regional specialization in business operations. While the Krajina region leads in digital integration (88%) and automation, Semberia remains focused on labor-intensive models and economies of scale (65% digitalization). Herzegovina distinguishes itself through a model of "entrepreneurship of authenticity," utilizing ICT tools (75%) for the branding of high value-added products. A particularly significant finding is the structural problem of the property ownership gap (women own only 28.1% of real estate), which is identified as the primary obstacle to accessing credit facilities and achieving further growth.

Key words: female entrepreneurship, the Republic of Srpska, digital integration, regional specialization, property ownership gap

P2_06

Production, trade and competitiveness of Serbia in the meat market

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Abstract

Negative trends observed in the livestock sector over the past decade highlight the need to examine the main developments in the production and trade of the key livestock products, as well as to analyse Serbia's position in regional and global markets. This paper examines trends in the production and foreign trade of meat and meat products over the five-year period (2020–2024), as well as the competitive position of Serbia in the global meat market. The situation in the domestic market is analysed through the assessment of meat production (in total and by meat type), and using the self-sufficiency rate, which indicates the share of domestic demand satisfied by domestic production. Serbia's competitiveness in regional and global markets is analysed using export and import unit values, the relative unit value indicator, and two revealed comparative advantage indices. The results show that total meat production slightly increased during the observed period, but Serbia still does not hold a significant position, even at the European level. A self-sufficiency rate below 100% indicates Serbia's dependence on imports, primarily from European Union countries, to meet domestic demand for meat, which is also confirmed by the negative trade balance of this product group. Finally, the competitiveness analysis shows that Serbia achieves a limited competitive advantage only in the CEFTA market, and even this advantage has gradually weakened over the observed period, while its competitiveness in the European Union and global markets for meat and meat products remains low.

Key words: meat and meat products market, foreign trade, competitiveness, Serbia

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P2_07

Agricultural productivity in the Western Balkans: Structural transformation and the role of capital intensity

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Abstract

The agricultural sectors of the Western Balkan countries continue to face significant structural challenges, reflected in relatively low labor productivity and an incomplete process of structural transformation. This paper analyses the evolution of agricultural productivity in the Western Balkans over the period 2004–2024, using the European Union as a benchmark, within the broader context of trade integration and structural changes in the agri-food sector. The first part of the analysis examines indicators of trade integration, including export intensity, import dependence and overall trade openness, in order to assess the position of Western Balkan economies in global markets and the structure of agri-food trade. The study then focuses on key structural characteristics of agriculture, particularly the relationship between agricultural employment and the sector's contribution to GDP. The results reveal a persistent productivity gap between the Western Balkan countries and the European Union, indicating that the process of structural transformation remains incomplete. An empirical analysis of productivity determinants shows that capital intensity plays a crucial role in explaining differences in agricultural labor productivity across countries in the region. In particular, net capital stock per worker emerges as the most influential factor affecting labor productivity. Overall, the findings suggest that strengthening investment and capital accumulation will be essential for improving agricultural productivity and enhancing the long-term competitiveness of the agri-food sector in the Western Balkans.

Key words: agricultural productivity, structural transformation, capital intensity, agri-food sector, Western Balkans

P2_08

Digital agriculture software systems: Global developments and the case of Slovenia with the LoginEKO platform

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Abstract

Digitalization of agriculture has become a key factor in improving productivity, sustainability, and traceability in food production systems. Agricultural software platforms — especially Farm Management Information Systems (FMIS) — have evolved into complex decision-support systems integrating data from soil monitoring, crop production, weather conditions, and supply chain logistics. The aim of this paper is to review the current global state of agricultural software systems and to examine recent developments in Slovenia, with a particular focus on the LoginEko platform developed by Login EKO. The study is based on a literature review of scientific publications related to precision agriculture, digital farming and FMIS platforms. Results show that modern agricultural software increasingly integrates sensor networks, machine learning, and cloud-based data systems to support decision-making at the field level. The LoginEko platform represents a comprehensive information system designed to integrate crop production management, storage logistics and product traceability. The system enables digital recording of agricultural operations, monitoring of environmental parameters and full traceability of production batches. Such integrated platforms significantly contribute to the optimization of agricultural operations and the transparency of agricultural supply chains.

Key words: digital agriculture, precision agriculture, farm management information systems, agricultural software, traceability, decision-support systems

P2_09

Income and price elasticities of pork consumption: A two-part model evidence from the Republic of Srpska

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Abstract

The income responsiveness of pork meat consumption in Republic of Srpska was analyzed using a two-part modeling framework that separates the decision to consume (propensity to buy) from the level of consumption (intensity). The empirical analysis is done based on Household Budget Survey (HBS) data for 2015 and 2022. A logit model is employed to estimate the probability of pork consumption, while in the second stage a generalized linear model (GLM) is applied to positive consumption levels. The share of households consuming pork is 32% (i.e. households reporting pork consumption), while the total household expenditure (income proxy) has a positive and statistically significant effect on both the propensity and the intensity of pork meat consumption. In addition to income, pork meat prices significantly affect the consumption decision, with higher prices reducing the likelihood of consumption. Urban households, with more male members and share of adults are more likely to consume pork. Income positively affects the quantity consumed. Urban residence has a negative and significant effect on consumption intensity, indicating lower quantities consumed in urban areas despite higher participation rates. Certain labor market characteristics and education variables also show statistically significant effects. While the consumption of other types of meat increases the probability of pork meat consumption, reflecting general dietary preferences, it simultaneously reduces consumption quantities, confirming a substitution effect at the intensive margin. Estimated income elasticities suggest that pork is a normal good, with total income elasticity ranging between 0.87 and 0.93, while price elasticities are not statistically significant. The decomposition indicates that both extensive and intensive margins contribute to overall demand, with a slightly stronger effect coming from the intensity component. The findings underline the importance of accounting for heterogeneity in consumer behavior and provide relevant insights for food demand analysis and policy design in the context of changing income levels.

Key words: pork meat consumption, income and price elasticity two-part model, the Republic of Srpska

P2_10

Life cycle assessment of a fruit-based frozen dessert: Identifying environmental hotspots along the product life cycle

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Abstract

Agri-food systems significantly contribute to climate change and resource use, highlighting the need for optimization of production and supply chains. This study aimed to evaluate the environmental impacts of a fruit-based dessert on a stick using life cycle assessment (LCA), with a focus on identifying key contributors and improvement opportunities across the product life cycle. An LCA was conducted in open LCA using the BAFU life cycle inventory database and the Environmental Footprint method. The functional unit was defined as one packaged fruit-based frozen dessert on a stick. Primary production data, including ingredient inputs, energy use, packaging materials, and origin of raw materials, were obtained from the manufacturer. Scenario analysis included comparisons between local and imported fruit, short versus extended supply chains, and alternative packaging options. Environmental impacts were assessed with emphasis on climate change and resource use categories. The results indicate that different life-cycle stages (raw material production, processing, transport, packaging, distribution, and end-of-life) contribute variably to the overall environmental impact. Raw material production and processing were identified as major contributors, while transport impacts increased significantly with longer supply chains. Scenario analysis demonstrated that the use of local raw materials and shorter distribution routes can substantially reduce environmental impacts. Packaging also contributed notably, depending on material type and disposal scenarios. The study demonstrates that LCA is an effective tool for identifying critical points in agri-food systems and supports the development of targeted strategies for reducing environmental impacts. Optimizing raw material sourcing, transport distances, and packaging solutions can significantly improve the sustainability of fruit-based frozen desserts. These findings contribute to the design of more sustainable food products and support the transition toward low-carbon and resource-efficient agri-food systems.

Key words: agri-food, sustainability, life cycle assessment, food production, environmental impact, supply chain

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P2_11

Purchasing habits and market preferences of young consumers regarding chicken meat in the Banja Luka region

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Abstract

This research aims to examine the habits and preferences of young consumers aged 21 to 35 regarding the purchase of chicken meat as well as to determine how demographic characteristics shape their purchase decisions. Primary data were gathered through an online questionnaire completed by 174 respondents from the Banja Luka region (Republic of Srpska, BiH). Descriptive analysis and the Chi square test were utilized for the statistical processing of the data. The results reveal a high frequency of consumption, as 79% of the respondents consume chicken meat at least once or multiple times a week. Supermarkets represent the dominant point of purchase (46%), although a notable proportion of consumers (31%) prefer buying directly from small, local producers. Furthermore, 86% of buyers favoring chicken meat of domestic origin. Most consumers (70%) prefer specific carcass parts, primarily fillets, whereas offal is purchased the least. When evaluating meat quality, consumers predominantly prioritize taste, while price is perceived as the least important determinant. Female consumers pay considerably more attention to shelf life and are more inclined to buy specific meat parts. Married consumers and those over the age of 30 exhibit a strong preference for meat originated from small, local producers, showing a higher demand for drumsticks and thighs, as well as offal. Additionally, urban consumers consume chicken meat more frequently and display a higher tendency to buy specific parts compared to rural consumers. Overall, this research emphasizes how demographic factors influence the market, providing valuable insights for creating better marketing strategies focused on quality and domestic origin rather than just price.

Key words: chicken meat, meat quality, young consumers, consumer behavior

P2_12

Comparative analysis of the competitiveness and sustainability of organic and conventional wheat production in Serbia

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Abstract

In conventional production, wheat (*Triticum aestivum* L.) ranks behind maize in Serbia in terms of production volume and cultivated area, yet it plays a strategically crucial role due to its importance for human nutrition and national food security. In contrast, in organic production, wheat ranks first in both cultivated area and production volume, ahead of maize. Organic cereal production in Serbia is increasing but remains limited in scale. This study aims to evaluate the competitiveness and sustainability of organic and conventional wheat production through comparative production analysis and a SWOT approach. According to data from the Statistical Office of the Republic of Serbia, total conventional wheat production in 2025 was 3,681,000 tonnes on 607,075 hectares, with an average yield of 6.1 t/ha. In contrast, organic wheat is cultivated on 1,536.39 ha, representing only about 0.25% of the total agricultural land used for wheat. Yields of organic wheat are significantly lower, averaging 2.0–3.0 t/ha, while production costs are higher due to the need for certified seed, organic fertilizers, and mechanical weed control. The market price of organic wheat is 35–50% higher than that of conventional wheat, partially compensating for lower yields. The SWOT analysis indicates that the strengths of organic production include sustainability, access to export markets, and increasing demand, while the weaknesses involve limited scale, high costs, and administrative requirements. Opportunities include increased exports, development of new varieties, and improved subsidies, whereas the threats comprise climate change, competition from EU producers, and limited consumer trust. Conventional wheat is characterized by more stable yields, lower costs, and reliable income, but with lower added value and greater environmental impact. The results suggest that organic wheat production in Serbia has significant economic and ecological potential; however, to enhance competitiveness, improvements in yields, certification processes, market strategy, and farmer education are required.

Key words: wheat, organic production, conventional production, yield, opportunities

P2_13

Seed soybean production in Europe: An economic analysis

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Abstract

Seed soybean production is becoming increasingly strategically important in Europe due to the EU's significant dependence on imports of soybeans and soybean products, as well as the growing demand for GMO-free and high-quality certified seed. This study aims to assess the economic viability of seed soybean production under European conditions, based on statistical and market data. The analysis uses data from USDA-FAS, Eurostat, and relevant market reports, covering the period 2020–2025.The results show that the EU produces an average of 2.7–2.9 million tonnes of soybeans annually on approximately 1.0–1.1 million hectares, with an average yield of about 2.6 t/ha. The leading soybean-producing countries in the EU are Italy, France, Romania, Hungary, and Austria. Despite a slight increase in cultivated area compared with the previous decade, domestic production covers less than 40% of total demand, while annual imports of soybeans and soybean products range from 9 to 13 million tonnes. The market price of non-GM soybeans in Europe during the period 2023–2025 averaged 430–450 €/t at the farm-gate level. Seed production achieves higher economic returns than commodity soybean production but is associated with higher costs. Total production costs of seed soybeans in the EU are estimated at 900–1,200 €/ha, including certified basic seed, enhanced weed control, seed processing, storage, and certification. With an average seed yield of 2.4–2.6 t/ha and a seed price 20–40% higher than that of commodity soybeans, gross revenue may exceed 1,300–1,500 €/ha. The results indicate that seed soybean production is economically viable but highly sensitive to climatic extremes and market fluctuations. The study concludes that further development of this sector in Europe requires stable yields, improved varietal performance, and a long-term, predictable agricultural and market policy.

Key words: soybean, prices, yield, EU

P2_14

Assessing the implementation of environmental impact assessment for water infrastructure projects in the Republic of Srpska

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Abstract

Environmental Impact Assessment (EIA) is a central regulatory instrument for managing environmental risks associated with water management infrastructure projects in the Republic of Srpska (RS) and for supporting approximation to the European Union environmental acquis. The EIA Directive (2011/92/EU, as amended by Directive (2014/52/EU) has been substantially transposed into national legislation through the Law on Environmental Protection (Official Journal of the RS, no. 71/12, amended in Official Journal of RS no. 79/15 and 70/20) and a set of secondary regulations governing project screening, scoping, preparation of EIA studies, public participation, expert review, and issuance of environmental consent. This work provides a structured analysis of the legal, administrative, and procedural framework governing EIAs for water-related infrastructure, including the allocation of competences between national and local authorities, where the assessment indicates a high level of formal legislative alignment with EU requirements. The priority areas for regulatory and institutional improvement aimed at enhancing procedural certainty, transparency, and environmental performance in water infrastructure development within the EU accession context has been identified.

Key words: Environmental Impact Assessment (EIA), environmental governance, water management infrastructure, EU accession, regulatory compliance

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P2_15

Extensive institutional coverage with a logistics-dominated AVC focus in the Czech Republic

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Abstract

The higher educational institutions in the Czech Republic presents a comparatively broad basis for value-chain teaching, but the content remains unevenly aligned with holistic AVC thinking. The screening reviewed 28 universities and closely analysed 28 courses. Only seven courses focused directly on agricultural value chains, although a larger number addressed adjacent themes such as logistics, supply chains, sustainability, and rural development. Among the strictly AVC-focused courses, six explicitly used the terms value chain or food chain. Logistics and governance were the most frequent conceptual frames. Pedagogically, Czech higher education programmes show a moderate use of experiential approaches: case studies appeared in four of the seven core agricultural VC courses, and only one course offered fieldwork or direct experiential learning. Assessment methods show a near-even split between theoretical exams and practice-oriented projects or field reports. Significant "blind spots" persist in critical modern dimensions, including digitalization (4 courses), gender (3 courses), and informality (1 course), while themes such as labor rights and climate justice are almost entirely absent.

Key words: Czech Republic, agricultural value chains, logistics, case studies, curriculum screening, blind spots

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P2_16

Fragmented and predominantly theoretical AVC teaching in Slovakia

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Abstract

The Slovak screening identified a substantial gap between broad institutional coverage and the actual availability of agricultural value-chain education. From a total of 35 national universities, 10 relevant public institutions were identified; however, only one course explicitly referred to value chains, and its syllabus was not publicly accessible. In total, just seven courses were found to be tangentially related to AVCs, predominantly located within economics and logistics programs rather than agriculture or rural development. The Slovak institutional offer is both narrow and less integrated with agricultural disciplines. The pedagogical profile is also more limited: all identified courses were primarily theoretical, with no case studies, simulations, or practical components reported. Evaluation was based on standard tests, seminars, and exams. Content gaps were pronounced, since ethics, sustainability, digitalization, gender, and informality were almost entirely absent. The Slovak case illustrates one of the clearest needs for curriculum redesign within the TeachAVC corpus. It suggests that future development should not only increase the number of relevant courses but also diversify teaching methods, reconnect logistics with agriculture, and incorporate applied and socially aware perspectives into AVC education.

Key words: Slovakia, theoretical teaching, logistics, agricultural value chains, curriculum gap, higher education

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P2_17

Value chain education in Georgia: Expanding interest, uneven agronomy integration

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Abstract

The Georgian screening assessed the extent to which agricultural value-chain topics are present in university education and whether current provision reflects labour-market needs. Twenty-two universities were screened, including public and private institutions, and value-chain related subjects were identified in 15 universities, 30 programmes, and more than 20 courses across Bachelor's and Master's levels. The strongest concentration of teaching was found in Business Administration, followed by Tourism and Hospitality Management. Agronomy-related provision remained much more limited, with only a small number of programmes explicitly addressing agricultural value chains. Existing courses most often focus on procurement, logistics, inventory management, cost efficiency, marketing, and operations planning. Practical elements are present in the form of internships, case studies, projects, and presentations, and lecturer interviews indicate some degree of industry involvement. However, the results also show that value-chain education is still only weakly embedded in agronomy curricula. The Georgian case points to a clear strategic need: to complement business-oriented teaching with stronger agronomic and chain-wide perspectives so that graduates can understand production, coordination, and market dynamics as an integrated system rather than as separate functional domains.

Key words: Georgia, value-chain education, agronomy, business administration, internships, curriculum development

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P2_18

Romania: Stronger explicit integration of agricultural value chain teaching

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Abstract

Romania appears as one of the most advanced cases in the uploaded TeachAVC corpus for the explicit integration of value-chain education into higher education. The screening initially reviewed more than 20 Romanian universities and approximately 70 programmes, before narrowing the analysis to 14 universities and 28 programmes at Bachelor's and Master's levels. The results indicate a substantial presence of dedicated value-chain content, with explicit value-chain programmes outnumbering implicit forms of integration. The Romanian offer is especially visible in agronomy and agri-food management, but it also connects to logistics, marketing, and business administration. Illustrative examples include dedicated agri-food chain management courses at institutions such as Babeș-Bolyai University and USAMV București. The broader Romania-Moldova analysis shows that value-chain teaching in this part of the consortium is increasingly multidimensional, combining disciplinary expertise with management and market-oriented perspectives. At the same time, the evidence suggests that hard skills still dominate the curricula, especially in logistics, quality assurance, data analysis, project planning, and strategic management. The Romanian case therefore provides a useful model for explicit curricular integration, while also underlining the need to strengthen soft skills and stakeholder-oriented capabilities within AVC education.

Key words: Romania, agri-food chain management, explicit curriculum, higher education, logistics, hard skills

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P2_19

Moldova: Interdisciplinary value chain teaching with an agronomy and project focus

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Abstract

The Moldovan case shows that agricultural value-chain education is developing through an interdisciplinary combination of agronomy, business, logistics, and project management. The initial scan covered more than 20 universities and around 40 programmes, while the detailed analysis retained 6 universities and 13 programmes at Bachelor's and Master's levels. The uploaded materials indicate both explicit and implicit integration of value-chain concepts, with a notable concentration in programmes linked to agronomy and related sectors. The Technical University of Moldova is highlighted as an example of innovative practice, especially through project-management training applied to the agronomy value chain, including wine tourism and oenological products. More broadly, the Moldova-Romania evidence suggests that universities are preparing students for interconnected economic systems by embedding value-chain concepts in logistics, marketing, business administration, and agri-food management. However, as in the neighbouring Romanian case, hard skills are more visible than soft skills, and chain coordination is still framed primarily through technical, analytical, and managerial competencies. The Moldovan experience therefore illustrates both the progress already made and the next step required: a more balanced curriculum that combines technical performance with communication, leadership, and broader stakeholder engagement.

Key words: Moldova, interdisciplinary teaching, agronomy, project management, value chains, higher education

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P2_20

A value chain approach to teaching barley in Bosnia and Herzegovina: Curriculum review and stakeholder interview insights

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Abstract

This study examines the integration of a value chain approach into higher education curricula related to barley production in Bosnia and Herzegovina. The main objective is to assess the extent to which value chain concepts and barley-specific content are embedded within study programs, and to identify potential gaps between academic training and the needs of the agri-food sector. The research combines curriculum analysis with stakeholder survey data. Curriculum screening covered seven public universities, focusing on faculties within the agri-food sector and all three academic study cycles (Bachelor, Master, and Doctoral levels), resulting in a total of 44 analyzed study programs. The analysis revealed that no courses explicitly address value chain concepts; instead, relevant topics are dispersed across subjects such as food technology, crop production, storage and logistics, feed production and quality, agricultural markets, and short supply chains. In parallel, a stakeholder survey was conducted using a questionnaire adapted to the local context. The survey collected data on respondents' roles within the barley value chain, as well as their perspectives on required skills, competencies, existing training gaps, and future sector needs. The combined findings provide a comprehensive basis for identifying mismatches between higher education and labor market demands. Key challenges include insufficient practical training, limited exposure to digital tools and modern agricultural practices, and a lack of organizational and leadership competencies among graduates and young professionals.

