



Faculty of Agriculture
University of Banja Luka



XIV INTERNATIONAL SYMPOSIUM ON AGRICULTURAL SCIENCES



BOOK OF ABSTRACTS

26-29 May 2025, Trebinje, Bosnia and Herzegovina

XIV International Symposium on Agricultural Sciences "AgroReS 2025"

26-29 May 2025, Trebinje, Bosnia and Herzegovina

BOOK OF ABSTRACTS

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XIV INTERNATIONAL SYMPOSIUM ON AGRICULTURAL SCIENCES

AgroReS 2025



and

XXX CONFERENCE OF AGRICULTURAL ENGINEERS OF THE REPUBLIC OF SRPSKA

26-29 May 2025

Trebinje, Bosnia and Herzegovina

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Symposium Program



SYMPOSIUM PROGRAM OVERVIEW

26-29 May 2025

Monday, 26 May 2025		
12.00 – 19.00	Participant Registration	Hotel <i>Leotar</i> , Lobby
17.00 – 17.30	Opening Ceremony	HET Hall
17.30 – 19.00	Plenary Session	HET Hall
19.00 – 20.00	Welcome Cocktail	Hotel <i>Leotar</i>
Tuesday, 27 May 2025		
08.30 – 17.00	Participant Registration	Hotel <i>Leotar</i> , Lobby
09.00 – 13.30	Session 1: Horticulture	Hotel <i>Leotar</i> , Large Salon
09.00 – 13.00	Session 2: Agricultural Economics and Rural Development	Hotel <i>Leotar</i> , Red Salon
14.00 – 16.00	Lunch Break	
16.00 – 17.30	XXX Conference of Agricultural Engineers of the Republic of Srpska	Hotel <i>Leotar</i> , Large Salon
20.00 – 22.00	Tour of the City of Trebinje, Wine Evening	
Wednesday, 28 May 2025		
08.30 – 17.00	Participant Registration	Hotel <i>Leotar</i> , Lobby
09.00 – 13.30	Session 3: Crop Science	Hotel <i>Leotar</i> , Large Salon
09.00 – 12.30	Session 4: Animal Science	Hotel <i>Leotar</i> , Red Salon
14.00 – 16.00	Lunch Break	
16.00 – 18.00	Round Table: Rural development as perceived by young people: sociological, demographic and economic aspects	Hotel <i>Leotar</i> , Large Salon
20.00	Gala Evening	Hotel <i>Leotar</i> , Restaurant
Thursday, 29 May 2025		
09.00 – 12.00	Excursion: Visit to the “Agrofin” Vineyard and Tvrdoš Monastery	

Monday, 26 May 2025

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
- Savo Minić, Minister of Agriculture, Forestry and Water Management of the Republic of Srpska
- Željko Budimir, 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 SESSION

HET Hall

17.30 – 18.00 *Francois Stefanus Lategan*

PL_01

AGRI-TECHNICAL KNOWLEDGE, ADVISORY COMPETENCE AND THE FUTURE OF SUSTAINABILITY IN FARMING SYSTEMS

18.00 – 18.30 *Jiří Sedlák*

PL_02

MODERN TRENDS IN POME AND STONE FRUIT GROWING

18.30 – 19.00 *Vladan Bogdanović, Dragan Stanojević, Nikolija Gligović*

PL_03

EXTREME WEATHER EVENTS AND LIVESTOCK PRODUCTION: CASE OF HEAT STRESS IN MILK PRODUCTION – SHOULD WE BE CONCERNED?

19.00 – 20.00 WELCOME COCKTAIL

Leotar Hotel

Tuesday, 27 May 2025

Session 1

HORTICULTURE

Leotar Hotel, Large Salon

Moderators: Jiří Sedlák, Slađana Marić, Dushko Nedelkovski

9.00 - 9.10

Nataša Čereković, Nataša Lukić

O1_01

ENHANCING CROP RESILIENCE TO CLIMATE CHANGE, ADAPTATIONS AND SOLUTIONS

9.10 - 9.20

Sanja Radičević, Ivana Glišić, Slađana Marić, Milena Đorđević, Nebojša Milošević, Radosav Cerović, Melpomena Popovska