Key words: Bosnia and Herzegovina, value chains, barley, higher education, curricula, stakeholders

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P2_21

Towards a value chain - oriented higher education curricula for barley in Croatia

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Abstract

This study examined the integration of a value chain approach within higher education curricula related to barley production in Croatia. Curriculum screening was conducted across eight higher education institutions, focusing on faculties in the agri-food sector and covering all three academic study cycles (Bachelor, Master, and Doctoral programs). A total of 29 study programs were analyzed. The analysis focused on course titles, modules and syllabus content to identify the presence of value chain concepts and barley-related topics. Findings reveal that no courses explicitly focus on the study of value chains. Instead, relevant content is dispersed across multiple disciplines, including crop production, processing and storage, feed production, food engineering, animal nutrition, quality assessment of barley-based products, agricultural economics and rural development. The dispersion of value chain topics across various subjects suggests a fragmented approach to teaching and undescore the potential for further curriculum development. Integrating value chain concepts more systematically could enhance the coherence of study programs, better align education with sectoral needs, and equip graduates with the skills and competencies required for modern agri-food systems. This review provides a foundation for designing more targeted and comprehensive courses that bridge the gap between theoretical knowledge and practical applications in the barley value chain.

Key words: Croatia, value chain, barley, higher education, curriculum development, agri-food sector

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P2_22

Reframing agricultural canal networks as multifunctional freshwater agroecosystems through nature-based solutions

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Abstract

Agricultural water management is increasingly constrained by climate variability, declining irrigation water quality, hydro-morphological alteration, and progressive degradation of freshwater-dependent agroecosystems. Drainage and irrigation canal networks within the Danube–Tisa–Danube (DTD) hydro-system, one of the largest lowland hydraulic systems in Europe — are predominantly managed as technical infrastructure for flood control and irrigation, with limited integration of ecological functions, habitat connectivity, and ecosystem service into operational management. Existing policy and management approaches frequently address water quality, biodiversity conservation, and climate adaptation as separate regulatory and sectoral domains, resulting in fragmented and often inefficient interventions, weak cross-sector coordination, and suboptimal ecological outcomes. To address this gap, study develops a conceptual integration framework grounded in the FAO Blue Transformation framework, linking Sustainable Development Goal 6 (SDG 6), Nature-Based Solutions (NbS), and the EU Nature Restoration Law to agricultural drainage and irrigation canal systems through structured policy and ecosystem-service analysis. The paper examines the potential of canal networks in lowland agricultural landscapes to function as multifunctional freshwater agroecosystems capable of improving irrigation water quality and strengthening climate resilience when managed through NbS-oriented restoration measures. The analysis indicates that NbS including riparian buffer establishment, ecological channel re-profiling, and natural water retention measures — can mitigate water quality degradation, improve habitat connectivity, and enhance hydrological stability. Interpreted through the FAO Blue Transformation framework, these measures directly contribute to SDG 6 targets on water quality improvement. Furthermore, the EU Nature Restoration Law functions as a binding policy instrument that operationalizes NbS through mandatory restoration targets in degraded freshwater and agricultural ecosystems, reinforcing SDG 6 implementation while promoting cross-sectoral alignment between water management, biodiversity conservation, and agricultural policy. The proposed framework offers a transferable conceptual model for integrating irrigation management and ecosystem restoration, providing guidance for restoration planning, policy harmonization, and sustainable water management across European lowland regions.

Key words: nature-based solutions, water management, agroecosystems, infrastructure

P2_23

Economic benefits and regional distribution of *Phacelia tanacetifolia* in Serbian organic farming

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Abstract

Phacelia (*Phacelia tanacetifolia* Benth.) is an annual honey and cover crop with significant agronomic, ecological, and economic potential in organic agriculture. This fast-growing species, suitable for green manure and cover cropping, improves soil physical, chemical, and biological properties, increases organic matter content, and supports beneficial soil microorganisms. Additionally, phacelia is an important source of nectar and pollen, enhancing pollinator populations and agroecosystem biodiversity. The aim of this study is to analyze phacelia's presence in organic production in Serbia in 2024, including regional distribution and its share in the conversion period and certified organic status, to assess its agronomic, ecological, and economic significance. The analysis is based on official data from the Ministry of Agriculture, Forestry, and Water Management of the Republic of Serbia. In 2024, the total area under organic plant production in Serbia was 27,549.67 ha, of which 46.2 % was in conversion and 53.8 % in certified organic status. Phacelia occupied 2.23 ha (0.008 % of total organic areas), with 71.6 % in conversion and 28.7 % in organic status. Regionally, the largest areas were in Belgrade (1.43 ha; 34.4 % in organic status), while in Southern and Eastern Serbia it was present only in the Pirot District (0.15 ha), and in Vojvodina in the South Bačka District (0.66 ha in conversion). Compared to other forage crops (1,926.50 ha; 7 % of total organic areas), phacelia is minimally represented, highlighting the need for promotion and farmer education. Nevertheless, it provides multiple benefits: improving soil structure and fertility, contributing to nitrogen fixation, reducing erosion, and enhancing pollinator biodiversity, including honeybee species. Although currently marginal, integrating phacelia into organic crop rotations can significantly enhance the sustainability and resilience of Serbia's agricultural systems, particularly in urban and peri-urban areas and regions with favorable agroecological conditions.

Key words: Phacelia tanacetifolia, organic production, areas, regional distribution

Acknowledgment

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P2_24

Consumer behavior towards local food products

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Abstract

This study examines consumer behaviour related to the purchase of local food products in the Banja Luka area, with a focus on the role of socio-demographic characteristics, purchasing power, and key attitudinal factors such as trust, perceived quality, and support for local producers. The research is based on primary data collected through a structured questionnaire using the CAWI method, with a sample of 150 respondents. Descriptive statistics, analysis of variance, Pearson correlation, and hierarchical cluster analysis were applied. The results indicate that local food products are characterized by a high level of consumer trust, with the majority of respondents perceiving them as higher quality compared to imported alternatives. Supporting local producers and trust in producers emerge as the most important factors influencing purchasing decisions, while price is of relatively lower importance. Statistically significant differences were observed across age and income groups, with older and higher-income respondents showing stronger preferences for local products. The analysis also reveals a strong positive relationship between purchasing power and food purchasing behaviour, highlighting the importance of economic capacity as a key determinant of actual consumption. Cluster analysis identified three distinct product groups, with traditional and minimally processed products showing the highest levels of consumer trust and loyalty, while processed products are less associated with local origin. The findings suggest that, despite favourable consumer attitudes, the development of local food markets in Bosnia and Herzegovina depends on improving the economic accessibility of local products and strengthening direct links between producers and consumers.

Key words: local food products, consumer behaviour, consumer trust, hierarchical clustering, Bosnia and Herzegovina

P2_25

Wastewater treatment methods – with a focus on biological methods

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Abstract

Water pollution is the biggest global environmental problem. Any pollution from waste from industry, transport, agricultural production reaches groundwater, rivers, lakes and the sea. Some industrial wastewater contains toxic or difficult to decompose pollutants that endanger the living world of the environment. Nitrates from agricultural sources are one of the main causes of water pollution. Pathogenic microorganisms and parasites are also transmitted by contaminated water. These pollutants lead to ecological changes that lead to the loss of plant and animal species, as well as endangering human health. Before being discharged into a recipient or public sewer, wastewater must meet the prescribed quality. Municipal wastewater is discharged into public sewer systems and is treated in a collector system in a wastewater treatment plant. Industrial wastewater is discharged into a public sewer system or natural recipient after pretreatment. Wastewater from health, veterinary and other institutions, companies, other legal entities and entrepreneurs in which pathogenic microorganisms can be expected are disinfected before being discharged into the recipient. Mechanical, physical-chemical and biological methods are used for wastewater treatment. Removal of coarse and colloidal particles from water can be carried out in several ways, namely: coagulation, flocculation, sedimentation, filtration. Biological treatment is an efficient and economical way to treat wastewater. These methods are based on the application of communities of microorganisms, collectively called activated sludge. Biological treatment can take place in aerobic and anaerobic conditions. Aerobic processes are of greater importance in wastewater treatment. In these processes, activated sludge is made up of bacteria from the genera *Pseudomonas*, *Bacillus*, *Agrobacterium*, *Spirillum*, *Arthrobacter*, *Nitrosomonas*, *Nitrobacter*, *Sphaerotilus*, etc., which, above all, have the ability to oxidize and nitrify. Given the importance of water for life on earth, great and continuous attention should be paid to its preservation.

Key words: wastewater, contamination, purification, biological methods

P2_26

Certification based on the example of regional products as a way to strengthen communication with the market and the food value chain

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Abstract

The food market is highly competitive. Supply-side entities are therefore undertaking various initiatives to strengthen communication with buyers and help increase the food value chain. These include distinguishing products with special certificates, brands, and signs indicating or confirming a specific place of origin, unique quality characteristics, including health benefits, traditional production methods, and the use of local raw materials. This is intended to help increase sales revenues and increase trade margins, which contributes to the growth of the food value chain. This also serves to protect these specific products from potential counterfeiting and unfair competition, which may attempt to impersonate genuine products and profit from this practice. Furthermore, the use of such additional markings and certificates serves to send strong signals to customers that such products are of higher quality and worth purchasing, even if substitute products without certification are cheaper.The aim of this study is to demonstrate the link between certification and the strength of market communication and increased value in the food chain, using regional products as an example. The study utilized secondary data sources, including industry reports, specialized scientific articles, and materials available online. Data collection was conducted using a documentary approach and a critical literature review. The results were prepared using a descriptive method. Product certification and the use of regional labels or brands promote increased value in the food chain. This is a valuable tool for communicating with the market and can be used to promote regional products. Companies' disclosure of their permission to use special labels and confirming the high quality of their certificates also provides additional benefits for buyers. This facilitates consumer purchasing decisions and allows them to choose between regional products of higher quality than the substitute offer available on the market thanks to the use of easily recognizable labels.

Key words: market communication, regional food product, product certification, food value chain, CHAIN Erasmus+ project

Acknowledgment

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P2_27

Empirical research on the willingness of young people to start an agribusiness in Serbia

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Abstract

This paper examines the willingness of young people in Serbia to start an agribusiness, with particular emphasis on the perception of government financial support and entrepreneurial education as key determinants of entrepreneurial intentions. The research was conducted using a quantitative methodology on a sample of 485 respondents of different ages and educational backgrounds. The results indicate that respondents highly evaluate the availability and adequacy of government financial instruments ($M>4.27$), and that this perception significantly influences their willingness to start an agribusiness ($R^2=31.01\%$; $p<0.0001$). The perception of entrepreneurial education also demonstrates a statistically significant and stronger effect ($R^2=44.88\%$; $p<0.0001$), although greater variability in responses was observed, particularly regarding mentoring support and the alignment of programs with market needs. The key empirical finding shows that the combined effect of financial support and education explains 51.81% of the variance in entrepreneurial willingness, with education exhibiting a higher relative contribution. The results provide a basis for designing integrated support policies for young agripreneurs.

Key words: agribusiness, government financial support, entrepreneurial education, entrepreneurial intentions, young agripreneurs

P2_28

Sustainable agricultural production as a determinant of agritourism development in rural areas: An empirical study Republic of Srpska

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Abstract

Agritourism is increasingly recognized in contemporary research as an important instrument for the sustainable development of rural areas, as it contributes to the diversification of economic activities, the preservation of cultural heritage, and the improvement of the quality of life in rural communities. The aim of this research was to examine the relationship between sustainable agricultural production and the development of agritourism. The study was conducted on a sample of 419 respondents using a five-point Likert scale, while descriptive statistics and linear regression methods were applied for data analysis. The results indicate a high level of agreement among respondents with statements related to the importance of agritourism for the economic development of rural areas (M=4.47) and the preservation of traditional culture (M=4.33). Linear regression analysis shows that sustainable agricultural production has a statistically significant positive impact on the development of agritourism (β=0.7896; $p<0.0001$), with the model explaining 62.35% of the variance of the dependent variable (R^2=0.6235). The obtained results confirm that the integration of sustainable agricultural practices and tourism activities represents an important factor in the development of the rural economy.

Key words: agritourism, sustainable agricultural production, rural development, diversification of the rural economy, sustainable tourism

P2_29

Building resilient agricultural value chains for sustainable local development in Togo and Cameroon

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Abstract

The "Clé en main" project, led by YCID, is part of an international cooperation initiative designed to support decentralization processes in Togo and Cameroon by strengthening the technical capacities of local stakeholders and fostering the financial autonomy of local authorities. The project focuses on sustainable territorial and agricultural development, the structuring of selected value chains with local potential, and adaptation to climate change. Three different territories and agricultural sectors were targeted: ginger in Kara (Togo), coffee and cocoa in Blitta (Togo), and coffee in Foumban (Cameroon). In Kara, the processing of ginger into essential oil demonstrated significant economic potential, provided that technical, legal, and organizational challenges are adequately addressed. In Blitta, the revival of the coffee-cocoa sector is based on improved agroecological practices, the strengthening of cooperatives, diversification of production systems, and quality enhancement through agroforestry and local processing. In Foumban, the development of artisanal roasting, quality improvement, and access to certification schemes represent key levers for strengthening market integration at national and international levels. Project activities combined expert missions, socio-economic surveys, agroecological assessments, soil analyses, technical training sessions, and support for product marketing. These actions enhanced understanding of local dynamics, identified major constraints (climatic variability, pests and diseases, limited access to finance and market information, and declining youth engagement), and generated practical, context-specific solutions. Special emphasis was placed on empowering women and young people, disseminating sustainable farming practices, and consolidating value chains.By mobilizing researchers, students, local governments, cooperatives, and institutional partners, the project contributes to strengthening the resilience of rural territories, sustainably improving agricultural incomes, and promoting an integrated model of territorial development based on cooperation, innovation, and long-term sustainability through a proposed and projected cocoa post-harvest center in Blitta which is to be opened in June 2026.

Key words: cocoa, sustainable developpement, value chain

Session 3: Crop Science

Oral Presentations

O3_01

Frequence of the Fibonacci sequence of disc-florets in four genotypes of sunflower

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Abstract

The disc-flowers on the sunflower head are formed spirally in two directions. One clockwise and the other counterclockwise. In the experiment carried out in 2024 and 2025 at two locations in Hungary, we analysed the frequency of members of the Fibonacci sequence on four sunflower genotypes. We focused our research on two sequence categories: N + NB (N=exact number of the Fibonacci sequence and NB= N-1, N+1, N-2, N+2, N-3, N+3) and NoF – outside the N+NB category. Data for all eight groups were part of our research. The frequency of occurrence of Fibonacci sequence categories also depends on genotype, location, and year of testing. The experiment involved a large number of samples and required high-quality field trials. The research examined several characteristics of sunflower seeds to determine the relationship between the frequency of the Fibonacci sequence and these characteristics, and to explore their potential use in sunflower breeding. The experiment clearly showed the tendency of sunflower to form spirals closer to the Fibonacci sequence in the sunflower heads, but in much lower frequency than reported in the literature. We have concentrated on the Fibonacci sequence in our research, although the data can be used to determine the frequency of other sequences, such as the Lucas or F4 sequence.

Key words: sunflower, Fibonacci sequence, clockwise, counterclockwise, location, year

O3_02

Plant microbiome for climate-smart agriculture: Integrating flipped learning and design thinking in higher education (BIOSHIELD Project)

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Abstract

Climate change poses profound challenges to agricultural sustainability, soil health, and global food security. The Erasmus+ project *BIOSHIELD – Novel Biotechnological Solutions in Climate Change Mitigation* addresses these challenges by developing innovative, practice-oriented higher education curricula grounded in digitalization and student-centred learning. By embedding Flipped Learning and Design Thinking into biotechnology education, the project promotes systems thinking and problem-solving skills. The partner consortium has developed five higher education modules, each structured around two problem-based learning units addressing key climate-relevant biotechnology domains: food and microbiome innovations; sustainable food systems and circular bioeconomy; soil microbiomes and spatial environmental analysis; plant-based carbon capture strategies; and phytoremediation and in vitro plant technologies. All modules will be piloted in the summer semester. This paper presents Module 3: *From Micro to Macro – Soil Microbiome for Climate-Smart Farming*, an interdisciplinary module linking soil microbiology, agronomy, and Geographic Information Systems (GIS). Reflecting the multi-scalar nature of climate impacts, the module addresses two complementary problem contexts. The first focuses on plant–microbiome interactions. Students explore the plant holobiont concept and the roles of diazotrophic and beneficial microbial consortia in enhancing nutrient efficiency and crop resilience. Through the Design Thinking framework, they formulate research questions and design pot experiments to assess how environmental factors influence microbial inoculant performance. Results generated during the pilot phase will be analysed and interpreted in relation to field applicability under practical farming conditions. The second problem context examines environmental variability at broader spatial scales. Students apply GIS tools to analyse variables influencing soil microbiomes and develop map-based proposals supporting climate-smart soil management. Prior to piloting, the modules were refined during an international Learning, Teaching and Training Activity. A student guidebook and two instructional videos per module were developed to support the flipped learning model.

Key words: educational innovation, interdisciplinary curriculum, problem-based learning, soil–plant systems, Geographic Information Systems

Acknowledgment

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O3_03

Variation of weight of spike in wheat varieties

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Abstract

The weight of the spike serves as a measure of the wheat seed yield. This study aimed to assess the variation in the weight of the spike among 50 genetically diverse wheat varieties. The experiment was set up as a randomized block design consisting of three replications during the 2016/17 growing season. The seeds were planted at a distance of 0.10 m in rows that were 1.0 m long, with 0.2 m between each row. Sixty fully mature plants (20 plants per replication) were collected and utilized to assess the weight of the spike. The variance analysis was carried out using MSTAT C (version 5.0). The hierarchical method of Euclidean distance was utilized to analyze similarities among wheat varieties. The results obtained showed considerable differences in the average values of the spike weight among the wheat varieties in the experimental year. The lowest weight of the spike was in the Kosmajka and Šumadija varieties (2.79 g), whereas the Milica variety had the highest spike weight (4.45 g). The average weight of the spike for all 50 wheat varieties was 3.51 g. The coefficient of variation values ranged from 10.4% for Danica to 20.5% for the Kremna variety. Similarity was illustrated in a dendrogram containing five clusters. The similarity was depicted in a dendrogram containing five groups of mutually similar varieties. The prominent cluster contained different numbers and compositions of varieties with the highest degree of similarity.

Key words: wheat, spike weight, variety, similarity

O3_04

On- and off-site impacts of different land management practices related to soil health and flood control within small watersheds of Celinac in BiH

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Abstract

Understanding the impact of land management on soil health and runoff is crucial for effective flood risk control in watersheds. However, the Flood Risk Management Plan for the Vrbas River Watershed has not adequately recognized the impact of soil-degrading practices and sustainable land management options. This study aimed to assess the effects of different land management practices on soil health and flood risk within small watersheds in the Celinac Municipality along the Vrbas River. Several field plots with different management were examined, including deciduous forest, 10-yearold grassland, and crop rotations of maize-wheat with and without manure, maize-wheat-fallow, maize-wheat-grass with manure, and maize-wheat-alfalfa with manure. On-site assessments focused on documenting practices in the WOCAT database and analyzing soil properties such as aggregate stability, water infiltration, organic matter, acidity, and nutrients. Off-site impacts, specifically surface runoff, were estimated using the SCS-CN Method and GIS. The findings revealed that fields with grass, alfalfa or fallow in the rotation maintained significantly higher macroaggregate stability (>2 mm) compared to conventional maize-wheat. Fields lacking adequate cover, particularly maize, exhibited severe degradation and contributed disproportionately to runoff. Conservation practices such as contour ploughing, cover crops, strip buffers, and reduced tillage could potentially reduce runoff from cropland by 35%. During daily rainfall events of 40 mm, the watershed runoff varied between 6.3-32% depending on the scenarios. This study highlights the importance of transitioning from traditional engineering to sustainable land management approaches that enhance soil health and reduce runoff on croplands. Thus, flood risks downstream can be significantly mitigated.

Key words: aggregate stability, conservation, flood, land degradation, maize, manure, runoff, SCS-CN, SLM, soil health, watershed, WOCAT

O3_05

Uncovering a sustainable system that enhances dietary fiber accumulation in grains

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Abstract

Driven by the fact that climate change has a burdening impact on agriculture, beside the yield reduction, the grain quality of cereals and legumes is affected, too. Sustainable agriculture represents a key strategy for mitigating these effects. Thus, the main goal of this research was to examine whether intercropping and biofertilization can enhance fiber accumulation, as an important nutrient, in soybean and proso millet grains. The field experiment encompassed three intercropping combinations (SM - alternating rows; SSMM - two-row strips; SSMMMM – two rows of soybean and four rows of millet strips), with sole crops as controls, during two years. The influence of the biofertilizer Coveron (BF) was also investigated. The results revealed that intercropping significantly increased total dietary fiber accumulation in both, soybean and millet grains, increasing the content by 8% in soybean and 18% in millet within the SSMMMM combination. The same combination stood out when soluble and insoluble fiber were evaluated. Conversely, an opposite trend was observed regarding the arabinoxylan content in both crops, where this combination yielded significantly lower or similar values to the sole crops. Regarding resistant starch, competition between crops was evident, with sole crops exhibiting higher values in general. Among the intercrops, the combination that provided the highest resistant starch value in soybean was SSMMMM (0.27 g/100 g DM), while for millet, it was SSMM (10.15 g/100 g DM). In most cases, the biofertilizer reduced fiber content in the grains, or its influence was not found to be statistically significant. The findings of this research highlight intercropping as a viable and sustainable strategy for enhancing dietary fiber content in both, soybean and millet grains, thus boosting their quality.

Key words: soybean, millet, intercropping, dietary fiber, arabinoxylan, resistant starch

Acknowledgment

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O3_06

Advantages and disadvantages of non-chemical weed management: Case study of medicinal and aromatic plants

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Abstract

Weeds are the main problem in achieving the desired yield and profit in the production of all field crops, including medicinal and aromatic crop plants. Weed control methods may vary depending on the type and abundance of weeds, crop type, season, and production goals. In this study, the advantages and disadvantages of non-chemical weed management strategies in medicinal and aromatic plants (*Matricaria chamomilla*, *Mentha piperita*, *Lavandula officinalis*, *Plantago* spp., *Salvia officinalis*, *Angelica archanagelica*, etc.), were analyzed. Mechanical and cultural methods including mulching, hand weeding, tillage, and grazing are mainly used to manage the weed infestation in the medicinal and aromatic crop plants. Mulching with natural and synthetic mulches was the main method used on medicinal and aromatic crop plantation. In addition, a few conventional methods such as hand weeding and tillage were applied to reduce the problem. Although the methods were effective and affordable, the effect was not highly effective on plots with high weed abundance. Since one method is not enough to weed control, an integrated system is needed to reduce the possibility of failure in weed management. Along with the existing strategies, planting cover crops, applying organic herbicides and using flame are recommended. Through the education of farmers and the higher education of future managers, it is possible to improve the weed control strategy in medicinal and aromatic crops production.

Key words: medicinal plants, aromatic plants, weeds, non-chemical management

O3_07

Synergy of traditional and modern approaches in biotechnology and digital agriculture for sustainable food production and public health

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Abstract

Sustainable food production represents key challenge of modern agriculture, particularly in the context of climate change, soil degradation, and global food demand. Traditional practices, based on knowledge and ecological principles, provide a stable foundation for biodiversity conservation and the resilience of agroecosystems. The synergy of these methods with biotechnological innovations and digital technologies, including precision agriculture, IoT sensors, data analytics, improved crop varieties, and biostimulants, enables the optimization of resources, increased yields, and the minimization of negative environmental impacts. Food quality and safety are linked to public health and the outcomes of chronic non-communicable diseases. Poor in micronutrients nutrition, contributes to the global burden of type 2 diabetes, cardiovascular diseases, and metabolic syndrome. Biofortification, an biotechnological strategy aimed at increasing the content of bioactive compounds in crops, has emerged as a scientifically grounded approach to the prevention of chronic diseases. Polyphenols derived from biofortified plants exhibit anti-inflammatory and antioxidant properties relevant to disease prevention. Phytosterols, present in plant-based foods and available through biofortified varieties, have demonstrated significant reduction in LDL cholesterol. Omega-3 fatty acids from plants, whose concentration depends on cultivation conditions, contribute to reducing cardiovascular risk. This paper presents an analysis of contemporary research conducted under different agroecological conditions to identify the synergistic effects of combining traditional and modern approaches. The results indicate that the integration of these methods enhances efficiency, climate resilience, and global food security, while improving the nutritional profile of food for the prevention of chronic diseases.

Key words: biotechnology, digital agriculture, sustainable food production, phytochemicals, public health

O3_08

Integrating soil seed bank and aboveground vegetation for prediction of weed dynamics in soybean production

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Abstract

Weeds in soybean reduce yield and quality and complicate harvest, while herbicide use, combined with other management practices, effectively controls weeds and supports stable, profitable production. The aim of this study was to assess and predict weed flora in soybean production using three methods: (I) floristic composition of weeds, (II) soil weed seed bank, and (III) seedling emergence method. A field experiment was established during 2024 at the agricultural farm of Marko Kovačević in Velika Greda. The trial was arranged as a randomized complete block design with four replications. Weed presence and abundance were assessed using the first method by counting plants within a 1 × 1 m, where a total of 12 weed species were recorded with *Ambrosia artemisiifoila* L., *Chenopodium album* L. and *Sorghum halepense* (L.) Pers. being the absolutely dominant species. During second method soil samples were collected from depth (0–20 cm), weed seeds were extracted from soils and identified and counted by species. The method indicated that one additional weed species, with a pronounced dominance of *Amaranthus retroflexus* L. The same soil samples were placed for germination and it was found that *A. artemisiifolia* L. and *S. halepense* (L.) Pers. showed the best germination. All three methods indicated a high level of weed infestation in the recorded species. While the first and third methods suggest good germination of the examined species, the soil weed seed bank method, clearly shows that the soil is a constant and endless reservoir of weed seeds - a hidden threat. This serves as a serious warning for farmers: seeds of species *A. retroflexus* L. will sooner or later become active and can cause significant problems in crop production, highlighting the need for a continuous and integrated approach to weed management.

Key words: weeds dynamics, soybean, aboveground vegetation, soil weed seed bank

O3_09

Buckwheat response to abiotic stresses: Effect of hail on different cultivars

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Abstract

Buckwheat is a summer crop of growing interest due to the ecosystem services it provides (e.g., pest control and pollination), its nutritional value (gluten-free, low glycemic index), and its agronomic advantages, including a short growing cycle and low input requirements. However, it is highly sensitive to abiotic stresses. High temperatures and drought can cause flower abortion and poor grain filling, significantly reducing yield and stability. Other stresses, such as hail, remain less studied despite their increasing relevance under climate change. In northern Italy, hailstorms frequently occur during the buckwheat growing season and may severely impact crop performance. This study aimed to evaluate the effect of hail on the performance of different buckwheat cultivars. It was hypothesized that cultivars differ in their branching capacity, influencing flower production and yield recovery after damage. The experiment was conducted in summer 2025 at the University of Udine experimental farm. Buckwheat was sown on 18 July as a second crop after soft wheat. Eight commercial cultivars and one pre-breeding line were arranged in a randomized complete block design with three replicates. A severe hailstorm occurred on 17 August at the pre-flowering stage. Plant density was recorded after emergence and after the hail event. Additional measurements were taken at full flowering and at harvest, including biomass, yield, thousand seed weight, and first flower height. The hailstorm reduced plant density by an average of 73%, with no significant differences among cultivars. Mean yield was 944 kg ha^{-1}. The highest yields were observed in Esquire (1326 kg ha^{-1}), Sofia (1240 kg ha^{-1}), and breeding line 1 (1411 kg ha^{-1}), while Čebelica (462 kg ha^{-1}) and Darja (648 kg ha^{-1}) performed worst. Weed biomass did not differ significantly among cultivars. Despite severe damage, some cultivars showed strong recovery, achieving yields comparable to a previous growing season without abiotic stress.

Key words: buckwheat, hail, plasticity, Italy

Acknowledgment

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O3_10

Total phenolic content and antioxidant potential of the traditional wheat landrace

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Abstract

This study aimed to determine the total phenolic content and evaluate the antioxidant potential of the traditional spring wheat landrace Brkulja from Knezevo cultivated in Republic of Srpska, municipality Knezevo, Brkulja from Bijelo Polje cultivated in Montenegro and winter old wheat variety Rimljanka from Berane Montenegro contributing to its chemical characterization and assessment of nutritional value. Grain samples of the three studied wheat varieties were extracted with methanol in an ultrasonic bath for 2 h. After centrifugation, supernatants were evaporated to dryness and re-dissolved in methanol. Total phenolic content (TPC) was determined spectrophotometrically using the Folin–Ciocalteu method. Absorbance was measured at 725 nm after reaction with diluted Folin–Ciocalteu reagent and sodium carbonate. Gallic acid was used for calibration, and results were expressed as µg gallic acid equivalents per gram (µg GAE/g) of sample. Antioxidant activity was evaluated using the DPPH radical scavenging assay (EC_{50}). The highest total phenolic content was observed for Brkulja from Kneževo (311 µg GAE/g), followed by Brkulja (Bijelo Polje) (284 µg GAE/g) and Rimljanka (Berane) (214 µg GAE/g). However, the EC_{50} values obtained using the DPPH assay were approximately 20.0 mg/mL for Kneževska brkulja, 20.0 mg/mL for Brkulja (Bijelo Polje), and 20.1 mg/mL for Rimljanka (Berane), indicating relatively low radical-scavenging activity of the whole-grain extracts under the applied experimental conditions. The analyzed Brkulja landraces exhibited moderate levels of total phenolic compounds, with noticeable variation among samples, whereas Rimljanka showed the lowest levels. However, antioxidant activity, as measured by the DPPH assay, was minimal in all three studied varieties. These findings highlight the need for further investigation, particularly of bran fractions enriched in phenolic compounds, in order to better evaluate the functional and nutritional potential of these underutilized wheat landraces.

Key words: Brkulja, Rimljanka, total phenolic content, Folin–Ciocalteu method, DPPH assay, wheat landrace

O3_11

Basic characteristics of the agricultural land in the Republic of Srpska

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Abstract

Land cover and land use (LCLU) is the key GIS layer for analyzing the state of agricultural land. The delineation of polygons has been done based on Sentinel 2 satellite imagery (10 m spatial resolution) by applying GIS technologies according to the LCLU classes. The LCLU classification is consisted of 12 main classes, which are further split into 36 LCLU classes: 18 agricultural and 18 non-agricultural. For three regional brunch units (RBU) of the Republic of Srpska (Prijedor, Gradiska, and Banja Luka - total of 22 cities/municipalities), precise delimitation of the LCLU classes was carried out. The smallest mapping unit was 0.5ha. The LCLU created in this way enables, among other, for high-quality monitoring of changes in the use of agricultural land. For the RBUs Doboj, Bijeljina, Sokolac and Trebinje, Corine (CLC) 2018 data were used, which were translated into the LCLU classification. The updated LCLU shp file of the Republic of Srpska (RS) for 2018-2025 contains 34931 polygons (LCLU from 2008 has 5056 polygons). Non-agricultural areas occupy 62.5%, while agricultural areas occupy 37.5% of RS area. From the total 925211 ha of agricultural land, 21% are pastures, and 79% are arable land. Data from 8052 (geo-located) average soil samples were used to conduct the inteppolation (IDW method) and gain the conclusions regarding the fertility of cultivated land (730872ha). The major shortcomings of the cultivated land are low contents of humus (63%) and easily available forms of phosphorus. Acidic soils cover 22%, while the land with easily available forms of of potassium cover 0.5% of cultivated areas. The 60.9% of agricultural land is located up to 500m above sea level, whereas 71.4% of the agricultural activity is conducted on the terrain with the slope up to 10%. The area of the agricultural land per capita is 1.26ha.

Key words: agricultural land, land cover, land use, GIS

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Session 3: Crop Science

Poster Presentations

P3_01

Effects of different mulching treatments on tomato production

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Abstract

Climate change and increasingly frequent heat waves pose a serious challenge to tomato production, as high temperatures negatively affect flower fertilization and fruit quality. Lack of rainfall, drought periods, and extreme weather conditions further complicate cultivation, increase production costs, and lead to reduced yields. In order to mitigate the negative effects of high temperatures, the Agriculture Extension Service in Sombor (Vojvodina Province, Serbia) established a field trial in which soil mulching was applied as an agrotechnical measure. This practice helps preserve soil moisture, reduces evaporation, and stabilizes temperature in the root zone. As a result, it improves conditions for plant growth and development, reduces stress, and decreases production losses in vegetable farming. The trial included the following variants: control, black plastic mulch, black plastic mulch with hay, black plastic mulch with straw, soil without plastic mulch with hay, and soil without plastic mulch with straw. The trial was conducted at the experimental field. The selected variety was Novosadski jabučar, with seedlings produced in-house. The highest yield of first-class fruits was achieved in the variant with soil without plastic mulch with hay, amounting to 50.0 t/ha. This variant also recorded the highest total yield of 78.50 t/ha. The highest yield of second-class fruits was recorded in the control variant, reaching 40.0 t/ha. The results indicate a significant yield increase compared to the control and the standard practice of using black plastic mulch alone in production. Increasingly pronounced climate changes make vegetable production more vulnerable, highlighting the need for adaptation through the selection of new varieties, improved irrigation systems, and the application of modern agrotechnical measures.

Key words: tomato production, mulching treatments, climate change, yield performance, temperature

P3_02

Assessment of bioaccumulation and potential ecological risk in maize seeds

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Abstract

Heavy metals in seeds are undesirable contaminants that can affect seed quality, germination, and the nutrition of humans and animals. The Bioaccumulation Index (BAI) and Potential Ecological Risk Index (RI) were used to assess the accumulation of essential and potentially toxic elements in organic and conventional maize seeds (*Rumenka*) produced at the Maize Research Institute Zemun Polje from 2015 to 2017. Elemental analysis was performed using inductively coupled plasma–optical emission spectrometry (ICP-OES). BAI was calculated as the ratio of element concentrations in organic to conventional seeds, while RI was estimated based on the potential ecological risk approach, integrating the concentrations and toxicity factors of Cd, Pb, Hg, Sb, and Al. In 2016, organic maize showed higher accumulation of P (BAI=1.24), Zn (BAI=1.46), Mn (BAI=1.21), Mg (BAI=1.07), and Se (BAI=1.70), while Ni (BAI=0.69) and Cu (BAI=0.86) were higher in conventional seeds. In 2017, BAI for Se reached 13.06, with Zn and Ni showing BAI values of 1.15 and 1.29, respectively. Conventional maize accumulated more P (0.91), Mg (0.85), Mn (0.82), and Fe (0.82). RI values for organic maize remained low across years (85.2 in 2016; 82.9 in 2017), indicating minimal ecological risk despite higher metal concentrations in 2017. The results demonstrate that organic cultivation reduces potential environmental risks while promoting selective accumulation of beneficial micronutrients. Overall, BAI and RI assessments indicate that organic maize preferentially accumulates Se, Zn, and Ni while maintaining low levels of toxic metals, highlighting the significant influence of cultivation system and production year on mineral composition and ecological safety.

Key words: maize, heavy metals, ICP-OES, BAI, RI

P3_03

Wheat straw as a renewable energy source

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Abstract

Every year, large amounts of waste are generated in agricultural production, but also in other economic activities, which represents organic biomass suitable for use for energy purposes. Wheat straw is increasingly used for biogas production. Energy from straw can be obtained conventionally (by combustion for heat production) or by new technologies for the production of liquid biofuels. The paper examined the biomass of two alternative cereals: Spelt wheat and khorasan wheat, during a two-year research period in 2024-2025. on degraded land in Ilandža, Alibunar Municipality, and the possibility of more rational use of their secondary products for energy purposes. The results showed that there was a statistically significant difference between the genotypes in the level of the investigated parameter, while the year did not have a statistically significant effect on the level of biomass yield. Khorasan wheat had a statistically significantly higher biomass yield (1635 kg ha^{-1}), compared to emmer wheat (1034 kg ha^{-1}), on average, for the two-year research period, by 58.12%. Khorasan wheat is more desirable in the production of biofuels. It is necessary to develop industrial plants that would use crop residues from field and other crops for the production of biofuels.

Key words: biomass, renewable sources, energy, grain, straw, Spelt and Khorosan wheat

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P3_04

Fatty acid profile and cardioprotective indices of spelt seeds

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Abstract

Fatty acids in seeds play a crucial role in germination and plant protection while serving as a key source of essential ω-3 and ω-6 fatty acids, determining both nutritional and industrial value. The fatty acid profile of spelt seeds (*Triticum spelta* L., cultivar Nirvana, obtained from the Maize Research Institute Zemun Polje) was analyzed to assess nutritional quality under organic (OS) and conventional (KS) cultivation over three consecutive years (2015–2017). Fatty acid content was determined by GC capillary method and expressed as a percentage of total fatty acids. Sixteen fatty acids were identified. Major saturated fatty acids (SFA; C14:0, C16:0, C18:0) ranged from 14.96% to 18.33%, with the lowest values observed in organic 2017 (OS17), indicating reduced atherogenic potential. Monounsaturated (MUFA) and polyunsaturated fatty acids (PUFA) were dominant, with PUFA reaching 62.66% in OS17. The UFA/SFA ratio was highest in OS17 (5.65), reflecting a favorable balance of unsaturated to saturated fats. The ω-6/ω-3 ratio varied from 19.76 in KS16 to 31.29 in OS17, highlighting higher linoleic acid content in organic seeds. The Atherogenic Index (AI) ranged from 0.164 in OS17 to 0.214 in OS15, while the Thrombogenic Index (TI) ranged from 0.310 in OS17 to 0.380 in OS16, confirming a more cardioprotective lipid profile in organic samples. These results indicate that organic cultivation enhances MUFA and PUFA content while reducing SFA, improving indices related to cardiovascular health. Overall, organic spelt seeds, particularly in 2017, exhibited higher UFA/SFA ratios, lower AI and TI, and favorable ω-6/ω-3 proportions compared to conventional seeds. These findings demonstrate that both cultivation system and production year significantly affect fatty acid composition. Organic farming can therefore provide spelt seeds with enhanced nutritional quality and health benefits, supporting their use as functional foods and ingredients in health-oriented diets while promoting a cardioprotective lipid profile.

Key words: Triticum spelta L., UFA/SFA ratio, ω-6/ω-3 ratio, atherogenic index, thrombogenic index

P3_05

Genetic basis of high yield of white-seeded maize (*Zea mays* L.) hybrids

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Abstract

High yield of white-seeded maize (*Zea mays L.*) hybrids is the result of complex genetic interactions and pronounced heterosis, with genetics playing a central role in determining yield potential and stability across diverse agroecological conditions. The aim of this study is to systematise and analyse current knowledge of the genetic basis of high yield recorded in white-seeded maize hybrids, with particular emphasis on quantitative genes, heterosis, genomic associations, and molecular markers that enable targeted breeding. Yield potential is a quantitative trait controlled by multiple QTL regions influencing key agronomic traits, including the number of ears per plant, rows and kernels per ear, thousand-kernel weight, photosynthetic efficiency, and adaptation to abiotic and biotic stresses. Heterosis provides a synergistic effect through the combination of complementary genotypes, resulting in increased productivity and yield stability. Molecular markers, genome-wide association studies (GWAS), and QTL mapping allow the identification of key genomic loci associated with high yield, accelerating the development of superior white-seeded maize hybrids and optimising parental line selection. Understanding the underlying genetic mechanisms, including epistatic interactions and gene regulatory networks, enables precise cross-planning and improvement of adaptive and productive traits. The integration of traditional and molecular breeding approaches to white-seeded maize hybrid development represents an effective strategy for achieving high, stable, and genetically optimised yield, contributing to food security and sustainable agricultural production.

Key words: hybrids, genetic basis, heterosis, molecular markers, yield

P3_06

Heavy metal toxicity in seeds

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Abstract

Heavy metals such as cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), lead (Pb), nickel (Ni), zinc (Zn), and arsenic (As) belong to the group of pollutants known as persistent inorganic pollutants (PIPs), which are widely used in agriculture and industry and are consequently released into the environment. As a result, more than 10,000 sites across Europe have been identified as contaminated with heavy metals. Numerous studies consistently demonstrate that the presence of heavy metals, including Cd, Pb, Hg, Ni, and Cr, significantly impairs seed germination, germination energy, and seedling vigor across a wide range of plant species. In most cases, a clear dose–response relationship has been observed, whereby increasing metal concentrations lead to a progressive decline in germination parameters. Comparative analyses further indicate that the phytotoxic potential varies among metals, with Hg and Cd most frequently reported as the strongest inhibitors of germination, while Pb and Cu exhibit moderate but statistically significant adverse effects. In addition, pronounced interspecific variability in plant sensitivity has been documented, which is attributed to differences in genotype, efficiency of detoxification mechanisms, and the capacity for metal binding and sequestration in less sensitive tissues. Systematic reviews highlight that the inhibitory effects of heavy metals on germination arise from the combined action of multiple physiological and biochemical mechanisms, including the suppression of hydrolytic enzymes responsible for reserve mobilization, destabilization of cellular membranes, disruption of ionic homeostasis, and induction of oxidative stress through enhanced production of reactive oxygen species. These processes ultimately result in delayed germination, reduced root and shoot growth, and the occurrence of morphological abnormalities in seedlings. The literature consistently recognizes heavy metals as a major abiotic stress factor in early plant development, with potential long-term impacts on crop productivity and food safety.