O1_02

CHARACTERIZATION OF AUTOCHTHONOUS BALKAN SWEET CHERRY GENOTYPES FOR TEMPERATURE-ADAPTABLE REPRODUCTIVE BEHAVIOUR

9.20 - 9.30	<i>Miljan Cvetković, Danilo Vidović</i>
O1_03	MULTI-AXIS TRAINING SYSTEMS – THE END OF SPINDLE DOMINANCE IN PEAR CULTIVATION?
9.30 - 9.40	<i>Nataša Čereković, Mirela Kajkut Zeljković, Vanja Daničić</i>
O1_04	UNDERSTANDING THE RESPONSE OF FRUIT CROPS TO DROUGHT STRESS AND IRRIGATION NEEDS UNDER CLIMATE CHANGE CONDITIONS
9.40 - 9.50	<i>Miljan Cvetković, Marija Ilić, Silva Grobelnik Mlakar</i>
O1_05	APPLES PUT TO THE TEST OF CHILDREN'S TASTE: WHICH VARIETIES PASS, AND WHICH DO NOT?
9.50 - 10.00	<i>Stefan Gligorić, Nenad Magazin, Maja Milović, Jelena Kalajdžić, Gordana Barać, Biserka Milić</i>
O1_06	EFFECT OF BIOREGULATORS ON LEAF MORPHOLOGY AND NUTRIENT COMPOSITION IN SOUR CHERRY
10.00 - 10.10	<i>Aleksandar Piperevski, Biljana Balabanova</i>
O1_07	PHYSICO-CHEMICAL EVIDENCE OF SOIL QUALITY FROM SOUTHEASTERN PART OF THE OVČE POLE WINE REGION
10.10 - 10.20	<i>Viktor Rajchin, Dushko Nedelkovski, Marija Gjoseva Kovachevikj, Milena Taseska-Gjorgijevski, Goran Milanov, Klime Beleski, Despina Popovska Stojanov</i>
O1_08	TRADITIONAL VS. MODERN DISTILLATION AND THE EFFECTS ON CHEMICAL COMPOSITION OF RAKIJA
10.20 - 10.45	Discussion
10.45 - 11.00	Coffe Break
11.00 - 13.00	Poster Presentations: P1_01 – P1_45
13.00 - 13.30	Discussion

Session 2

AGRICULTURAL ECONOMICS AND RURAL DEVELOPMENT

Leotar Hotel, Red Salon

Moderators: Gordana Rokvić Knežić, Lovro Sinković, Marija Goševska Kovachevikj

9.00 - 9.10	<i>Marija Gjoseva Kovachevikj, Vesna Mrdalj, Despina Popovska Stojanov, Marin Cagalj, Lazo Dimitrov</i>
O2_01	AGRI-FOOD IMPORT DEPENDENCY AND CERTAIN DETERMINANTS IN THE CONTEXT OF THE EU INTEGRATION PROCESSES: EVIDENCE FROM BOSNIA AND HERZEGOVINA, NORTH MACEDONIA AND CROATIA
9.10 - 9.20	<i>Lazo Dimitrov, Marija Gjoseva Kovachevikj, Sreten Andonov, Bodan Andonov, Vesna Mrdalj, Sasho Kjosev</i>
O2_02	INTERNATIONAL MARKETS INFLUENCE ON COW'S MILK IN THE REPUBLIC OF NORTH MACEDONIA