Key words: heavy metals, pollutants, seeds, germination.

P3_07

Cadmium and mercury in seeds: Comparative analysis of organic and conventional production

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Abstract

Cadmium (Cd) and mercury (Hg) in seeds accumulate and impair germination, growth, and nutritional quality by causing oxidative stress and metabolic disruption, posing health risks and highlighting the need for environmental control. In this study, the content of Cd and Hg was analyzed in organic and conventional seeds of spelt (*Triticum spelta* L., cv. Nirvana), buckwheat (*Fagopyrum esculentum* Moench, cv. Novosadska), maize (*Zea mays* L., cv. Rumenka), and soybean (*Glycine max* L., cv. Kaća) during 2015–2017. Elemental analysis was performed using inductively coupled plasma–optical emission spectrometry (ICP-OES). Concentrations were expressed in μg g^{-1}, converted to mg 100 g^{-1}, and additionally presented as percentages for comparative evaluation. The results showed that Cd was present at very low concentrations in all crops (0.023–0.06 μg/g), with minimal differences between organic and conventional samples. In certain years, organic production exhibited slightly lower Cd (e.g., spelt 2017), while in soybean and maize the differences were statistically significant but small, indicating that the production system does not substantially affect Cd accumulation in seeds. For Hg, the situation was different: in seeds collected in 2015–2016, Hg was not detected, whereas samples from 2017 showed significant concentrations. Conventional maize (0.910 μg/g) and soybean (0.753 μg/g) samples had higher Hg contents compared to organic samples (maize 0.673 μg/g; soybean 0.535 μg/g), while organic spelt from 2017 showed markedly higher Hg (0.766 μg/g) compared to conventional (0.205 μg/g), suggesting possible local contamination sources or specific agronomic factors. In conclusion, the seeds of the analyzed crops are generally safe regarding Cd, while Hg concentrations vary across years and production types, emphasizing the importance of continuous monitoring of heavy metals in agricultural products.

Key words: seeds, organic production, conventional production, ICP-OES, health risks

P3_08

Linum usitatissimum L. - Flaxseed nutritional components

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Abstract

Flaxseed (*Linum usitatissimum L.*) is an important source of bioactive and nutritional compounds, including oil rich in omega-3 fatty acids, proteins, dietary fibers, and lignans, which have beneficial effects on human and animal health. In addition to these valuable components, flaxseed contains potentially toxic compounds, including cyanogenic glycosides and phytic acid, and saponins and protease inhibitors, which can partially limit protein digestibility and nutrient absorption. The aim of this review was to summarize and systematize current knowledge on the chemical composition of flaxseed, with particular focus on its nutritional components, the presence of antinutritional factors, and strategies for their effective detoxification. Antioxidant polyphenols and tannins, although sometimes exhibiting antinutritional effects, contribute to seed stability and preservation of bioactive compounds. The chemical composition of flaxseed, including lipid, protein, carbohydrate, lignan, polyphenol, and antinutritional factor content, varies among cultivars and is influenced by agroecological conditions. Thermal treatment, milling, or fermentation are effective methods for reducing cyanogenic glycosides and phytic acid, allowing detoxification of the seeds while preserving their nutritional and bioactive components. Understanding the chemical composition of flaxseed is essential for its application in human nutrition, pharmaceutical products, and animal feed, as well as for optimizing processing and functional properties. Because flaxseed contains large amounts of fibre, lignans, and alpha-linolenic acid (ALA, an omega-3 fatty acid), it is becoming more widely acknowledged as an important functional food component. Numerous health benefits, such as the prevention and treatment of cardiovascular illnesses, atherosclerosis, diabetes, cancer, arthritis, osteoporosis, autoimmune disorders, and neurological ailments, are offered by flaxseed oil, fibre, and lignans. Flax protein helps support a robust immune system and is useful for treating and preventing cardiovascular illnesses. As a result, flaxseed oil has been used as a functional food ingredient in a variety of products, including meat products, baked goods, beverages, muffins, pasta etc.

Key words: flaxseed, phytic acid, cyanogenic glycosides, saponins, chemical composition

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P3_09

Genetic basis of polyphenol biosynthesis and accumulation in plant seeds

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Abstract

Polyphenols represent an important group of secondary metabolites in plant seeds, playing a significant role in protection against abiotic and biotic stress, regulation of germination, and determination of the nutritional and antioxidant value of seeds. The aim of this paper is to review and systematize existing knowledge on the genetic basis of polyphenol content and composition in plant seeds, with particular emphasis on key biosynthetic pathways and mechanisms of their regulation. The content and composition of polyphenols in seeds are determined by a complex genetic background and represent quantitative traits controlled by multiple genes, with a pronounced influence of environmental factors and genotype–environment interactions. Polyphenol biosynthesis primarily occurs through the phenylpropanoid metabolic pathway, which includes structural genes such as *PAL, C4H, 4CL, CHS, CHI, DFR,* and *ANS*, responsible for the synthesis of phenolic acids, flavonoids, anthocyanins, and tannins. The expression of these genes is tightly regulated by regulatory genes, particularly transcription factors from the MYB, bHLH, and WD40 families, which form regulatory complexes responsible for the spatially and temporally specific accumulation of polyphenols in seeds. Numerous QTL and GWAS studies indicate the presence of multiple chromosomal regions associated with variability in total polyphenol content and profile, confirming the polygenic nature of this trait. In addition to genetic factors, epigenetic mechanisms, including DNA methylation and histone modifications, further influence the regulation of polyphenol biosynthesis during seed development. Understanding the genetic basis of polyphenol content in seeds is of great importance for plant breeding aimed at improving functional and nutritional traits, particularly in the context of sustainable and organic agriculture.

Key words: polyphenols, seeds, genetic regulation, phenylpropanoid pathway, QTL analysis

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P3_10

Genetic regulation of atinutritional factors in plant seeds: Biosynthetic pathways and molecular mechanisms

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Abstract

Antinutritional factors in plant seeds, including phytic acid, protease inhibitors, lectins, saponins, and glucosinolates, significantly affect the nutritional value, digestibility, and bioavailability of nutrients. Their presence can limit the usability of seeds in human and animal nutrition, while also playing a role in plant defense against pathogens and pests. The aim of this review is to summarize and analyze current knowledge on the genetic regulation of the content and composition of antinutritional compounds in plant seeds, with particular emphasis on key biosynthetic pathways and molecular regulatory mechanisms. The accumulation of these compounds in seeds is a quantitative trait controlled by multiple genes, including structural and regulatory genes, quantitative trait loci (QTL), and transcription factors that coordinate the biosynthesis of antinutritional components. Epigenetic mechanisms, such as DNA methylation and histone modifications, further modulate gene expression, enabling a plastic response of the plant to environmental factors during seed development. Studies conducted in various crops, including soybean, common bean, wheat, and oilseeds, have identified key genes and QTL regions associated with reduced content of antinutritional factors, providing a basis for selection and marker-assisted breeding. Understanding the genetic and molecular basis of antinutritional compound accumulation in seeds facilitates the development of crop varieties with improved nutritional quality, reduced negative effects of antinutritional factors, and enhanced suitability for human and animal consumption, particularly in the context of sustainable and organic agriculture.

Key words: antinutritional factors, seeds, genetic regulation, QTL analysis, biosynthetic pathways

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P3_11

Improving maize hybrid seed production through optimized male sterility systems

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Abstract

Cytoplasmic male sterility (CMS) and nuclear male sterility genes (ms-genes) are key components in the production of hybrid maize seed. The aim of this study is to analyze different male sterility systems and their potential application for producing stable and genetically diverse hybrid seed. In certain inbred lines, the cms-T cytoplasm can become resistant to the *Helminthosporium maydis* "T" race toxin, indicating the presence of nuclear genes capable of correcting this deficiency. Continuous introduction of corrective genes increases genetic uniformity and complicates line conversion, leading to the development of chromosome-genetic male sterility systems based on combining ms-genes with chromosomal aberrations. While these systems reduce genetic uniformity in hybrid seed, the parental seed carries genotypes with chromosomal aberrations that exhibit reduced vigor and segregate into male-sterile and male-fertile plants, creating additional challenges. The use of ms-genes in combination with restorer cytoplasm, which suppresses male sterility, represents a potentially optimal solution. Furthermore, new types of CMS have been identified, and the application of multiple CMS types in hybrid seed production (multipla plasm approach) enhances system efficiency and stability. These approaches highlight the ongoing need to explore new CMS sources and optimize male sterility systems in maize.

Key words: CMS, ms-genes, hybrid maize seed, genetic uniformity, restorer cytoplasm

P3_12

Genetic regulation and molecular mechanisms of protein synthesis in maize grain

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Abstract

Protein synthesis in maize grain is a highly regulated process central to endosperm development, directly influencing the nutritional quality, functional properties, and market value of the grain. Zeins, the predominant storage proteins in maize endosperm, account for the majority of total protein and are critical determinants of amino acid composition, particularly the limited essential amino acids lysine and tryptophan. The biosynthesis of zeins is controlled by a complex network of structural genes, which encode the different zein classes (α, β, γ, δ), and regulatory genes, including transcription factors such as opaque2 (O2) and prolamin-box binding factors (PBF), which coordinate temporal and spatial expression during endosperm development. This study aims to elucidate the genetic and molecular mechanisms that govern protein synthesis in maize grain, focusing on the interplay between maternal and paternal genotypes in the triploid endosperm, the role of cis-regulatory elements in zein gene promoters, and the impact of epigenetic modifications such as DNA methylation and histone acetylation on gene expression. The endosperm integrates these signals to modulate both the quantity and quality of protein accumulation, with distinct zein classes following specific biosynthetic pathways and forming protein bodies with defined subcellular localization patterns. Natural genetic variation among maize inbred lines and hybrids enables breeders to select for enhanced zein composition and improved amino acid balance, providing the foundation for quality protein maize (QPM) and other nutritionally enhanced varieties. Understanding the coordinated regulation of structural and regulatory genes, combined with epigenetic influences, offers critical insights for breeding programs aimed at increasing protein content, optimizing essential amino acid profiles, and ultimately improving both the nutritional and commercial value of maize grain.

Key words: maize, proteins, synthesis, grain, genes, zein

P3_13

Preparation and application of yarrow (*Achillea millefolium* L.) decoctions and macerates in sustainable crop production

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Abstract

Yarrow (*Achillea millefolium* L.) is a multifunctional plant widely used in sustainable and organic agriculture. It serves as a soil cover (mulch), a compost activator, and a component of ecological corridors or flowering belts, enhancing biodiversity and crop protection. Its bioactive compounds confer antifungal and insecticidal properties, making it effective against powdery mildew, rust, aphids, thrips, and onion flies. Two primary preparations are commonly employed in crop management: decoctions and macerates. Yarrow decoction is produced from dried aboveground plant parts harvested during flowering. Eight hundred grams of herb are ground and boiled in 10 liters of water for 30 minutes. The hot decoction is filtered into a well-sealed container and, prior to foliar application, supplemented with 40 g of homemade soap per 10 liters to improve adhesion. This preparation provides preventive and curative control of various fungal pathogens and insect pests. Yarrow macerate is obtained by soaking 200 g of dried flowering herb in 10 liters of water for 24 hours. After filtration, it is diluted 1:10 with water before application. When combined with garlic tea, this macerate effectively suppresses soil-dwelling pests such as wireworms and cockchafers (*Melolontha* spp.) through targeted spraying between plant rows. The scientific significance of these plant-based preparations lies in their dual role as biostimulants and biocontrol agents. Their application improves soil biological activity and fertility, strengthens plant resistance, and reduces reliance on synthetic agrochemicals. Furthermore, utilizing underexploited plant biomass aligns with circular and agroecological approaches, promoting sustainability and environmental stewardship in crop production systems.

Key words: yarrow, *Achillea millefolium*, plant-based preparations, organic agriculture, biocontrol agents

Acknowledgment

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P3_14

Plant-based preparations as multifunctional inputs in sustainable crop production systems

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Abstract

Since ancient times, plants have been used not only for food and human health but also as raw materials for construction, textiles, paper, and, more recently, bioplastics and bio-based industrial products. However, in modern agricultural systems, a substantial portion of plant biomass remains underutilized and is often treated as waste, including weeds, crop residues, and non-harvested plant parts from field crops, vegetables, orchards, vineyards, and medicinal and aromatic plants. The valorization of this biomass through the production of plant-based preparations represents a promising pathway toward more sustainable and circular agricultural practices. The use of plant-based preparations intensified with the development of biodynamic and organic farming systems in the early twentieth century. Today, such preparations are applied both in traditional on-farm production and as commercially formulated products registered for plant nutrition, plant protection, and soil improvement. These preparations contribute to enhanced soil biological activity and fertility, improved plant nutrition, and increased resilience of crops to biotic stress factors. In addition to preventive and curative effects against economically important pests and diseases, they are also used in soil and substrate disinfection and as microbial activity stimulators during composting processes, including in the production of compost teas. Plant-based preparations can be produced from fresh or dried plant material, preferably harvested from the beginning to full flowering stage when bioactive compounds are most abundant. Depending on the preparation method, several types are distinguished: infusions, decoctions, macerates, and fermented extracts, each differing in extraction procedure and intended agricultural application. Proper preparation techniques, including the use of non-reactive containers, are essential to preserve their biological efficacy. Plant-based preparations therefore represent low-cost, locally available, and environmentally friendly inputs that support agroecological crop production and reduce dependence on synthetic agrochemicals.

Key words: plant-based preparations, sustainable agriculture, biostimulants, agroecological crop production, environmentally friendly inputs

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P3_15

Analysis of ochratoxin A in maize grain of different hybrids and populations

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Abstract

Ochratoxin is a type of mycotoxin produced as a metabolic product of molds belonging to the genera *Aspergillus* and *Penicillium*. Ochratoxins are considered to be one of the risk factors in the etiology of endemic nephropathy. They have harmful effects on health by causing liver necrosis, inducing immunosuppression, and exhibiting reproductive toxicity and teratogenicity. Ochratoxin A in maize develops when grain is stored under moist and poor conditions, which favor mold growth. The problem is that it cannot be detected with the naked eye, and regular consumption of contaminated food can seriously endanger the health of humans and livestock. Therefore, monitoring and detection of ochratoxin A in maize is an important measure for preserving food quality and safety. The aim of this study was to examine the content of ochratoxin A in samples of commercial maize seed produced at the Maize Research Institute Zemun Polje in 2024: the white and the yellow Osmak, the blue popcorn population, the ZP Rumenka variety, the yellow popcorn hybrid ZP 611k, and the hybrid ZP 552b. The determination of ochratoxin A was carried out using the DML 1.29:2017 method based on liquid chromatography–tandem mass spectrometry (LC-MS/MS), a technique known for its high sensitivity, selectivity, and analytical reliability. The results showed that ochratoxin A levels were below 1 μg/kg in yellow Osmak, white Osmak, the yellow popcorn hybrid ZP 611k, the hybrid ZP 552b, and the variety ZP Rumenka, while the level in the blue popcorn population was below 2 μg/kg. All measured values were in accordance with the limits prescribed by the Regulation on maximum levels of certain contaminants in food, published in the Official Gazette of the Republic of Serbia, confirming that the analyzed samples are safe and suitable for consumption.

Key words: maize, ochratoxin A, LC-MS/MS, toxicity, teratogenicity

P3_16

Quantitative determination of lead and cadmium in different genotypes of commercial maize using ICP-MS technique

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Abstract

Lead (Pb) and cadmium (Cd) are toxic heavy metals with no biological role in the human body, which can accumulate even in small amounts over prolonged periods. Chronic exposure to these metals is associated with damage to the nervous and cardiovascular systems, kidneys, bones, and liver, as well as potential carcinogenic effects. Plant-based foods, including cereals, can be contaminated with lead and cadmium due to environmental pollution, making regular monitoring necessary to protect consumers. The aim of this study was to examine the content of Pb and Cd in the following samples of commercial maize kernels: populations of white and yellow Osmak, blue popcorn population, ZP Rumenka variety, yellow popcorn hybrid ZP 611k, and hybrid ZP 552b. The maize kernel samples were produced in 2024 from the Maize Research Institute Zemun Polje. Determination of Pb and Cd concentrations was performed according to the SRPS EN 15763:2012 method, using the ICP-MS technique, which allows precise and reliable determination of trace elements. Laboratory results showed that the lead content in all analyzed samples was below 0.02 mg/kg, while the cadmium content was below 0.01 mg/kg. The measured values are below the maximum permitted concentrations prescribed by the current Regulation on Maximum Levels of Certain Contaminants in Food, published in the Official Gazette of the RS. Based on the results obtained, it can be concluded that all tested commercial maize samples meet the prescribed requirements for Pb and Cd content and are considered safe for further use.

Key words: maize, lead (Pb), cadmium (Cd), ICP-MS, toxicity, food

P3_17

Temporal dynamics of soil water content in the area of the "Kupinski Kut" management unit

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Abstract

This paper deals with the impact of hydrological, climatic, geological and pedological conditions on forest ecosystems, with a special focus on the relationship between hygrophilous species, primarily poplars, and the groundwater regime in the area of the management unit “Kupinski kut”. The aim of this research is to determine how groundwater fluctuations affect the stability of forests. The results show that groundwater dynamics plays a key role in the formation and preservation of poplar populations, while groundwater level fluctuations affect a lot the site conditions, so during flood periods the groundawater level increases in the zone of the root system, which has a positive influence for species adapted to wet and ocassionally flooded sites. On the other hand, during dry periods, when the groundwater level drops below the critical values, the reduction of groundwater level occurs, which negatively affects physiological processes and growth of hygrophilous species. The obtained results are the basis for better understanding the relation between water and vegetation and can serve as a guide for the planning of the sustainable management measures when it is about the lowland forests situated in the area of Srem.

Key words: Sava, poplar, floodplain forests, precipitation, Kupinski kut

P3_18

Variability of mineral elements in maize populations – background for biofortification

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Abstract

Increasing the concentration of mineral elements in maize grain through breeding also involves reducing antinutrients such as phytate, which limits mineral absorption. This study was conducted on 23 maize populations with different grain types (4 semi-dent, 4 semi-flint, 7 flint, and 8 dent), along with five genotypes used as standards, to evaluate grain mineral composition and to determine the relationship between phytic acid and mineral elements. Phytic phosphorus (Pphy) and inorganic phosphorus (Pi) contents were determined using a UV/Vis spectrophotometer, while the concentrations of potassium (K), magnesium (Mg), phosphorus (P), zinc (Zn), copper (Cu), iron (Fe), calcium (Ca), and manganese (Mn) were quantified using inductively coupled plasma optical emission spectrometry (ICP-OES). Variability in mineral content highlights the potential of targeted breeding programs to improve micronutrient density in maize grain. The results indicate higher concentrations of phytic phosphorus in the grain of the examined semi-dent, semi-flint, flint, and dent genotypes compared with the standards, with the highest average values observed in semi-dent types, particularly genotype 15. In relation to the lower concentrations of inorganic phosphorus (Pi), higher levels of phytic phosphorus were also reflected in increased Phy/Pi ratios. Conversely, the grain of the examined genotypes was richer in mineral elements. On average, higher concentrations of Zn, Cu, Fe, Mn, Mg, Ca, and P were detected in flint maize grain, whereas higher K concentrations were recorded in dent maize grain. Consequently, the lowest ratios of phytic acid to mineral elements were observed in flint maize, which, despite relatively high levels of phytic phosphorus, suggests potentially greater mineral bioavailability from the grain of these genotypes and their suitability for use in biofortification programs.

Key words: micronutrient density, mineral bioavailability, phytic acid, grain type

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P3_19

Influence of sowing density on plant height of different maize hybrids (*Zea mays* L.)

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Abstract

Maize (*Zea mays* L.) is one of the most important grains in the entire agricultural production. Choosing the optimal sowing density can play a key role in achieving high and stable yields. This research presents the results of a two-year study (2023/2024), examining the influence of sowing density on the plant height of six maize hybrids from the FAO maturity groups 400, 450, and 500. Maize was sown at three densities: 70 x 35 cm (40,816 plants ha^{-1}), 70 x 20.5 cm (69,686 plants ha^{-1}) and 70 x 14.5 cm (98,522 plants ha^{-1}). Plant height was measured from the first cob to the tip of the panicle during the silking phenological phase. In 2023, the highest plant heights were recorded in the second sowing density variant (70 x 20.5 cm), whereas the lowest heights were observed at the largest intra-row spacing (70 x 35 cm). The hybrid ZP 5601 exhibited the greatest height overall among hybrids. In 2024, ZP 5601 again demonstrated the highest plant height at a seeding density of 70 × 35 cm and also showed the greatest height to the first cob at a density of 70 × 14.5 cm (98,522 plants ha^{-1}). The smallest height to the first cob is at a seeding density of 70 x 35 cm, in the hybrid ZP 4790. In both examined years, the cob height and the total plant height varied. The higher planting densities were associated with a higher proportion of plants reaching maximum height, as a result of the effects of interplant competition, which promoted stem elongation and resulted in taller plants. The results of this study provide a valuable basis for optimising crop density, balancing efficient resource utilisation with desirable plant architecture, which also contributes to stable yield performance.

Key words: sowing density, hybrids, plant height

Acknowledgment

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P3_20

Angelica (*Angelica archangelica* L.) hydrolate: A potential stimulator of barley (*Hordeum vulgare* L.) seed germination

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Abstract

Angelica (*Angelica archangelica* L.) is a medicinal and aromatic plant whose root is rich in essential oil. During essential oil distillation, a hydrolate is produced as a by-product with certain biological activity. Previous studies have reported stimulatory effects on the germination maize, wheat, and soybean seeds. This study aimed to determine whether angelica hydrolate affects barley seed germination. Different concentrations of angelica hydrolate (10%, 25%, 50%, and 100%) were applied to three barley genotypes (J4, J5, and J6), while distilled water was used as the control. Seeds were surface-sterilized with a 0.2% sodium-hypochlorite (NaOCl) solution. Subsequently, the seeds were placed in plastic germination boxes (14.5 × 20.5 cm) on filter paper moistened with 15 mL of the respective hydrolate concentration. The experiment was conducted in four replicates with 25 seeds per replicate. Seven days after incubation under controlled temperature conditions, root length, shoot length, and germination percentage were measured. On average across all genotypes, the greatest root length was recorded in the 10% treatment (7.57 cm) and in the control (7.07 cm), with no statistically significant difference between these two treatments, while genotype J6 exhibited the highest value overall (8.37 cm). The greatest shoot length was also observed at the 10% concentration (3.47 cm), compared to the control (2.77 cm), with the largest difference recorded in genotype J5 (2.8 cm in the treatment; 1.6 cm in the control).With increasing concentration, both growth parameters and germination percentage significantly decreased; germination was 100% at 10%, while the 100% concentration resulted in complete inhibition of germination.Successful seed germination enables the establishment of the next plant generation. This study focuses on evaluating the hydrolate as a potentially effective natural biostimulant. The results obtained represent an initial step in this research area and indicate the need for further investigation under real production conditions.

Key words: hydrolate, *Angelica archangelica* L., germination, barley seed, biostimulant

Acknowledgment

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P3_21

From soil to plant: Microbial mechanisms reducing toxic heavy metals in crops

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Abstract

Contamination of agricultural soils with toxic heavy metals represents a serious ecological and agronomic problem, threatening plant growth and development, crop yield, and food safety. The aim of this study is to examine the role and mechanisms of key microorganisms that contribute to the reduction of heavy metal bioavailability and toxicity in crops, with a particular focus on rhizospheric and endophytic microorganisms. Beneficial microorganisms, including plant growth-promoting rhizobacteria (PGPR), arbuscular mycorrhizal fungi (AMF), endophytic fungi, and actinomycetes, constitute an important component of plant protection in contaminated agroecosystems. PGPR, such as members of the genera *Pseudomonas*, *Bacillus*, *Azospirillum*, *Rhizobium*, and *Enterobacter*, act through biosorption, bioaccumulation, and chelation of metal ions, thereby reducing their mobility and uptake by plant tissues. These bacteria also produce siderophores, organic acids, and enzymes that modify the chemical forms of metals in the soil, while simultaneously promoting plant growth through phytohormone synthesis, ACC-deaminase activity, and stimulation of plant antioxidant defense mechanisms. Arbuscular mycorrhizal fungi, particularly from the genera *Glomus* and *Rhizophagus*, efficiently immobilize heavy metals within their mycelium and cell walls, significantly reducing their translocation from roots to aboveground organs. Endophytic microorganisms further enhance plant tolerance to metal-induced stress by reducing oxidative damage and improving metabolic balance. The synergistic activity of these microorganisms contributes to the reduction of phytotoxicity and accumulation of metals such as cadmium, lead, arsenic, chromium, and nickel in edible plant parts. Existing research indicates that the application of beneficial microorganisms represents an effective, environmentally friendly, and sustainable strategy for crop protection and remediation of heavy metal-contaminated soils, particularly within organic and sustainable farming systems.

Key words: heavy metals, PGPR, fungi, bioavailability, phytotoxicity

P3_22

Morphological characteristics of sweet corn depending on irrigation and sowing date

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Abstract

The paper examines the effects of irrigation regimes and sowing time on leaf and ear numbers per plant across three sweet corn hybrids (Enterprise F1, Union F1, and Sweet Nugget F1). The experiment was set up in 2021, 2022, and 2023 in Velika Plana on land prone to overwetting, using a drip irrigation system in three modes: natural wetting regime (control), reduced regime (50%), and full irrigation regime (100%). Two sowing dates were applied: I - end of April - beginning of May, and II - mid-July, after the wheat harvest. Enterprise and Union hybrids showed stability and similar leaf counts of 10.4–11.8, while Sweet Nugget had significantly lower leaf counts, 7.0–8.4. The full rate of irrigation increased leaf number, with the highest value recorded in the Enterprise hybrid during the first sowing date, from 10.4 to 11.3. A later sowing date significantly reduced the number of leaves under natural moisture conditions, while full irrigation mitigated the negative effect. The interaction between irrigation and hybrid had the greatest effect on the average number of ears per plant. Switching to the full irrigation regime increased this parameter in all hybrids and in both sowing dates, with values exceeding 1.3 ears per plant. The Sweet Nugget hybrid showed the highest sensitivity and variability, from 0.9 under stressful conditions to 1.5 under optimal conditions. The first sowing date and irrigation increased the number of ears per plant. The irrigation and hybrid factors had a statistically significant influence on both examined parameters, while their interaction indicated a specific genotypic response to water availability. The results indicate the need for an adapted irrigation strategy. Depending on the hybrid and sowing date, an optimal balance between sweet corn's vegetative and reproductive potential can be achieved.

Key words: maize plant, hybrids, number of leaves, number of ears per plant, interaction of factors

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P3_23

Role of PGPR in enhancing germination and protecting seeds from heavy metal stress

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Abstract

Soil pollution with heavy metals adversely affects both seed germination and early seedling development, in addition to compromising the performance of mature plants. The aim of this study is to highlight the role of plant growth-promoting rhizobacteria (PGPR) in enhancing seed germination, seedling growth, and tolerance to toxic heavy metals. PGPR are beneficial rhizospheric bacteria that colonize seed surfaces and the rhizosphere, improving germination through multiple direct and indirect mechanisms. They produce phytohormones such as auxins, gibberellins, and cytokinins that stimulate embryonic growth, as well as ACC-deaminase, which reduces ethylene levels in seeds under stress, facilitating normal germination. In soils contaminated with cadmium (Cd), lead (Pb), chromium (Cr), nickel (Ni), and zinc (Zn), PGPR enhance seedling establishment by decreasing the bioavailability and toxicity of metals. Mechanisms include biosorption and bioaccumulation of metal ions on bacterial cell walls, production of siderophores and organic acids that chelate metals, and enzymatic transformation of metals to less toxic forms. These processes protect the seed and emerging radicle from oxidative damage and metal-induced stress, promoting healthier early plant development. Common PGPR genera involved in seed protection include *Enterobacter, Pseudomonas*, *Azotobacter*, *Bacillus*, *Serratia*, and *Rhizobium.* Studies show that inoculation of seeds with these bacteria increases germination rates, enhances root and shoot growth, and reduces metal accumulation in embryonic and seedling tissues. The use of PGPR consortia often provides synergistic benefits, combining multiple protective mechanisms that single strains alone cannot achieve. Incorporating PGPR into seed management practices provides an effective means to reduce heavy metal toxicity, improve germination, and ensure healthy crop establishment under contaminated conditions.

Key words: seed, PGPR, germination, stress, development, toxicity

P3_24

Fagopyrum esculentum - Biological properties and nutritional significance

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Abstract

The genus *Fagopyrum* belongs to the Polygonaceae family and includes several species cultivated worldwide. The greatest importance in agriculture and human nutrition is attributed to common buckwheat (*Fagopyrum esculentum*). The aim of this manuscript is to systematically present the biological properties of buckwheat and to examine its significance in human nutrition. The study applies the method of analysis and synthesis of data collected from relevant scientific studies, as well as from the authors' own scientific publications. One of the most important biological characteristics of buckwheat is its wide ecological tolerance to environmental factors, which enables its cultivation under unfavorable climatic conditions and on soils of lower quality. Owing to its favorable nutritional composition and the presence of bioactive compounds, particularly flavonoids such as rutin, buckwheat plays a significant role in human nutrition. Numerous scientific studies indicate that the high biological value of buckwheat proteins results from its favorable amino acid profile, characterized by a substantial proportion of essential amino acids, including lysine, threonine, tryptophan, and sulfur-containing amino acids. Starch is the predominant component of the carbohydrate fraction in buckwheat seeds, and its proportion varies. Buckwheat is also an important source of macro- and microelements, fiber and tannins. Research results indicate that buckwheat leaves contain 2-3% rutin, while some varieties may contain up to 8%. It has been established that rutin acts as a strong antioxidant, contributes to the prevention of platelet aggregation and thrombus formation, protects cells from damage, exhibits anticancer potential, and has cardioprotective and vasoprotective effects, thereby contributing to the preservation of heart and blood vessel health. Based on the analysis of available scientific studies, it can be concluded that the inclusion of buckwheat in the diet contributes to antioxidant cell protection, the maintenance of cardiovascular health, and the reduction of the risk of developing chronic diseases.

Key words: buckwheat, biological properties, nutrition, significance.

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P3_25

Structural and chemical analysis of maize (*Zea mays* L.) cell walls using DP-LSM and FTIR: Effects of cellulase and pectinase treatments

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Abstract

Maize (*Zea mays L.*) is one of the most important crops worldwide and a major source of lignocellulosic biomass. Maize leaves represent abundant agricultural residues with significant biotechnological potential, while their cell walls contain approximately 30% cellulose, 24% hemicelluloses, and 24% lignin (dry mass). Detailed structural and compositional characterization of these cell walls is essential for understanding their organization and for improving biomass utilization strategies. The aim of this study was to investigate structural and compositional changes in maize leaf cell walls and to evaluate the effects of selective enzymatic degradation of major polysaccharide components. Cell walls were isolated from maize leaf tissues and analyzed using a combination of Differential-Polarization Laser Scanning Microscopy (DP-LSM), which enabled high-resolution imaging and anisotropy assessment, and Fourier Transform Infrared (FTIR) spectroscopy for chemical characterization of functional groups. To examine structural changes in the cell wall, the isolated cell walls were subjected to enzymatic treatments with cellulase and pectinase, which selectively degrade cellulose and pectic polysaccharides. Comparative analysis of untreated and enzyme-treated samples revealed noticeable structural and compositional changes within the cell wall matrix. Enzymatic treatment resulted in partial degradation of structural polysaccharides and a decrease in the intensity of characteristic polysaccharide-related FTIR bands, indicating modifications in cell wall organization. These changes were accompanied by alterations in anisotropic properties observed by DP-LSM, reflecting modifications in the spatial arrangement of cell wall components. Overall, the results demonstrate that enzymatic treatment simplifies the structural organization of maize leaf cell walls, increasing the accessibility of their polysaccharide components. Such structural modifications may facilitate further processing and improve the utilization of maize biomass in various biotechnological applications, including biomass valorization and sustainable bioresource development.

Key words: maize, cell wall, DP-LSM, FTIR spectroscopy, enzymatic treatment

Acknowledgment

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P3_26

Application of microorganisms in the treatment and bioindication of water and soil

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Abstract

Given the increasing environmental pollution, a very important field of environmental biotechnology is the microbiological treatment of wastewater and soil. In addition, microorganisms can also be used to monitor the state and changes in the environment, that is, for bioindication. The aim of this manuscript is to present the possibilities of applying microorganisms in the processes of treating contaminated water and soil, as well as their importance in bioindication. The study applies the method of analysis and synthesis of data collected from relevant scientific studies, including the authors' own scientific publications. Scientific studies have shown that the biological treatment of polluted environments is based on the aerobic and anaerobic degradation of organic matter. During these processes, organic substances are removed from water and decomposed by microorganisms. In aerobic degradation, organic matter is oxidized to carbon dioxide and various nutrients, assimilated into biomass, and transformed into other organic compounds. In anaerobic biological water treatment, methane, carbon dioxide, hydrogen, hydrogen sulfide, and nitrogen are produced. Microbiological investigations of activated sludge have identified more than one hundred bacterial species. Some of the most important microbial taxa involved in the treatment of contaminated water and soil include *Pseudomonas*, *Achromobacter*, *Flavobacterium*, *Bacillus*, *Alcaligenes*, *Moraxella*, *Nitrosomonas*, *Nitrobacter*, and others. Numerous scientific studies indicate that microorganisms are also successfully used in monitoring the state and changes in the environment - both in water and soil. Biological environmental control includes two groups of methods: bioindication and biotesting. Thanks to specific indices and coefficients, the results of bioindication are precise and reliable. Based on the analysis of available scientific studies, it can be concluded that the application of biotechnological principles and methods in pollution prevention and environmental bioindication has significant potential, with microorganisms playing a key role in these processes.

Key words: pollution, bioindication, water, soil, microorganisms.

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P3_27

Comparative analysis of total phenolic content and antioxidant activity of cold-pressed *Helianthus annuus*, *Silybum marianum*, and *Nigella sativa* oils

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Abstract

Plant phenolic compounds have attracted considerable scientific interest due to their antioxidant properties and ability to inhibit digestive enzymes involved in carbohydrate metabolism, which may be relevant in metabolic diseases. The aim of this study was to compare the chemical composition, total phenolic content, and antioxidant activity of cold-pressed edible oils obtained from sunflower (*Helianthus annuus*), milk thistle (*Silybum marianum*), and black cumin (*Nigella sativa*) seeds. The analyzed oils were natural, unfiltered, and unrefined products obtained by cold pressing. Ethanol extracts of the oils were prepared for the determination of phenolic compounds and antioxidant activity. Total phenolic content (TPC) was determined spectrophotometrically using the Folin–Ciocalteu method. Antioxidant activity was evaluated using DPPH•, ABTS•+ and FRAP (ferric reducing antioxidant power) assays. The inhibitory effect of milk thistle oil on α-amylase activity was also evaluated using the DNS method. The tested oils showed different antioxidant properties. The highest phenolic content was found in black cumin seed oil (4.61±0.18 mgGAE/goil). Milk thistle oil contained 1.19±0.03 mgGAE/goil whereas sunflower oil contained 0.39±0.02 mgGAE/goil. The antioxidant parameters for black cumin seed oil were: IC_{50} = 7.11±0.27% v/v in the DPPH assay, IC_{50}=22.41±0,68% v/v in the ABTS•+ assay, and a FRAP value of 42.98± 2.48 µmol Fe^{2+}/goil. For sunflower oil, the corresponding values were IC_{50} = 2.34 ±0.34% v/v (DPPH), 31.12±0.79% v/v (ABTS•+), and FRAP value of 63.77±2.63 µmol Fe^{2+}/goil. Milk thistle oil showed IC_{50} = 5.87±0.60% v/v (DPPH), 84.49±9.60% v/v (ABTS•+), and FRAP value of 7.75±0.19 µmol Fe^{2+}/goil. The ethanolic extract of milk thistle exhibited a maximum α-amylase inhibition of 50% at the highest tested concentration.

Key words: cold-pressed oils, total phenolic content, antioxidant activity

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P3_28

Methods of remediation of contaminated soil - with focus on bioremediation

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Abstract

Soil is one of the most important natural resources for human life. Soil pollution with large amounts of waste materials that cannot be decomposed by self-purification processes leads to soil degradation and negative consequences for the ecosystem and human health. Agricultural farms are also exposed to various environmental pollutants, but they themselves can pollute the environment if they do not implement good agricultural practice measures. The most significant pollutants are persistent organic compounds, polycyclic aromatic hydrocarbons and heavy metals. In order to improve the condition of polluted and degraded soil to a level that is safe for use, soil remediation and recultivation are carried out. The aim of the paper is to present the most significant methods of soil remediation - with focus on bioremediation. Remediation can be carried out by physical, chemical and biological methods. Today, due to their cost-effectiveness and positive impact on the environment, biological remediation – bioremediation is increasingly used. Bioremediation is the process of using living organisms to achieve environmental detoxification. The basic processes of bioremediation are oxidation and reduction, which can take place in aerobic and anaerobic conditions. Bioremediation achieves complete mineralization of organic pollution. In addition to yeasts from the genera *Candida, Hansenula, Rhodotorula*, *Torulopsis* and fungi from the genera *Aspergillus, Penicillium, Fusarium, Trichoderma* and others, bacteria also play a role in the biodegradation, primarily species from the genera *Pseudomonas, Mycobacterium, Vibrio, Aeromonas, Arthrobacter, Acinetobacter, Rhodococcus, Nocardia* etc. In addition to the use of microorganisms, plants can also be used to detoxify polluting materials present in the soil. Given the environmental and economic benefits of bioremediation, but also the limitations in its application, additional scientific research is needed to increase its application in practice.

Key words: soil, bioremediation, phytoremediation, contamination, composting

P3_29

Agricultural waste as a source of bio-based flame retardants designed for bioplastics

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Abstract

Due to the growing production of plastics and the significant amount of waste generated, polymers produced from natural or renewable sources are increasingly attracting attention as more sustainable alternatives. However, their application across various industry branches is still limited. One of the main obstacles is their flammability and smoke emission in fire conditions, which may pose a threat to both human health and property. In order to mitigate that fire risks, the use of flame retardants becomes necessary. The growing global production of flame retardants also includes compounds containing halogen atoms and organophosphorus compounds, which may have adverse effects on the environment and human health. Moreover, many traditionally used flame retardants are persistent and have been shown to accumulate in the environment. Therefore, in recent years, an increasing interest in biomass as a valuable source of precursors for the production of more sustainable, economically accessible, non-toxic, and at the same time effective bio-based flame retardants have been observed. The aim of this study is a comprehensive review of bio-based flame retardants originating from agricultural waste materials including methods of their production, and provides a comparative analysis of their effectiveness. This review summarizes the latest findings in that field and includes the literature from the last decade indexed in Scopus and Web of Science databases. The keywords used in research were ‘bio-based’, ‘flame retardant’, ‘agricultural waste’, and ‘bioplastic’. Among the compounds extracted from agricultural waste, such as peels, leaves, seeds, and other residues, phytic acid, lignin, and tannic acid exhibited the greatest potential for flame-retardant applications. These compounds may act in both the gas phase, thorough the formation of non-flammable gases, and in the condensed phase by accelerating carbonization processes, thus reducing heat transfer and oxygen availability. Therefore, the use of flame retardants derived from agricultural waste in bioplastics represents an important step toward the implementation of sustainable development strategies.

Key words: bio-based flame retardant, agricultural waste, bioplastic

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P3_30

Alfalfa growth in response to rhizobial inoculation under heavy metal stress

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Abstract

The application of inoculants with beneficial microorganisms can improve the soil properties, promote plant growth and alleviate stress in plants under elevated concentrations of potentially toxic elements. Rhizobial bacteria which forms symbiosis with leguminous providing nitrogen to the plant, in addition can also mitigate the effects of different stress factors. In this study the effects of rhizobial inoculation on alfalfa growth in soils with increased nickel (Ni) concentrations during two years was evaluated. The experiments were conducted in two locations with different concentrations of potentially toxic elements, primarily Ni concentrations, but also lead (Pb) and chromium (Cr), with six different rhizobial inoculants and followed during the two years. The inoculation in some treatments significantly increased alfalfa yield in particular cuts, depending on the locations and treatments, with up to 25% increase compared to non-inoculated plants. The statistical analyses showed that the year of utilisation and treatment, as well as interactions year x location, location x treatment, significantly influenced the yield of alfalfa. Overall, for all seasons and location the best treatments were inoculated for G-nov, 4193cs, and 252 *Ensifer meliloti* strains. The results showed potential of inoculation with particular rhizobia to improve alfalfa yield in soils with elevated potentially toxic elements and indicate the complex of the interactions of multiple factors in the environment.