9.20 - 9.30 O2_03	<i>Črtomir Rozman, Karmen Pažek</i> WEATHER INFLUENCE ON YIELD, SUGAR CONTENT AND MARKET VALUE OF SUGAR BEET
9.30 - 9.40 O2_04	<i>Sebastian Stepień, Ivo Zdráhal</i> SUSTAINABILITY AND ITS DETERMINANTS FOR FARMS PARTICIPATING AND NOT PARTICIPATING IN SHORT FOOD SUPPLY CHAINS - COMPARATIVE ANALYSIS FROM POLAND
9.40 - 9.50 O2_05	<i>Blagoje Paunović, Nebojša Novković, Sandra Pauljev</i> MODELING THE DEVELOPMENT GOALS OF AGRICULTURAL FARMS USING THE DELPHI METHOD
9.50 - 10.00 O2_06	<i>Gordana Rokvić Knežić, Ljiljana Drinić</i> NEEDS ASSESSMENT OF GENDER MAINSTREAMING IN AGRICULTURE AND RURAL DEVELOPMENT OF BOSNIA AND HERZEGOVINA
10.00 - 10.10 O2_07	<i>Aleksandar Ostojić, Željko Vaško, Gordana Rokvić Knežić, Nemanja Jalić</i> SPATIAL DISTRIBUTION OF THE YOUNG POPULATION IN THE REPUBLIC OF SRPSKA
10.10 - 10.20 O2_08	<i>Željko Vaško, Nemanja Jalić, Gordana Rokvić Knežić, Aleksandar Ostojić</i> PREFERENCES OF YOUNG FARMERS IN THE REPUBLIC OF SRPSKA
10.20 - 10.30 O2_09	<i>Petar Nikolić, Violeta Lemić, Dragan Vučković, Bojan Ćikić, Bojana Petrović, Nemanja Jalić, Borut Bosančić</i> DEVELOPMENT OF MECHANISMS FOR SUCCESSFUL RURAL ACTIVE GENERATIONAL RENEWAL – INITIAL CASE STUDY FOR AGRICULTURAL SECTOR OF THE REPUBLIC OF SRPSKA
10.30 - 10.40 O2_10	<i>Anastasija Grgić, Milana Šešum, Marinko Vekić, Nemanja Jalić, Aleksandar Ostojić</i> ATTITUDES OF YOUNG CONSUMERS TOWARD FARM ANIMAL WELFARE
10.40 - 11.00	Coffee break
<i>Moderators: Nemanja Jalić, Dragana Vidojević, Ivo Zdráhal</i>	
11.00 - 11.10 O2_11	<i>Gajo Prcovic, Anastasija Grgic, Marija Petijevic, Milana Sesum, Borut Bosancic</i> QUALITY AND DIVERSITY OF TRADITIONAL EAST HERZEGOVINA FRUIT DISTILLATES
11.10 - 11.20 O2_12	<i>Oliver Kartheiser, Jakob Weigel</i> AGRI-PHOTOVOLTAICS AS A STRATEGIC RESPONSE TO LAND-USE CONFLICTS IN THE ENERGY-FOOD NEXUS: EVIDENCE FROM THE HyPErFarm PROJECT
11.20 - 11.30 O2_13	<i>Dragana Vidojević, Dragana Drobnjak, Nenad Katanić, Mira Milinković</i> STATUS OF SOILS LINKED TO CLIMATE CHANGE IN AGRICULTURE IN SERBIA
11.30 - 11.40 O2_14	<i>Omaradin Mohammadi, Said Rahmatullah Sadaat</i> SPATIOTEMPORAL STUDY OF LST RESPONSE TO NDVI AND NDBI CHANGES IN KABUL (2000-2025): REMOTE SENSING AND GIS

11.40 - 11.50 O2_15	Said Hedayatullah Sadaat, Muhammad Hassan Muhammadi PARTICULATE MATTER (PM2.5) SPATIOTEMPORAL ANALYSIS AND HEALTH RISK ASSESSMENT OVER KABUL CITY FOR 2024: A REMOTE SENSING AND GIS APPROACH	
11.50 - 12.10	Poster presentations: P2_01 – P2_12	
12.10 - 13.00	Discussion	
16.00 – 17.30	XXX Савјетовање инжењера пољопривреде Републике Српске <i>Будућност стручних скупова у области пољопривреде – Да ли можемо покренути стручни часопис?</i> XXX Conference of Agricultural Engineers of the Republic of Srpska * <i>The future of professional meetings in the field of agriculture - Can we start a professional journal?</i> <i>Leotar Hotel, Large Salon</i> Радно предсједништво: Проф. др Свјетлана Зељковић, проф. др Бранимир Њежић <i>Working Committee: Prof. Dr Svjetlana Zeljković, Prof. Dr Branimir Nježić</i>	
	* This part of the Symposium program is in Serbian.	
16.00 - 16.10	Отварање Савјетовања <i>Проф. др Златан Ковачевић</i>	Opening of the Conference <i>Prof. Dr Zlatan Kovačević</i>
16.10 - 16.20	Првих 30 година Савјетовања пољопривредних инжењера Републике Српске и како даље? <i>Проф. др Синиша Митрић</i>	The first 30 years of Conference of agricultural engineers of the Republic of Srpska and what to do next? <i>Prof. Dr Siniša Mitrić</i>
16.20 - 16.30	Искуства са радионица РЕЗ <i>Проф. др Миљан Цветковић</i>	Experiences from REZ workshops <i>Prof. Dr Miljan Cvetković</i>
16.30 – 16.40	Искуства са стручних савјетовања у организацији компанија <i>Милан Вујановић, Agro Group, Брчко</i>	Experiences from professional consulting in the organization of companies <i>Milan Vujanović, Agro Group, Brčko</i>
16.40 – 17.30	Панел дискусија и закључци <i>Горан Бурсаћ, помоћник министра, Ресор за пружање стручних услуга у пољопривреди</i> <i>Саша Божић, Agrimatco, Бијељина</i> <i>Сања Товарлажа, Мрежа младих агропредузетника, Градишка</i>	Panel discussion and conclusions <i>Goran Bursać, assistant minister, Department for agricultural extension service</i> <i>Saša Božić, Agrimatco, Bijeljina</i> <i>Sanja Tovarlaža, Youth Agripreneurs Network, Gradiška</i>
20:00 - 22:00	Tour of the City of Trebinje Wine Evening	

Wednesday, 28 May 2025

Session 3

CROP SCIENCE

Leotar Hotel, Large Salon

Moderators: Ranko Gantner, Jelena Vukadinović, Vojo Radić

09.00 – 9.10 O3_01	<i>Milosav Babić, Dušan Stanisavljević, Vojka Babić, Tijana Kovačević, Natalia Petrovska, Viliana Vasileva, Emil Vasilev</i> DATA MANAGEMENT PRIOR STATISTICAL PROCESSING IN MULTI ENVIRONMENT YIELD TRIAL ANALYSIS
09.10 – 09.20 O3_02	<i>Dragan Perovic</i> GENETIC RESOURCES OF BARLEY FROM THE BALKANS: VALUABLE ASSETS IN THE ERA OF PAN-GENOMICS AND GENE EDITING FOR MODERN BREEDING
09.20 – 09.30 O3_03	<i>Dragana Božić, Dragan Lazarević, Teodora Tojić, Nikola Radović, Sava Vrbničanin</i> MOLECULAR CONFIRMATION OF RESISTANCE TO ALS INHIBITORS IN <i>Sorghum halepense</i> L. (Pers.)
09.30 – 09.40 O3_04	<i>Markola Saulić, Ivica Đalović, Darko Stojićević, Dragana Božić, Sava Vrbničanin</i> EFFECT OF CROP DIVERSIFICATION ON WEED BIODIVERSITY
09.40 – 10.20	Poster presentations: P3_01 – P3_20
10.20 – 10.40	Discussion
10.40 – 11.10	Coffee break
<i>Moderators: Milosav Babić, Dragana Božić, Borislav Petković</i>	
11.10-11.20 O3_05	<i>Jelena Vukadinović, Jelena Srdić, Snežana Mladenović Drinić, Aleksandar Popović, Vesna Perić, Milan Brankov, Vesna Dragičević</i> HEATING TREATMENTS FOR INCREASING THE PHYTOCHEMICAL CONTENT?
11.20-11.30 O3_06	<i>Natalija Kravić, Violeta Anđelković, Aleksandar Popović, Vesna Perić, Marijenka Tabaković, Vojka Babić</i> MINING MAIZE GENE BANK DIVERSITY FOR DESIRABLE ALLELES
11.30-11.40 O3_07	<i>Ranko Gantner, Vojo Radić, Borislav Petković, Boro Krstić, Gjoko Bunevski, Vesna Gantner</i> PRODUCTION POTENTIAL OF PERMANENT GRASSLANDS IN THE REPUBLIC OF SRPSKA AND RELATED EMPLOYMENT OPPORTUNITIES
11.40-11.50 O3_08	<i>Relja Suručić, Vojo Radić, Duška Delić</i> ANTIOXIDANT POTENTIAL OF WHEATGRASS JUICE FROM THE ANCIENT BRKULJA WHEAT VARIETY: ANTIRADICAL ACTIVITY ANALYSIS AND BIOACTIVE COMPOUND CORRELATION
11.50-12.40	Poster presentations: P3_21 – P3_44
12.40-13.30	Discussion