Key words: alfalfa, rhizobia, soil, potentially toxic elements

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P3_31

Variability in some nutritional components of seeds in Serbian populations of faba bean (*Vicia faba* L.)

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Abstract

Faba bean (*Vicia faba* L.) is an important grain legume known for its high protein content and considerable nutritional value for both human consumption and animal feed. Although widely cultivated worldwide, faba bean production in Serbia remains limited, despite the existence of valuable local populations that have not yet been sufficiently studied. For this reason, Institute for forage crops Kruševac (IKBKS) initiated a research program aimed at evaluating the potential of these local genetic resources. The objective of this study was to determine the chemical composition of seeds of ten local faba bean populations collected from southeastern Serbia. The analyzed parameters included dry matter, crude protein, crude cellulose, starch, total sugars and monosaccharaides. A two-year field experiment was conducted during 2023 and 2024 at the experimental field of IKBKS using a randomized block design. Standard agronomic practices were applied during the growing season without the use of fertilizers or pesticides. Seeds were harvested at technical maturity, air dried, and stored frozen until chemical analysis, after prior inspection for the presence of parasites. The dry matter, protein, and cellulose content were determined using the Weende analytical system, total sugars, monosaccharides, and starch were determined using the spectrophotometric method. Statistical analyses were performed using Statistica software. The average values of the investigated traits were 90.19 - 91.24% dry matter, 26.72 - 29.02% crude protein, 6.74- 8.75% crude cellulose, 14.5 - 16.31% starch, 18.75 – 22.04% total sugars, and 14.0 – 17.5% monosaccharides. Significant differences among the studied populations were observed for all examined parameters. The results highlighted the variability and nutritional potential of local faba bean populations, indicating their importance for further research, conservation, and potential utilization in breeding programs aimed at developing varieties suitable for both human consumption and animal feed.

Key words: faba bean, geographic origin, pulses, seed chemical composition

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P3_32

Biological effects of lemon peel essential oil on *Tribolium confusum* du Val. (Coleoptera, Tenebrionidae)

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Abstract

Stored products pests represent a significant problem in maintaining the quality and quantity of stored agricultural products. One of the most common and economically important species occurring in storage facilities is the confused flour beetle, *Tribolium confusum* du Val. Due to increasing restrictions on the use of synthetic pesticides and their negative effects on the environment and human health, growing attention has been directed toward the investigation of natural alternatives such as essential oils. The aim of this study was to examine the biological effect of lemon peel essential oil (*Citrus limon L.*) on the mortality of adult individuals of *T. confusum* and to evaluate its potential use as a biological control measure in the protection of stored products. The experiment was carried out in the entomological laboratory. A total of 1000 adult individuals of *T. confusum* of both sexes were used in the experiment. The fumigant effect of nine different concentrations of lemon peel essential oil (1, 5, 7, 15, 18, 21, 24, 27, and 30 µl/L of air) was tested. Each concentration was applied in four replicates, while the control treatment was without essential oil. Insect mortality was recorded after 24, 48, and 72 hours of exposure. The obtained results showed that the mortality of insects increased with increasing concentrations of the essential oil. Low concentrations (1–7 µl/L of air) caused very low mortality, whereas concentrations of 15 and 18 µl/L of air resulted in a significant increase in mortality. The highest biological effect was observed at concentrations of 27 and 30 µl/L of air, where mortality reached 99–100%. The results indicate that lemon peel essential oil exhibits significant insecticidal activity against *T. confusum* and has potential as an environmentally friendly alternative to synthetic insecticides in the protection of stored products.

Key words: Tribolium confusum, biological effects, essential oil, lemon peel

Acknowledgment

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P3_33

Soil polyethylene microplastics as a stressor: Effects on survival and spatial distribution of *Allolobophora chlorotica*

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Abstract

Microplastic contamination is increasingly recognized as a pervasive pollutant in terrestrial ecosystems, raising concerns about its potential impacts on soil organisms and ecosystem functioning. Earthworms are widely used as sensitive bioindicators in soil ecotoxicology due to their key role in organic matter decomposition, nutrient cycling, and soil structure formation. The aim of this study was to assess the behavioral response and mortality of adult *Allolobophora chlorotica* (Annelida: Lumbricidae) exposed to soil contaminated with polyethylene microplastics. The experiment was conducted using a modified six-chamber avoidance test. Microplastic particles were incorporated into soil at concentrations of 0.25%, 0.5%, and 0.75% (w/w), after which earthworm distribution and survival were recorded. The results revealed a pronounced avoidance response to contaminated soil, with the highest avoidance percentage (76.8%) observed at the concentration of 0.75%. This treatment also resulted in the greatest mortality of adult individuals compared with the control. Statistical analysis demonstrated a significant difference between chambers containing microplastics and uncontaminated soil ($p=0.000000$ for $p<0.01$), whereas differences among the tested concentrations were not statistically significant ($p=0.789324$ for $p<0.05$). The absence of a clear dose–response relationship may be associated with heterogeneous microplastic distribution in the soil matrix and complex interactions between soil particles and plastic fragments. Overall, the results indicate that microplastic contamination can induce behavioral avoidance and increased mortality in *A. chlorotica*. Considering the ecological importance of earthworms in regulating soil processes, the accumulation of microplastics in soils may represent an emerging threat to soil health, ecosystem stability, and the long-term sustainability of agroecosystems.

Key words: microplastic contamination, soil pollution, allolobophora chlorotica, behavioral avoidance, mortality

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P3_34

Potentially toxic elements uptake and translocation by alfalfa under the influence of rhizobium strains

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Abstract

Bacteria living in symbiosis with alfalfa can reduce the uptake of potentially toxic elements (PTE) from the soils with their increased content by different mechanisms. In this research, the degree of uptake and translocation of PTE, as well as alfalfa yield in the second year of cultivation (third cut) was analysed. The experiment was set up using thirteen rhizobia strains and 2 controls (without mineral N, with mineral N addition). The plants were grown in a glasshouse on Fluvisol soil type, with favourable basic physical and chemical properties and a slightly increased total Ni content of 58 mg/kg. The results showed that the values of all elements in alfalfa shoot were among the usual concentrations for plants (the average Ni content was 3 mg/kg). The significantly higher concentrations of elements were retained in the roots; therefore, the translocation factor (TR) was 0.03-0.47, and the value of TR increases in the following order: Fe, Co, Cr, As, Cd, Pb, Ni, Cu, Mn, Zn. The application of strains influenced significant differences in the content of all elements in the roots. Certain strains reduced the PTE content in the shoot compared to the controls, but the differences were not significant (except for Co). The shoot dry weight of alfalfa had higher values in the treatments inoculated with strains 224, 4148ss, 218, while the root dry weight was not significant different between treatments. The removal of elements by the shoot mass was the largest in the controls (As, Co, Cu, Fe, Mn, Zn, in both controls; Ni and Cr in the control with N). The removal of Ni was reduced by the application of strains 4193cs, 10-2BM, L3Si, 224, as well as the majority of other elements, especially Cr, Co and Fe. Since the effectiveness of bacterial strains depends on many factors, further research will enable more precise conclusions.

Key words: Medicago sativa, rhizobia, soil, potentially toxic elements

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P3_35

Biological significance and the influence of ecological factors on the growth and development of Triticale

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Abstract

Triticale is a hybrid of wheat and rye, developed with the aim of combining the high yield and good grain quality of wheat with the adaptability and resistance of rye to unfavorable environmental conditions. Owing to its wide ecological amplitude, triticale is successfully cultivated in various agroecological regions, including those with less favorable climatic and soil conditions. The aim of this paper is to present the biological significance and the influence of the most important ecological factors (water, temperature, and light) on the growth, development, and productivity of triticale, as well as to examine their interrelationship in yield formation. The study is based on the method of analysis and synthesis of data collected from relevant scientific studies and professional literature in the fields of crop production, plant physiology, and agroecology. Although relatively tolerant to short-term drought, triticale belongs to the group of hydrophilic plants. During ontogenesis, water requirements vary: in the rooting phase, plants consume about 30% of their total water needs, while the highest demands occur during the period of intensive stem elongation and formation of generative organs. During grain ripening, water requirements decrease; however, moisture deficit may negatively affect grain weight and quality. Triticale shows good tolerance to low temperatures during winter and early spring, enabling stable production in colder regions. Its tolerance to high temperatures depends on adequate soil moisture. As a long-day plant, it requires more than 12 hours of daylight to transition to the generative phase, with the greatest light requirements occurring during heading and ripening. Water, temperature, and light represent key ecological factors determining the intensity of growth, development, and yield of triticale. Their optimal interaction enables the full expression of the crop's genetic potential and ensures stable production under diverse agroecological conditions.

Key words: triticale, ecological factors, water, temperature, light

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P3_36

Agricultural biomass as a strategic renewable energy source in Europe and worldwide

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Abstract

Contemporary energy systems are facing accelerated depletion of fossil energy resources, resulting in increased energy instability and a growing need to identify sustainable alternative solutions. At the same time, the intensive use of fossil fuels significantly contributes to greenhouse gas emissions and global warming, with long-term consequences for the climate system and the environment. The aim of this study is to assess the contribution of agricultural biomass as a renewable energy source in Europe and worldwide, with particular emphasis on its role in diversifying energy sources, reducing greenhouse gas emissions, and enhancing energy security, while also considering the environmental and socio-economic aspects of its application. Within the portfolio of renewable energy sources, agricultural biomass occupies a distinctive position due to its wide availability, potential for local production, and relatively stable energy value. Its utilization enables efficient valorization of agricultural residues and by-products, reduces waste generation, and provides additional income opportunities for rural areas, thereby contributing to sustainable development and resource conservation. The European Union has recognized this potential through the development of strategic policy frameworks, subsidization of bioenergy facilities, and the integration of biomass into national energy plans. Projections of final energy consumption in the EU up to 2050 indicate a decrease in the share of oil from 40% in 2010 to 32% in 2050, while the consumption of solid fuels slightly declines and natural gas consumption remains relatively stable. Concurrently, increases in the share of electricity generated from renewable energy sources, from 21% to 28%, as well as the rise in the overall share of renewable energy sources (from 7% to 11%) suggest that biomass will play a key role in the transition toward a low-carbon energy system, particularly in the heating sector, electricity generation, and cogeneration.

Key words: biomass, renewable energy sources, energy transition, energy mix, sustainable development

P3_37

Bioenergy potential of agricultural biomass

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Abstract

Over the past century, the intensive exploitation of fossil fuels has contributed significantly to environmental degradation, increased greenhouse gas emissions, and accelerated climate change. In response, renewable energy sources, particularly biomass, have gained importance as key components of sustainable energy development. The aim of this study was to assess the potential of agricultural crop residues as renewable energy sources, with particular emphasis on biomass availability in the Republic of Serbia, its energy significance, and the environmental implications of different residue management practices. Numerous studies indicate that biomass can play a major role in reducing dependence on fossil fuels, enhancing energy security, and mitigating environmental pollution. In line with its energy and climate policies, Serbia committed to achieving a 27% share of renewable energy in total final energy consumption by 2020, as defined by the National Action Plan for Renewable Energy Sources. Within this framework, biomass from crop production represents the most significant domestic renewable resource. Globally, wheat, rice, and maize occupy more than 530 million hectares of arable land, making them the largest sources of crop residues. In Serbia, wheat straw, maize residues, and soybean straw dominate biomass availability, while sunflower and tobacco residues also represent important resources. Tobacco production alone generates approximately 76,000 tons of biomass annually, of which about 30% is incorporated into the soil to maintain fertility, leaving around 53,200 tons available for energy use. Crop residues contain substantial amounts of organic matter, mineral elements, and energy, making them suitable for biofuel production. While incorporation into soil and composting are environmentally acceptable practices, energy utilization offers additional economic and energy benefits. Conversely, open-field burning of residues leads to the loss of humus, harmful emissions, disruption of soil microbial activity, and agroecosystem degradation. Therefore, sustainable biomass utilization represents a rational and long-term solution within modern energy systems.

Key words: agricultural biomass, crop residues, renewable energy, bioenergy potential, sustainable resource management

P3_38

Structure, reactivity, and microbial activity of picolinic acid-derived herbicides

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Abstract

Clopyralid, aminopyralid, picloram and triclopyr are chlorinated derivatives of picolinic acid. They are commonly used as herbicides – substances used in agriculture to control or eliminate weeds. All herbicides derived from picolinic acid act as auxin mimics, which means that they disrupt natural hormonal and physiological balance in plants causing aberrant growth that is followed by decreased transpiration, carbon assimilation, chloroplast damage, breakdown of membranes and vascular system and eventually, death of a plant. After fulfilling their function, herbicides enter the environment. The persistence of herbicides in soil depends on their chemical properties, soil characteristics and climatic conditions. They can also leach into groundwater and contamination of environmental waters with herbicides is a direct consequence of chemical weed control, particularly in agricultural production. Clopyralid and picloram are among the herbicides with the greatest potential to leach into groundwater, and picolinic acid–derived herbicides have been detected in groundwater on multiple occasions. This study investigated the structural properties, reactivity and microbiological activity of picolinic acid and four of its derivatives: clopyralid, aminopyralid, picloram, and triclopyr. Structural characterization was carried out using spectroscopic techniques, including FTIR, Raman, and UV–VIS spectroscopy. The experimental results were supported by theoretical calculations based on quantum chemistry methods. Microbiological activity was evaluated against selected soil bacterial strains. Combining theoretical and experimental approaches provides insights into the environmental behaviour, persistence, and biological effects of pyridine carboxylic acid–based herbicides, supporting the development of safer and more environmentally friendly agrochemicals.

Key words: herbicides, picolinic acid, structure

Acknowledgment

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P3_39

Valorisation of crop-derived quercetin in the development of functional food systems: A review

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Abstract

Quercetin (3,3′,4′,5,7-pentahydroxyflavone) is a naturally occurring flavonoid widely distributed in cereals, vegetables and medicinal plants. Increasing interest in plant-derived bioactive compounds has highlighted their potential use in functional foods with enhanced nutritional and health-promoting properties. However, the application of quercetin as a food ingredient remains limited due to its low water solubility, chemical instability during processing, and poor bioavailability after oral intake. This study aimed to evaluate current technological strategies for effectively incorporating crop-derived quercetin into functional food systems and to assess their impact on compound stability and nutritional functionality. A systematic literature review was conducted, focusing on studies published within the last five years. Major electronic databases, including Google Scholar, Scopus, PubMed, MDPI, and Elsevier, were searched using keywords such as ‘quercetin’, ‘functional foods’, ‘microencapsulation’, ‘delivery systems’, ‘bioavailability’, ‘food matrix interactions’, ‘cereal-based products’, ‘thermal stability’, and ‘shelf-life stability’. The analysis showed that microencapsulation and lipid-based delivery systems significantly improve quercetin retention during thermal processing and storage. Interactions with cereal macromolecules may further enhance its technological stability and potential bioaccessibility. Additionally, the use of quercetin-rich plant materials can increase the value of agricultural raw materials and support the sustainable development of functional foods. Despite these advances, key challenges remain, including the optimisation of enrichment levels, preservation of sensory quality, and compliance with regulatory requirements for bioactive ingredient fortification. In conclusion, the integration of crop science, food technology and nutrition research is essential for the successful transformation of plant-derived quercetin into commercially viable functional food products and for strengthening the role of agricultural resources in promoting healthier dietary patterns.

Key words: quercetin, bioactive compounds, crop valorisation, functional food

Acknowledgment

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P3_40

Compact biomass: Briquetting for efficient renewable energy

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Abstract

Briquetting is a modern industrial process that compresses lignocellulosic waste into compact forms, biobriquettes, with the aim of reducing volume, facilitating transport and storage, and enabling the use of biomass as a renewable energy source. Historically, the first patented press for briquetting paper using a wet method was developed in Switzerland in 1918, while the fundamental principle of wood briquetting under high pressure and elevated temperature was established in 1923. In Serbia, biobriquette production began in the 1980s, with intensive development of briquetting and pelletizing companies recorded since 2007.The aim of this study is to analyze the biobriquette production technology, the physical and energy characteristics of various biomass types, the raw materials used, and the potential applications of biobriquettes as a renewable energy source in industry and households in Serbia. Biobriquette production is based on pressing finely ground plant or wood residues under high pressure (30–100 MPa) and elevated temperatures (80–180 ºC), at an optimal raw material moisture content of approximately 15%. The particle size of the raw material (3–5 mm) and the applied pressure directly affect briquette density (up to 1.1–1.3 t m^{-3}) and compactness. Raw materials include agricultural residues such as straw from cereals and oilseeds, maize stalks, sunflower stems, fruit shells and pits, branches of fruit trees and vineyards, as well as wood waste and industrial by-products. For wood briquettes, optimal moisture content ranges from 6–16%, while the final moisture content of finished briquettes is typically 7–10%. The energy value of biobriquettes varies from 13.9 MJ kg^{-1} for stems to over 19 MJ kg^{-1} for sunflower shells and wood briquettes. Briquetting enables the conversion of biomass by-products into marketable fuels with increased energy density and improved combustion efficiency, representing a sustainable and economically viable method for renewable energy utilization in Serbia.

Key words: briquetting, biomass, renewable energy, lignocellulosic residues, sustainable utilization

P3_41

Influence of soil chemical properties on the chemical and elemental composition of tobacco biomass

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Abstract

The chemical and elemental composition of agricultural biomass is one of the key factors determining its quality and suitability for energy and industrial applications. The aim of this study was to investigate the influence of soil chemical properties on the chemical and elemental composition of tobacco stalks in the Šabac area, as well as to determine the degree of correlation between individual biomass components and selected soil parameters. The study was conducted using tobacco stalk samples, with analyses of ash, cellulose, and lignin contents, as well as the elemental composition of the biomass (C, H, N, and O), in relation to soil pH (nKCl), humus content, total nitrogen, phosphorus (P_2O_5), and potassium (K_2O). The relationships between the investigated parameters were evaluated using statistical correlation analysis. The results showed a statistically significant positive correlation ($p \leq 0.05$) between ash content in tobacco stalks and all analyzed soil chemical properties. A statistically significant negative correlation was observed between lignin content and both total nitrogen and potassium (K_2O) in the soil ($p \leq 0.05$), while soil pH, humus content, and phosphorus content showed no significant influence on lignin levels. No statistically significant dependence was observed for cellulose, carbon, nitrogen, and oxygen contents in relation to the analyzed soil parameters. In contrast, hydrogen content in the biomass exhibited a strong positive statistical correlation with all examined soil chemical properties ($p \leq 0.01$). These findings indicate that soil chemical properties exert a selective but significant influence on agricultural biomass composition, providing an important basis for optimizing its utilization in energy production and other sustainable applications.

Key words: agricultural biomass, tobacco stalk, soil chemical properties, elemental composition, biomass energy potential

P3_42

Effect of sowing time and fertilizer type on weed infestation in different *Triticum aestivum* ssp. *spelta* L. varieties

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Abstract

Weed infestation is one of the major challenges in modern crop production, as the presence of weeds leads to competitive interactions with the cultivated plants. The aim of this study was to determine the effect of sowing time and different fertilizers on weed infestation in two spelt (*Triticum aestivum* ssp. *spelta* L.) varieties. The trial was conducted at the experimental field of the Research and Development Institute "Tamiš" in Pančevo during the 2023/2024 growing season. The preceding crop was triticale (×Triticosecale). Two spelt varieties (Nirvana and Ostro) were sown and represented as factor A of the experiment. Factor B consisted of two sowing dates. Factor C involved four different fertilizer treatments (Guanito; Unimax; Guanito + Unimax; Guanito + Unimax + Slavol) and control. Weed sampling for determining weed density and floristic composition using the square method was carried out on May 28th, 2024.The most dominant weed species were the perennial weeds *Convolvulus arvensis* L. and *Cirsium arvense* (L.) Scop. The highest weed density was observed in the first sowing date (19.4). On average, the highest fresh weed biomass was recorded in the control treatment (229.9 g m^{-2}), while the lowest was found in the treatment with a combination of all three fertilizers (86.3 g m^{-2}), wich was statistically significant. Similarly, the highest average dry weed biomass was observed in the control (75.7 g m^{-2}), whereas the lowest was recorded in the treatment with all three fertilizers combined (44.3 g m^{-2}). This difference was also statistically significant. The difference in dry weed biomass between first sowing date (73.4 g m^{-2}) and the second sowing date (47.6 g m^{-2}) was not statistically significant. The integration of appropriate spelt variety selection, fertilization type, and sowing date proves to be key in reducing weed infestation, ultimately resulting in improved organic crop performance.