Session 4

ANIMAL SCIENCES

Leotar Hotel, Red Salon

Moderators: Ksenija Čobanović, Vesna Gantner, Draženko Budimir

9.00 - 9.10 O4_01	<i>Vesna Gantner, Zvonimir Steiner, Biljana Rogić, Ranko Gantner, Denis Kučević</i> ARTIFICIAL MEAT: THE STORY BEHIND – INNOVATION OR ILLUSION?
9.10 - 9.20 O4_02	<i>Neđo Stokanović, Denis Kučević, Marija Klopčič</i> ASSESSMENT OF MICROCLIMATE AND GREENHOUSE GAS EMISSIONS IN DAIRY FARMS
9.20 - 9.30 O4_03	<i>Anja Duvnjak, Ksenija Čobanović, Petra Mohar Lorbeg, Borut Kolenc, Marija Klopčič</i> MILK COAGULATION PROPERTIES OF THREE CATTLE BREEDS
9.30 - 9.40 O4_04	<i>Vesna Gantner, Franjo Poljak, Boris Ljubojević, Zvonimir Steiner, Ranko Gantner</i> PREVALENCE, PERSISTENCE, AND COSTS OF ACIDOSIS IN HOLSTEIN COWS ACROSS BREEDING REGIONS
9.40 - 9.50 O4_05	<i>Boris Ljubojević, Zvonimir Steiner, Nini Mačesić, Dragan Solić, Vesna Gantner</i> VARIABILITY OF MILK PRODUCTION TRAITS AND THE MASTITIS PREVALENCE IN SIMMENTAL COWS CONSIDERING BREEDING REGION
9.50 - 10.00 O4_06	<i>Damir Rimac, Dušan Gajić, Vojislav Marjanović</i> IMPROVING PIGLET'S PRODUCTION: STRATEGIES FOR ANTIBIOTIC-FREE PRODUCTION
10.00 - 10.10 O4_07	<i>Milica Čutković, Rogić Biljana, Božo Važić, Slađana Preradović</i> MORPHOMETRIC DESCRIPTION OF THE BORIC ARABIAN HORSE MARE FAMILIES
10.10 - 10.20 O4_08	<i>Branimir Vidović, Ljuba Štrbac, Momčilo Šaran, Snežana Trivunović, Minja Zorc, Peter Dovč</i> MITOCHONDRIAL DNA ANALYSIS AND PHYLOGENETIC TREE CONSTRUCTION OF MATERNAL LINES IN LIPIZZAN HORSES
10.20 - 10.40	Coffee break
10.40 - 10.50 O4_09	<i>Katarina Pandžić, Vesna Gantner, Ksenija Duka, Nikola Raguž, Zvonimir Steiner</i> DETECTION OF GENETICALLY MODIFIED ORGANISMS IN BIO PRODUCTS ON THE CROATIAN MARKET
10.50 - 11.00 O4_10	<i>Doris Oračić, Mirko Ivković, Ksenija Čobanović, Dragan Glamočić</i> THE ROLE OF PHYSICAL STRUCTURE IN RUMINANT NUTRITION
11.00 - 11.10 O4_11	<i>Miroslava Polovinski Horvatović, Saša Krstović, Marko Vukadinović, Dejan Beuković, Mirko Ivković, Igor Jajić, Miloš Petrović</i> THE USE OF LIGNIN AS A MARKER IN A DIGESTIBILITY TRIAL ON TENEBRIO MOLITOR INSECT LARVAE

11.10 - 11.20 O4_12	<i>Ana Rita Inácio, Maria João Carvalho, Liliana Fidalgo, Flávia Silva, Manuela Costa, Célia Lampreia, Fernanada Fragoso, Rafaela Fantatto, Daniel Murta, Nuno Sidónio Pererira, Silvina Ferro Palma</i> TRADITIONAL PORTUGUESE CUSTARD TARTS AND ALTERNATIVE INNOVATIVE PROTEIN SOURCES -INSECTS
11.20 - 11.30 O4_13	<i>Zvonimir Steiner, Stipo Benak, Ranko Gantner, Vlatko Klisurić, Vesna Gantner</i> INFLUENCE OF SOLID FEED, LACTOSE, AND PROTEIN QUALITY ON CALF GROWTH AND RUMEN DEVELOPMENT
11.30 - 11.40 O4_14	<i>Dragan Dokić, Vesna Gantner</i> LIVESTOCK PRODUCTION AS A POTENTIAL FOR INTERNATIONAL TRADE EXCHANGE, THE CASE OF THE REPUBLIC OF CROATIA
11.40 - 12.00	Poster presentations: P4_01 – P4_13
12.00 - 12.30	Discusion
16:00 - 18:00	Round Table Rural Development as perceived by young people: sociological, demographic and economic aspects * <i>Leotar Hotel, Large Salon</i> <i>Moderator: Predrag Ćurković</i> <div>* This part of the Symposium program is in Serbian.</div>
20:00	Gala Evening <i>Leotar Hotel, Restaurant</i>

Thursday, 29 May 2025

09:00 - 12:00	Excursion Visit to the “Agrofin” Vineyard and Tvrdoš Monastery
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P1_02	<i>Anđela Ljujić, Đina Božović, Vučeta Jaćimović, Miroslav Čizmović</i> PHENOLOGICAL CHARACTERISTICS OF SOME CHERRY VARIETIES IN THE PODGORICA REGION (MONTENEGRO)
P1_03	<i>Vera Rakonjac, Dragan Nikolić, Slavica Čolić, Ivana Glišić, Milena Đorđević, Melpomena Popovska, Sanja Radičević</i> POLLEN ULTRASTRUCTURE CHARACTERIZATION IN SWEET CHERRY GENOTYPES
P1_04	<i>Zlatan Ristić, Marina Antić, Boris Pašalić, Mirjana Žabić, Borut Bosančić, Sonja Umičević, Predrag Ilić</i> CALCIUM EFFECT ON THE POMOLOGICAL PROPERTIES OF CHERRY FRUITS – MEASURING OF FRUIT FIRMNESS
P1_05	<i>Mira Milinković, Svetlana M. Paunović, Aneta Buntić, Magdalena Knežević, Jelena Pavlović, Vojislav Lazović, Dragana Vidojević</i> THE EFFECT OF MICROBIOLOGICAL FERTILIZER APPLICATION ON THE QUALITY OF APPLE FRUITS
P1_06	<i>Viktor Gjamovski, Goran Barac, Katerina Bandjo Oreshkovikj, Biljana Drvoshanova, Afrodita Ibushoska</i> GENETIC DIVERSITY OF MACEDONIAN AUTOCHTHONOUS APPLE ACCESSIONS
P1_07	<i>Sladana Marić, Sanja Radičević, Viktor Gjamovski, Ivana Glišić, Nebojša Milošević, Milena Đorđević, Bojana Banović Đeri</i> NEW S-ALLELES IDENTIFIED IN SWEET CHERRY CULTIVARS OF AUTOCHTHONOUS ORIGIN IN THE BALKAN COUNTRIES
P1_08	<i>Božana Odžaković, Pero Sailović, Darko Bodroža, Zoran Kukrić, Vesna Kojić, Dimitar Jakimov</i> TREASURES FROM NATURE: WILD CORNELIAN CHERRY AS A SOURCE OF NUTRIENTS AND ANTIOXIDANTS
P1_09	<i>Žaklina Karaklajić-Stajić, Svetlana M. Paunović, Jelena Tomić, Aleksandar Lepasavić, Boris Rilak, Marijana Pešaković</i> IMPACT OF FREEZING AND FREEZE-DRYING PROCESSES ON PHYTOCHEMICAL CONTENTS AND ANTIOXIDANT CAPACITY OF BLACKBERRY FRUIT
P1_10	<i>Boris Rilak, Jelena Tomić, Ivan P. Glišić, Žaklina Karaklajić-Stajić, Svetlana M. Paunović, Marijana Pešaković, Tatjana Anđelić</i> QUALITY MONITORING OF APPLE FRUIT DURING LONG-TERM COLD STORAGE
P1_11	<i>Gordana Barać, Nenad Magazin, Žarko Kevrešan, Jasna Mastilović, Biserka Milić, Jelena Kalajdžić, Maja Milović, Aleksandra Bajić</i> EFFECTS OF MODIFIED ATMOSPHERE PACKAGING (MAP) AND 1-METHYLCYCLOPROPENE (1-MCP) ON FRUIT QUALITY OF PLUM

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P1_16	<i>Biljana Korunoska, Vladan Pešić, Nenad Bunjac</i> TESTING THE GERMINATION OF SEEDS OBTAINED FROM HYBRIDIZATION OF SOME GRAPEVINE VARIETIES AS A BASIS FOR OBTAINING YOUNG SEEDLINGS
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Plenary session