Key words: competition, organic production, spelt, weediness

P3_43

Degradation of plastic by the wax moth (*Galleria mellonella*)

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Abstract

One of the most challenging environmental problems today is plastic waste, which is created by the daily use of plastic. Plastic decomposes very slowly, and often during decomposition, the production of microplastics or secondary pollution occurs. In recent years, more and more people are talking about biological ways of breaking down plastic. Therefore, in this study, we examined the possibility of plastic degradation using the grate wax moth. Three plastic bags belonging to the polyethylene (PE) group were used. On the label on the material, one bag is identified as high-density polyethylene (HDPE), while the other two are classified as low-density polyethylene (LDPE) and linear low-density polyethylene (LLDPE) according to texture and flexibility. The test was done for each type of plastic separately. At the bottom of a glass petri dish, was placed: (i) a piece of plastic bag, cut in the shape of a square (5x5 cm), i.e. (ii) a piece of plastic bag, cut in the shape of a square (5x5 cm) mixed with 10 grams of food, and 15 wax moth larvae, about 20 days old, were added to each petri dish. Each trial had three replicates. The control treatment included 20 g of food and 15 larvae of the same age. The Petri dishes were left in a dark place, at a temperature of 25°C and a relative humidity of 65%, 15 days. The results of this experiment showed that wax moth larvae were eating and degradated plastic, especially damage was noticed in the treatment with low-density polyethylene (LDPE). Although greater damage was observed in certain treatments with added food, such results were not uniform in all replicates. This research has shown that grate wax moth larvae have potential in plastic degradation, however, further research is needed to better understand the degradation mechanism.

Key words: polyethylene, damage, larvae, biodegradation

P3_44

Different maize hybrid in intercropping with millet under conditions of climate change

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Abstract

Maize - *Zea mays* L. is the most important cereals. Millet - *Panicum miliaceum* L. has the lowest water requirement and shortest growing season of any cereal. Climatic conditions in the Serbia favor the production of maize and millet. In order to determine the biomass productivity of maize and millet, research was carried out in 2025 in monoculture and in intercropping system in Serbia. The experiment was conducted in 2025 in Rača Kragujevačka (Serbia) on chernozem soil. Two variants were studied: control-monocropping and maize–millet intercropping. Two maize hybrids (Kneja 435 and Kneja 561), developed at the Maize Research Institute – Knezha, Bulgaria, and the millet variety-Biserka, developed at the Institute of Field and Vegetable Crops – Novi Sad (Serbia), were included. From the morphological and productive characteristics, the following were monitored: plant height (cm), cob/panicle length, plant mass (g) and 1000-seeds weight (g). The results showed that the maize hybrid Kneja 435 had higher values of all tested parameters compared to maize Kneja 561 and millet variety Biserka. The height of the maize plant Kneja 435 was 230 cm, Kneja 561 was 225 cm, while the height of the millet plants was the lowest and was 115 cm. The length of the ear of maize Kneja 435 was 17 cm, Kneja 561 was 16 cm, while the length of the millet panicle was 59 cm. The mass of the maize plant Kneja 435 was 608 g, Kneja 561 was 605 g, while the millet plants mass Biserka was the lowest, 25 g. In the control, the plants had higher values for all indicators compared to the inter-cropping, but in the inter-cropping of both cultures, higher values were achieved for biomass yield. Due to global warming, why you should opt for earlier hybrids to avoid critical periods for maize, but also for sowing in inter-cropping because a higher biomass yield is achieved under control.

Key words: maize hybrids, maize–millet intercropping, morphological-productive traits, global warming

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P3_45

Maize-soybean intercropping system in the context of climate change

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Abstract

Maize is the most significant food and feed crop in the world, with a seeded area of 208 mil. ha, while soybeans which occupy 137 mil. ha, are source of grains, oilseeds, and animal feed. Two types of trypsin inhibitor were found in soybean grain the Kunitz trypsin inhibitor and the Bowman-Birk inhibitor. Mature grain of soybean Lela is lacking Kunitz- trypsin inhibitor and makes soybean grain suitable for direct feeding in adult non ruminant animals without previous thermal processing. The aim of this study was to examine the productivity of maize and soybean in monoculture and intercropping. In 2025, the experiment was carried out on chernozem soil in Bački Petrovac, Serbia, in two variants: V1 - monocropping (control) and V2 - intercropping maize–soybean. Maize hybrid (Kneja 435), created at the Maize Research Institute – Knezha (Bulgaria), and the soybean variety Laura, developed at the Maize Research Institute, Belgrade (Serbia). From the productive traits, the following were monitored: dry-biomass yield and 1000-seeds weight. The results showed that the maize hybrid Kneja 435 had higher values of all tested parameters compared to soybean variety Laura. Maize and soybean 1000-seeds weight the average was 275g and 200g and the values of this parameter were higher in the V1-variant than in the V2-variant, inter-cropping. In V1-variant the maize dry biomass Kneja 435 was 15.4 t/ha and in V2-variant was 12.8 t/ha, and the soybean biomass yield in V1-variant was 6 t/ha, while in V2-variant was 3.4 t/ha. Maize+soybean dry biomass in intercropping variant was 18 t/ha. In the Intercropping variant, an overall higher biomass yield of maize and soybean was achieved than in the control variant. Since of climatic change, you should choose earlier hybrids for inter-cropping, given the rising frequency of droughts, temperature extremes, and erratic precipitation linked to climate change.

Key words: maize hybrid, soybean variety, productive traits, soil, climate change

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P3_46

Variability of red clover seed yield and quality on acidic soil

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Abstract

On poorer quality soils and in mountainous areas, red clover is an important forage crop for animal feed production. Knowing the production potential, adaptability and stability of a variety in a particular location is of utmost importance for the success of production in the future. Soil quality, weather conditions during the second mowing (the mowing in which seed production is most often carried out) and the lifespan of red clover have a major impact on seed yield. The aim of the research in this work was to determine the production potential of the yield and quality of red clover seeds on acid reaction soil, to select the best varieties because they can be expected to give high forage yields. The selection of the best varieties is also important for the production of animal feed, if a variety has a high seed yield, it can be expected that it will also have high forage yields. Research was carried out on 10 varieties of red clover in two years in the area of the Mrkonjić Grad municipality. For all tested traits, the factors of variety and year had a statistically significant influence. The highest average seed yield was achieved by the Marina variety, the highest total germination and the lowest proportion of hard seeds by the Kolubara variety. The Viva variety had the highest 1000- kernel weight and high germination. Statistically significantly higher seed yield and 1000- kernel weight were obtained in the first year of testing, and germination and proportion of hard seeds in the second year of testing. At this location, red clover seed production should be carried out in the second mowing of the second year of life, due to low seed yields, the second mowing in the third year should be used for fodder production.

Key words: red clover, variety, yield, seed quality

P3_47

Productivity of the local potato variety "Ruska krtola" depending on the size of virus-free seed tubers

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Abstract

The yield of local potato varieties in Montenegro is low and largely limited by poor seed quality, particularly due to a high level of viral infection. One of the key prerequisites for improving production is the use of virus-free seed tubers of appropriate size.This study was conducted to evaluate the effect of different size fractions of virus-free seed tubers (28-35 mm, 35-45 mm and 45-55 mm) on yield and other productivity parameters of the local potato variety "Ruska krtola". Field trials were carried out during 2020 and 2021 in Danilovgrad, under modified sub-Mediterranean climate conditions, on eutric cambisol soil, using a randomized block design with three replications.The results showed that seed tuber size significantly affected all productivity parameters. The highest total tuber yield, expressed as a two-year average, was achieved with the smallest fraction (28-35 mm) – 31.4 t ha^{-1}, while yields decreased with increasing seed size: 29.4 t ha^{-1} (35-45 mm) and 27.4 t ha^{-1} (45-55 mm).In terms of yield structure, medium-sized tubers (40-55 mm) predominated in the total yield. Their highest yield was obtained with the 35-45 mm fraction (16.7 t ha^{-1}), followed by 28-35 mm (16.4 t ha^{-1}) and 45-55 mm (14.05 t ha^{-1}). Large tubers (>55 mm) were mainly formed from the smallest fraction (16.95 t ha^{-1}), while lower yields were recorded for the 35-45 mm (12.1 t ha^{-1}) and 45-55 mm fractions (13.15 t ha^{-1}). Based on the obtained results, it can be concluded that the use of virus-free seed tubers significantly increases productivity, with optimal results achieved using smaller and medium-sized fractions. This approach also represents an important factor for the sustainable use and conservation of this local variety under production conditions.

Key words: potato, Ruska krtola, virus-free seed tubers, tuber size, productivity

P3_48

The Impact of different doses of mineral fertilizers on the yield of potatoes grown on illimerized soils

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Abstract

The impact of two different doses of mineral fertilizers (N160, P160, K160, and N192, P192, K192, in kg/ha) on yield of two varieties of potato (Arizona and Esmee) was investigated in the two-year period (2022–2023), on hilly-mountainous Luvisol soil-type. The ilimerized soils of Radočelo Mountain are characterized by moderately good agro-physical and slightly worsen agrochemical properties in terms of acidic soil reaction and poor available phosphorus content. The study area is located at 1107 m a.s.l, and it is suitable for growing mercantile potato, and especially seed potatoes. The experiment was set up as completely randomized block design with three replications, and the size of elementary parcel was 4.90 x 4.75 m. Two different doses of mineral fertilizers were applied in the furrows before planting. The tubers of the mid-late variety Arizona, category original, of the fraction 35-55 mm, were planted in four rows, and also four rows of the mid-early variety Esmee, of the fraction 35-55 mm, category original, were planted. The spacing distance was 70 x 25 cm. The total yield was determined by measuring the tubers of two middle rows of each variety, from each fertilization variant and all replication. Both doses of mineral fertilizers significantly increased the yield of both varieties, in both examined years, compared with the unfertilized treatment. In both investigated years, the Arizona variety achieved a significantly higher yields compared to the Esmee variety, 12% for lower fertilization dose, and 14% for higher dose, presented as two-year average. A higher dose of mineral fertilizers significantly increased the yield of the Arizona variety compared with the lower dose. The differences in the yield of the Esmee variety between two doses were smaller.

Key words: fertilization doses, luvisol, potato, varieties, yield

Session 4: Animal Science

Oral Presentations

O4_01

Digital technologies in dairy farming: Implications for efficiency, sustainability, and animal welfare in North Macedonia and Croatia

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Abstract

The increasing integration of digital technologies in dairy farming presents a transformative opportunity for enhancing productivity, sustainability, and animal welfare. This study examines the application of advanced digital tools and precision livestock farming (PLF) systems on dairy farms in Croatia and North Macedonia, with a focus on their impact on operational efficiency, milk quality, and herd management. Data were collected from multiple farms, including case studies in the Pelagonia region of North Macedonia and the Slavonia region of Croatia, supplemented by official statistics and industry reports. The analysis encompasses the use of automated milking systems, robotic milking, precision feeding, health monitoring devices, biogas production, and digital farm management software. Results indicate that farms employing these technologies demonstrate significant improvements in productivity and resource management, including optimized feeding, early disease detection, and enhanced environmental sustainability. In Croatia, digital systems enable nationwide monitoring of milk composition and cow health, contributing to more precise nutritional management and improved milk quality. In North Macedonia, farms in Pelagonia exhibit higher adoption rates of advanced digital technologies compared to other regions, reflecting the role of regional infrastructure, training, and investment in technology implementation. The findings highlight that digitalization in dairy farming supports economic viability, reduces labor dependency, and enhances overall animal welfare. Furthermore, the adoption of renewable energy solutions and data-driven decision-making facilitates sustainable practices and long-term resilience of dairy farms. This study underscores the critical role of precision technologies in addressing labor shortages, optimizing herd management, and fostering environmentally sustainable dairy production. The results provide evidence for policymakers, farm managers, and stakeholders regarding the benefits of integrating digital solutions into dairy farming operations, thereby contributing to the modernization and competitiveness of the dairy sector in Southeast Europe.

Key words: dairy farming, digital technologies, precision livestock farming, sustainability, animal welfare

Acknowledgment

This research was funded by the European Union - NextGenerationEU (the project "Optimization of the sustainability of animal production under climate change conditions: integration of genetic, environmental, and technological factors").

O4_02

Regional variability in milk production, milk urea nitrogen, and ammonia emissions in dairy cows in Croatia

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Abstract

This study aimed to evaluate regional variability in milk production traits, milk urea, milk urea nitrogen (MUN), and ammonia emissions in dairy cows in Croatia. The analysis was based on 3,953,637 test-day records of Holstein cows collected between 2005 and 2022 within the official milk recording system. Farms were grouped into three breeding regions: Central, Eastern, and Mediterranean Croatia. The results showed clear regional differences in production traits. Eastern Croatia achieved the highest average daily milk yield (24.39 kg), while Central Croatia had the lowest (20.59 kg) and the highest variability. Mediterranean Croatia showed intermediate milk yield but lower milk fat and protein content. Considerable variability in all traits was observed across regions. Nitrogen-related parameters also differed among regions. The highest values of milk urea (24.19 mg/dL), MUN (11.13 mg/dL), and ammonia emissions (80.97 g/cow/day) were recorded in Mediterranean Croatia, while the lowest values were observed in Central Croatia. Eastern Croatia showed intermediate but relatively consistent values. The results suggest that regional differences in production performance and nitrogen metabolism may be associated with variations in feeding practices, production intensity, and management systems. Higher urea and MUN levels were associated with increased ammonia emissions, indicating lower nitrogen utilization efficiency. These findings emphasize the importance of region-specific management and feeding strategies in improving production efficiency and reducing environmental impacts in dairy production.

Key words: Holstein cows, milk urea, milk urea nitrogen, ammonia emissions, Croatian dairy regions

Acknowledgment

This research was funded by the European Union - NextGenerationEU (the project "Optimization of the sustainability of animal production under climate change conditions: integration of genetic, environmental, and technological factors").

O4_03

Regional differences in milk production traits and mastitis prevalence in Holstein cows

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Abstract

The aim of this research was to analyse the variability of milk production traits and mastitis prevalence in Holstein cows across three breeding regions in Croatia: Central, Eastern, and Mediterranean. Data were derived from test-day records and included daily milk yield (DMY), fat and protein content, somatic cell count (SCC), and urea concentration. The differences due to the breeding region were observed in all analysed traits. The Eastern region exhibited the highest milk yield and fat production, which may be associated with more optimized nutritional and herd management practices. In contrast, the Mediterranean region recorded the lowest production parameters, likely reflecting the impact of environmental stressors, particularly elevated temperatures. The Central region showed intermediate production levels but the highest SCC values, indicating a greater risk of compromised udder health. Mastitis prevalence varied among regions, with the highest incidence of clinical mastitis recorded in the Central region. Similar regional patterns were observed for subclinical mastitis. These findings confirm the multifactorial influence of environmental conditions, management systems, and genetic background on milk production performance and udder health. In conclusion, the results highlight the importance of region-specific management strategies in dairy production systems. Identifying regional variability in milk traits and mastitis prevalence provides a basis for developing targeted interventions aimed at improving productivity, udder health, and overall animal welfare in Holstein populations.

Key words: Holstein cows, milk production, mastitis prevalence, breeding region, somatic cell count

Acknowledgment

This research was funded by the European Union - NextGenerationEU (the project "Optimization of the sustainability of animal production under climate change conditions: integration of genetic, environmental, and technological factors".

O4_04

A comparative study of production performance of *Zophobas morio* and *Tenebrio molitor* as alternative protein sources in animal diets

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Abstract

Insects are increasingly recognized as a potential protein source for both animal and human consumption. In this study, two species, *Tenebrio molitor* and *Zophobas morio*, were compared, starting from the same initial mass until *T. molitor* began pupating and *Z. morio* stopped growing. Production parameters, individual growth, and total insect biomass were analyzed. Results showed that the larger species, *Zophobas morio*, was more efficient in terms of growth rate over time, while the smaller species, *T. molitor*, was more efficient in terms of feed utilization. Zophobas growth was 22% higher per week (4.41 g/week vs 3.62 g/week), whereas Tenebrio used 8% less feed to produce the same amount of larval mass. Moreover, the economic efficiency of production was more favorable for *T. molitor*. These findings indicate that species selection should depend on production goals: *T. molitor* is preferable for higher overall productivity and lower feed costs, while *Z. morio* may be chosen when larger individual insects are desired. The choice of insect species for production should be guided by the intended production goal.

Key words: *Zophobas morio*, *Tenebrio molitor*, feed, production parameters, growth efficiency, biomass yield

Acknowledgment

This research was supported by the Science Fund of the Republic of Serbia under Grant No. 7284, titled "Advancing Sustainable Solutions by Developing Insect-based Protein as New Feed Options – PRO-SUSTAIN." Additionally, research funding was provided by the Ministry of Science, Technological Development and Innovation under the following contracts: Contract No. 451-03-33/2026-03/200117, dated 05 February 2026; Contract No. 451-03-34/2026-03/200117, dated 05 February 2026.

O4_05

Effects of whey and highly digestible protein sources in starter feeds on growth performance and morphometric development of Holstein calves

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Abstract

The aim of the present study was to evaluate the effects of incorporating whey and easily digestible protein sources into pelleted starter feeds on growth performance and overall development of calves. Forty Holstein Friesian calves were assigned to four feeding groups, receiving either a standard starter mix or experimental diets supplemented with whey, yeast nucleotides, soybean protein concentrate, and limiting amino acids. Body weight and detailed morphometric measurements were recorded at multiple time points from birth to three months of age, and growth trajectories were analyzed using LSmeans and correlation analyses. The inclusion of whey and digestible protein sources did not significantly alter growth parameters at weaning, but female calves from experimental groups demonstrated significantly greater withers height (WH) and improved skeletal development by three months of age. These results indicate that dietary supplementation with whey and digestible proteins can enhance structural growth beyond the weaning period without adversely affecting early postnatal growth, supporting the strategic use of such ingredients in calf starter feeds to optimize developmental outcomes.

Key words: Holstein calves, whey, easily digestible proteins, starter mix, body traits

Acknowledgment

This research was funded by the European Union - NextGenerationEU (the project "Optimization of the sustainability of animal production under climate change conditions: integration of genetic, environmental, and technological factors").

O4_06

Phenotypic description of the Lipizzan horses from the Republic of Srpska

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Abstract

The Lipizzan horse has a long breeding tradition in the world, but also in the Republic of Srpska. The Lipizzan population in the Republic of Srpska is about 180 horses with full pedigree and DNA parentage tested. The work aimed to show the differences in the morphometric characteristics of Lipizzan horses from the stud farm Vučijak and private breeders. The research was conducted on a total of 56 Lipizzan horses, 28 from the stud farm Vučijak and 28 from private breeding. Measurements were carried out with Litdyn's stick and tape. Horses with full origin, older than 4 years, were measured. A total of 10 measures were measured: height of the withers with a stick, height of the withers with tape, height of the back, height of the croup, height of the root of the tail, chest width, width of the shoulders, length of the body, circumference of the chest and cannonbone circumferences. The results showed that there is a statistically highly significant difference in height of the back and circumferences of the chest between stallions from a stud farm and stallions from private breeding. The statistically highly significant difference was recorded in the circumferences of the chest between stud farm and privately breeding mares. This research represents the first phenotypic description of Lipizzan horses from private breeding and these results can be used in further breeding and selection work.

Key words: Lipizzan horses, measurements, stud farm, private breeding

O4_07

Evaluation of the body conformation of Arabian horses originating from Borike based on body indices

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Abstract

The Arabian horse originated from Borike, or Boric Arabian horse, has a long tradition of breeding in the territory of Bosnia and Herzegovina (BiH), and the first stud farm for breeding these horses was established in Sarajevo at the end of the 19th century. A significant role in the development of this horse population was played by the stud farm Borike, which ceased operations in 2018. Today, the Borik Arabian horses has been preserved in BiH thanks to private breeding programs. This study aimed to examine, using body indices, whether there is morphometric similarity between Borik Arabian horses and traditional Arabian horses bred in the Republic of Croatia whose founders originate from the stud farm Borike. In this study, values were calculated for nine body indices: chest index (CI), body index (BI), compactness or eurysomy index (CIKOM), dactylo-thoracic index or bone index (DTI), caliber index I (KI1), caliber index II (KI2), cannon bone load index (CBLI), volume index (VI), and format index (FI), based on seven previously measured morphometric traits (withers height, back height, croup height, chest circumference, cannon bone circumference, body length, and back length). Based on the conducted research and statistical significance testing of the observed differences, it can be concluded that for most indices there is a statistically significant or highly significant difference (CI, BI, CIKOM, KI1, KI2, CBLI, VI, and FI). The obtained results indicate that there is a significant difference in body measurements between the two analyzed horse populations and may be applied in the process of defining compliance with the criteria for breed (strain) recognition.

Key words: body indices, Borik Arabian horses, traditional Arabian horses

O4_08

The impact of learning theory knowledge on improved horse welfare

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Abstract

Horse welfare in equestrian sport has received increasing attention from both researchers and practitioners. However, welfare remains a complex and multifaceted concept, influenced by physiological, behavioral, and cognitive factors. This review aimed to present key insights from equine learning theory and their implications for improving human-horse interactions and promoting welfare. While laboratory studies have greatly expanded understanding of equine cognition, translating these findings into practical training and management remains challenging. A critical aspect of equine welfare is balancing motivation and stress. Positive stress (eustress) can facilitate learning, while negative stress (distress) impairs performance and compromises well-being. Recognizing this balance is essential for designing training protocols that respect the horse's natural behavior and physiological needs. Despite the involvement of multiple stakeholders in equestrian sport, practices often prioritize performance over the horse's welfare, highlighting a need for evidence-based strategies. Recent advances in learning theory provide practical tools for enhancing training efficiency, handling methods, and overall management, with the potential to improve welfare outcomes across disciplines. Integrating these insights into equestrian education and professional curricula is crucial to bridge the gap between scientific knowledge and everyday practice. By applying learning theory principles, trainers and handlers can foster positive interactions, optimize skill acquisition, and support the long-term well-being of horses. In conclusion, equine learning theory offers a scientifically grounded framework for improving welfare in equestrian sport. Its implementation can enhance both the quality of human-horse relationships and the physiological and psychological health of horses, supporting sustainable and ethical practices within the industry.

Key words: horse welfare, human-animal interaction, learning theory

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O4_09

RETRACTED: Social network analysis in pigs: Insights into social organisation, behaviour, and welfare in pig production systems

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Abstract

Social network analysis (SNA) has become an increasingly valuable approach for studying social interactions in animal behaviour research. By moving beyond simple dyadic relationships, SNA enables the analysis of entire social systems and allows researchers to quantify both direct and indirect interactions among individuals. This approach provides insights into individual social roles, subgroup formation, and the stability of group dynamics. In pigs, social interactions during lactation, weaning, and the post-weaning period play a crucial role in shaping welfare, growth, and productivity. Applying SNA to pig behaviour therefore offers new opportunities for understanding how social structures emerge and how management practices influence group stability. This review summarises current knowledge on the application of social network analysis in pigs, focusing on early social interactions, suckling behaviour, regrouping at weaning, and post-weaning social dynamics. The potential of SNA for improving welfare assessment and supporting management strategies in pig production systems is also discussed.

Key words: social network analysis, piglets, early socialisation, weaning, pig behaviour

RETRACTED

RETRACTION NOTICE: The full-length paper corresponding to this abstract has been retracted by the Editorial Board. Please refer to the official Retraction notice: https://doi.org/10.63356/agrores.2026.019

O4_10

Majevički dimljeni sir Zarac - Production and quality characteristics

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Abstract

Majevički dimljeni sir Zarac is a dairy product that is protected in Bosnia and Herzegovina by the protected label of origin (PDO). It received the label in 2023, which speaks a lot about the quality of this cheese. Therefore, the goal of this paper was to describe the technology, examine the chemical composition and physical properties, and evaluate the sensory properties of this cheese. It is a cheese produced from partially skimmed, raw milk, by spontaneous fermentation carried out by the natural microflora present in the milk. The production area of this cheese is northeastern Bosnia. Majevički dimljeni sir Zarac is characterized by a low pH value and high acidity, which have a preservative effect, while smoking, which is used in the technology of this cheese as one of the stages of the technological process, also has a preservative effect. The average chemical composition of this cheese is as follows (%): dry matter 31.41; fat 6.00, fat in DM 19.10, MFFB 73.00, proteins 20.16 and salt 1.30, which places it in the category of semi-fat soft cheeses. Obtained physical characteristics, high water activity, low hardness and adhesuveness are expected for this category of cheeses. Sensory evaluation showed the high quality of Majevički dimljeni sir Zarac, so it is on the border of first and extra class according to the average rating. The conducted research and the obtained results justify the reputation and place of this cheese among the cheeses of Bosnia and Herzegovina and beyond.

Key words: cheese, quality, chemical composition, physical properties, sensory evaluation

O4_11

Agricultural resources and development opportunities in the Gambia

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Abstract

The Gambia, country with a total land area of approximately 11,000 km², is characterized by a high dependence on agriculture and significant exposure to climate variability. Agricultural land accounts for about 62.6% of the total land area, equivalent to roughly 6,300 km², while arable land represents approximately 43.5%. Despite this relatively favourable land resource base, agricultural productivity remains low due to strong reliance on rain-fed systems, with average annual precipitation around 800–850 mm and pronounced seasonal variability. Water resources are primarily determined by the Gambia River, which spans the entire country and represents a significant but underutilized potential for irrigation development and climate resilience enhancement. The agricultural sector employs a substantial proportion of the population, with estimates indicating that up to 70% of the labour force is engaged in crop production, while agriculture contributes around 24–30% of GDP. This labour force is predominantly composed of smallholder farmers, women, and youth, whose productivity is constrained by limited access to knowledge, technology, and extension services. Livestock production, mainly extensive and low-input, represents an important component of rural livelihoods. Current estimates indicate approximately 300,000 cattle, 140,000–150,000 sheep, and 200,000–230,000 goats, alongside a substantial population of local poultry. However, productivity remains low due to genetic limitations, disease pressure, and suboptimal feeding systems. In this context, the paper explores development pathways focused on: irrigation systems to reduce rainfall dependency, genetic improvement of livestock, and strengthening vocational education. Particular emphasis is placed on capacity building initiatives, such as those implemented within the AGREEN GAMBIA project, which aim to empower women and youth and promote sustainable, climate-resilient agricultural practices. The findings suggest that an integrated approach combining efficient water resource management, livestock genetic improvement, and targeted education interventions is essential for enhancing productivity, resilience, and socio-economic inclusion in rural Gambia.

Key words: the Gambia agriculture, climate-resilient farming, water resources management, livestock genetic improvement, agricultural education and training

Acknowledgment

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Session 4: Animal Science

Poster Presentations

P4_01

Dairy sector in Republika Srpska - Challenges and opportunities

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Abstract

The dairy sector in the Republic of Srpska is one of the most important branches of agricultural production. In recent years, it has faced a number of problems, the number of farmers is decreasing due to the check. This year they will face additional challenges. The value chains in this sector are quite fragmented and often at odds with each other, which slows down the growth of milk production. In recent years, there has been a decrease in the number of milk suppliers, but the total production of milk has remained stable. Despite all the difficulties, this sector has potential, especially in diversifying its production and starting small productions that would make products with added value and not just sell raw materials. One of the problems is that the dairies produced products that reduced the price value and with them achieved a surplus in the trade. In this paper, we tried to analyze value chains in the dairy sector of the Republic of Srpska. We analyze the production of the dairy industry and commodity exchange. Since the common market is in question, data on trade in goods for Bosnia and Herzegovina is included. The following methods were used in the research: survey method, analysis and synthesis method, description method and comparison method. As a challenge in managing and establishing a more efficient market chain, the question arises of how to include small producers in modern market chains. Milk production should be primarily focused on cheaper and higher quality products. This is possible with new technologies, especially in the way animals are kept and treated, nutrition, hygiene, etc. Milk production on smaller farms should gradually take on characteristics – organic, indigenous. In the future, greater importance should be given to longer-lasting dairy products and products with added value.

Key words: dairy sector, value chain, milk production, farmers

P4_02

Serbian dairy center of vocational excellence -MLEKOLOGIJA: A pathway to improving education and skills

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Abstract

The dairy sector plays a crucial role in food security, rural development, and economic sustainability worldwide. However, rapid technological development, digital transformation, and increasing sustainability requirements demand new competencies from current and future professionals in milk production and dairy processing. Traditional education and training should be updated and improved to keep pace with the needs of the industry and producers. The establishment of a Serbian Dairy Center of Vocational Excellence (CoVE) – MLEKOLOGIJA represents an innovative approach to bridging the gap between education, research, and industry. The centre's mission includes promoting the dairy industry as an attractive career option, transforming educational tools into digital formats and practical teaching for more modern and efficient learning – including flexible lifelong educational formats – and maintaining strong links between different stakeholders in the dairy sector. The Serbian Dairy CoVE focuses on several key pillars: modernizing curricula by integrating digital learning tools, industry case studies, and competence-based training; promoting work-based learning and stronger engagement of dairy companies in the education process; fostering international collaboration and knowledge exchange with European partners; and establishing continuous professional development (CPD) programmes for dairy professionals and small-scale producers. Special attention is given to supporting small and medium-sized dairy processors, which represent a significant part of the regional dairy economy. Through targeted training programs, practical workshops, and digital learning modules, the Center aims to enhance technological knowledge, product quality, and business sustainability. The CoVE model and its implementation presented in this paper demonstrate how integrated educational ecosystems can improve knowledge transfer, strengthen practical skills, and increase the competitiveness of the dairy sector in Serbia and the region.

Key words: dairy, Center of Vocational Excellence, vocational education, work-based learning, digital tools

Acknowledgment

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P4_03

Assessment of the nutritional status of Simmental cows based on milk chemical composition

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Abstract

The aim of this study was to determine, based on the analysis of milk constituents, whether cows were fed in accordance with their nutritional requirements. Milk urea concentration is a reliable indicator of the protein supply to the body, as well as the balance between energy and protein in the cows diet. Urea concentration can therefore be used to assess whether cows are appropriately fed according to their needs. Milk urea concentration is influenced by multiple factors, including breed, diet, stage of lactation, body weight, daily milk yield, season, age of the animal, parity, milking interval, environmental conditions, and health status. In the Republic of Srpska, milk sampling is performed monthly on all dairy farms to analyze protein and fat content, urea concentration, lactose content, dry matter content, and somatic cell count. All cows on the studied farm were kept under standard farming conditions and fed the same diet. The average milk composition was as follows: milk fat 4.29%, protein 3.74%, fat/protein ratio 1.15, urea concentration 18.24 mg/dl, and milk urea nitrogen (MUN) 8.39 mg/dl. Considering the average results over the 12-month period, it can be observed that the cows were generally fed in accordance with their nutritional requirements, but when considering the analysis for each month individually, it is clear that in some months the cows were not fed in accordance with their nutritional reguirements. The study results showed that the average values of milk urea concentration and other milk constituents indicate a properly balanced diet for dairy cows, with observed monthly variations confirming the importance of continuous monitoring of milk composition.

Key words: milk urea, milk urea nitrogen, dairy cattle, Simmental cow

P4_04

Production performance of broiler chickens under commercial farming conditions in the Banja Luka region

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Abstract

This study aimed to evaluate production performance on three commercial broiler farms of similar capacity (18.000 chickens production cycle) in the Banja Luka region (Republic of Srpska, Bosnia and Herzegovina) during the period 2022–2025. A total of 60 production cycles were analyzed, comprising five cycles per farm per year. Production parameters included fattening period, final body weight, feed conversion ratio (FCR), first-week mortality, total mortality, and the European Production Efficiency Factor (EPEF). Data were analyzed using descriptive statistics, analysis of variance (ANOVA), and Pearson correlation analysis. The average fattening period was 40.2 days, while the average feed conversion ratio was 1.69, and both parameters were significantly affected only by farm ($P < 0.05$). The average final body weight was 2.30 kg and was influenced only by production year ($P < 0.05$), suggesting the presence of annual variability related to environmental or organizational factors. First-week mortality and total mortality averaged 1.71% and 3.92%, respectively, with only total mortality showing a significant farm effect ($P < 0.05$). The European Production Efficiency Factor averaged 324.79 and was significantly influenced by both farm and production year ($P < 0.05$). Correlation analysis revealed a strong positive relationship between fattening period and final body weight ($r = 0.75$), a positive correlation between fattening period and FCR ($r = 0.37$), and significant correlations of EPEF with final body weight ($r = 0.43$) and FCR ($r = −0.75$) ($P < 0.05$). The results demonstrate that broiler production efficiency is influenced by farm-specific management and annual variation. These findings provide practical insights for optimizing broiler production and emphasize the importance of targeted management strategies to enhance production efficiency.

Key words: broiler chickens, production performance, feed conversion, mortality, EPEF, farm management

P4_05

Physicochemical evaluation of traditional Janj cheese with selected plant additives

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Abstract

Janj cheese is a traditional dairy product from the Janj region in Bosnia and Herzegovina, produced from raw milk using specific artisanal technology. The aim of this study was to evaluate the effects of selected plant additives on the physicochemical properties of traditional Janj cheese. Twelve cheese samples were produced in two batches. Each batch included one control sample and five samples supplemented with oregano, basil, parsley, rosemary, and chives as plant additives. In the first batch, the additives were applied at a concentration of 0.50%, and in the second batch at 1.00%. Physicochemical analyses included moisture, dry matter, fat, protein, ash, sodium chloride content, pH, titratable acidity, water activity, instrumental color (CIE L*a*b*), and texture parameters. Moisture content ranged from 53.39% to 57.72% in the first batch and from 48.96% to 51.31% in the second batch. Fat content in dry matter ranged from 38.62% to 45.18%, while protein content varied between 18.12% and 25.05%, confirming the high nutritional value of Janj cheese. Ash and sodium chloride contents varied depending on the type of plant additive used. Differences in pH and titratable acidity reflected variations in fermentation intensity among samples. Water activity ranged from 0.901 to 0.932, while instrumental color measurements showed significant differences within each batch. The results indicate that the addition of plant additives significantly influenced ($p<0.05$) the physicochemical properties of Janj cheese. Traditional production methods combined with local technological variations result in cheeses with distinct characteristics. Physicochemical evaluation plays a key role in maintaining the quality, safety, and distinctive character of traditional cheeses such as Janj, reflecting their cultural and economic importance. These findings highlight the potential of plant additives to modulate cheese properties while preserving the authentic features of this regional product.

Key words: Janj cheese, plant additives, physicochemical properties

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P4_06

Functional properties of full-fat acid-coagulated cheese enriched with spices: Phenolic content and antioxidant activity

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Abstract

The aim of this study was to investigate the influence of selected spices (oregano – *Origanum vulgare*, basil – *Ocimum basilicum*, parsley – *Petroselinum crispum*, rosemary – *Salvia rosmarinus*, and chives – *Allium schoenoprasum*) on the phenolic content and antioxidant activity of full-fat acid-coagulated cheeses. Six cheese samples were produced, including a control without spices and five samples containing 0.5% of individual spices. Antioxidant activity was determined using spectrophotometric methods (DPPH, ABTS, and FRAP), while total phenolic, flavonoid, and non-flavonoid contents were determined using gallic acid as a standard. The results showed that the addition of spices significantly increased ($p<0.05$) the phenolic content and antioxidant activity of the cheeses compared to the control sample. The highest total phenolic content and the highest antioxidant activity, as determined by DPPH, ABTS, and FRAP assays, were observed in the cheese enriched with oregano. High values were also recorded in cheeses with rosemary and basil, while parsley and chives showed a moderate effect. The lowest values for all examined parameters were found in the control sample without spices. The obtained results indicate that the selected spices, particularly oregano, rosemary, and basil, have a positive impact on the antioxidant properties of full-fat acid-coagulated cheeses and can be successfully used as functional additives in the production of these products.

Key words: cheese, spices, phenolics, antioxidant activity

P4_07

Thermal processing of finely comminuted cooked sausages: Influence of diameter and casing type

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Abstract

The objective of this study was to investigate the influence of sausage diameter and the casing type on the thermal processing parameters of finely comminuted cooked sausages. Thermal treatment plays a vital role in extending the shelf life and ensuring the safety of cooked sausages. During thermal processing, the product must reach a core temperature of at least 72°C to achieve a safe, high-quality, and stable product, maintaining desirable sensory properties such as color, aroma, and texture. The experimental part of this research involved producing three batches of chicken-based hot dogs with identical formulations but varying diameters and different casing types (22 mm with polyamide casings - PAC22, and 10 mm and 22 mm cellulose casings - CC10 and CC22). The process began with drying and smoking (both CC samples), followed by thermal processing at 75-80°C until the core temperature reached 72°C (all samples), and finished with a cooling phase. The cooking phase, as a part of the thermal process, was continuously monitored using probe thermometers. Results showed that the product's diameter significantly influenced the time required to reach the target internal temperature. Total process durations were 115.7 min (CC10), 141.3 min (CC22), and 129.3 min (PAC22), with corresponding cooking phase durations of 100, 111.7, and 101 minutes, respectively. Sausages with larger diameters needed longer heating periods due to slower heat penetration. In addition, the type of casing influenced heat transfer efficiency and moisture retention. The findings emphasize the importance of continuous temperature monitoring and precise control during processing to ensure both product safety and technological quality.

Key words: sausage diameter, casing type, thermal processing

P4_08

Nutritional properties of liver as an edible slaughter by-product

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Abstract

Liver represents one of the most nutritionally significant edible slaughter by-products, distinguished from skeletal muscle tissue by its exceptionally high content of biologically active compounds, including vitamins, minerals, and high-quality proteins. This study aimed to determine the chemical composition, nutritional value, and amount of biologically valuable compounds based on chemical analysis of the livers of different animal species, with respect to their importance for human nutrition. Analyses of chicken, porcine, and bovine liver were performed, and the contents of water, mineral substances, fat, protein, pH, and color (spectrophotometrically, CIELAB system) were determined. The results demonstrated that moisture content was highest in chicken liver (75.89%). Crude fat content was markedly higher in chicken liver (2.98%) compared to porcine (0.67%) and bovine (0.19%) liver ($p < 0.05$). The highest total protein content was recorded in porcine liver (20.46%), while chicken liver exhibited the lowest value (17.49%). Mineral content ranged from 1.27% (chicken) to 1.68% (porcine). Direct pH measurements ranged from 6.09 (bovine) to 6.49 (chicken), consistent with the known rapid post-mortem autolytic changes. Colorimetric analysis showed that chicken liver exhibited the highest redness ($a^* = 12.83$) and yellowness ($b^* = 13.13$) values, while bovine liver was the darkest ($L^* = 35.71$). The findings confirm that all three liver types are rich sources of proteins and minerals. Liver represents a highly valuable food ingredient suitable for direct consumption and for use as a raw material in the production of cooked meat products.

Key words: liver, chemical composition, color, nutritional value

P4_09

The influence of the type of rennet on the quality of white brine cheese

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Abstract

White brined cheese represents one of the most important traditional dairy products characteristic of the Balkan, Mediterranean, and Middle Eastern regions. The type of rennet used in its production has a decisive influence on the quality of the final product. This study investigated the effects of three different types of rennet — traditional animal, industrial animal, and microbial — on the chemical composition, sensory properties, and yield of white brined cheese.The research was conducted at the "Jašović" farm in Murino, Municipality of Plav, at an altitude of 920 m. The farm maintains an autochthonous livestock population consisting of 40 Buša cows and 120 Sora sheep. The experimental production included three batches of white brined cheese produced from the same raw material — a mixture of cow's and sheep's milk in a 70:30 ratio — with the only variable being the type of rennet applied.The basic quality parameters of milk as a raw material were analyzed, as well as those of cheese (fat content, proteins, dry matter, salt, pH value, sensory characteristics, and production yield). The results indicated that the cheese produced with traditional animal rennet had a statistically significantly higher fat content (20.88%) and dry matter (39.20%), as well as the best sensory scores (17.73 points – "excellent quality" category) and the most favorable yield (6.0 L/kg). The cheese produced with microbial rennet showed the highest protein content (14.00%) but the lowest sensory scores. Samples produced with industrial animal rennet exhibited intermediate values for all analyzed parameters (17.96% fat, 37.06% dry matter, 16.13 points, 6.36 L/kg). The obtained results provide scientifically grounded recommendations for producers regarding the optimal choice of rennet type, in accordance with the desired technological and sensory characteristics of the final product.

Key words: white brined cheese, rennet, yield, sensory characteristics, chemical composition

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