PL_01

Agri-technical Knowledge, Advisory Competence and the Future of Sustainability in Farming Systems

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Abstract

The future of sustainable farming systems hinges on the seamless integration of agricultural economic skills, agro-technical knowledge, and enhanced advisory competence. Agricultural advisory services are crucial in addressing farmers' challenges in a time of increasing food demand driven by population growth. A comprehensive approach to agricultural advisory services, emphasising participatory methods, is essential to fostering innovative and sustainable practices, particularly in engaging underrepresented female farmers. Agricultural Knowledge and Information Systems (AKIS) provide farmers with important market information, policy awareness, and decision support, thus enhancing their adaptive capacity to navigate rapid changes. Agricultural advisors with diverse skill sets - including diagnostic, communication, and problem-solving abilities - are necessary to promote innovation and boost productivity. Furthermore, the importance of gender-sensitive strategies within advisory services illustrates how female advisory agents can effectively tackle the unique challenges women farmers face. By cultivating trust and encouraging inclusive participation, these agents will not only contribute to gender equality but also facilitate collective resource management. Drawing on holistic scientific principles inspired by Albert Einstein - such as curiosity, freedom of thought, and empirical validation - it is argued that empowering agricultural advisors with robust skills and knowledge is fundamentally important. By enhancing agricultural advisory services and prioritising sustainable practices, a resilient agrarian sector will be well-positioned to meet current and future demands while promoting environmental stewardship and social equity.

Key words: sustainable agriculture, agricultural advisory services, gender inclusion, agricultural knowledge and information systems (AKIS), resilient farming

Modern Trends in Stone and Pome Fruit Growing

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Abstract

The cultivation of stone and pome fruits is undergoing transformative changes driven by technological advancements and evolving agricultural demands. Central to these trends is the certification of healthy propagation material, ensuring disease-free and genetically stable plant stock for fruit growers. This practice includes also biotechnological methods of systemic pathogen sanitation and safeguards orchards from mostly virus or phytoplasma pathogens while enhancing yield predictability. Concurrently, the conservation and utilization of genetic resources and gene pools of fruit species are critical for maintaining biodiversity and enabling resilience against climate change and biotic pathogens. Modern breeding programs leverage molecular markers and phenotyping based technologies to accelerate the development of new cultivars with traits such as drought tolerance, pest resistance, and improved postharvest quality. Innovations in plantation management practices focus on resource efficiency and sustainability. Precision agriculture tools, including soil sensors and IoT-enabled irrigation systems, optimize water and nutrient use, reducing environmental burdens. The integration of remote sensing data from drones and satellites offers unprecedented insights into orchard health, enabling early detection of stressors like nutrient deficiencies or pest infestations. Multispectral imagery and AI-driven analytics allow growers to implement targeted interventions, minimizing chemical inputs. Automation is reshaping labor-intensive tasks, with robotic fruit harvesting emerging as a future game-changer. Equipped with computer vision and soft grippers, these systems improve picking efficiency while reducing reliance on seasonal labor. Additionally, autonomous pruning and thinning robots enhance canopy management, promoting consistent fruit quality. Together, these advancements underscore a shift toward data-driven, ecologically conscious environment friendly fruit production. By harmonizing cutting-edge technologies with robust genetic stewardship, the industry is poised to meet global food security challenges while aligning with sustainable development goals. Future efforts must prioritize stakeholder collaboration and policy frameworks to scale these fruit growing innovations effectively.

Key words: biotechnology, genetic resources and gene pools of fruit species, breeding of new cultivars, innovations and modern agrotechnical practices, precision agriculture, application of remote sensing data (via drones and satellites) in fruit farming, robotic fruit harvesting

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Extreme Weather Events and Livestock Production: Case of Heat Stress in Milk Production – Should We be Concerned?

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Abstract

In recent decades, and particularly in recent years, the Western Balkans have been increasingly affected by extreme weather events, including prolonged droughts, extended periods of exceptionally high temperatures, and short but intense storms, all of which pose significant risks due to their potential for damage. In livestock farming, temperature levels have become a primary concern in recent years, as this climatic factor is the key driver of what is known as „heat stress“. In Serbia, dairy farming is primarily carried out by family-run farms with long-standing traditions, with small and medium-sized farms making up the majority. Regardless of farm size or production intensity, all dairy operations are vulnerable to the effects of heat stress. To assess the prevalence and severity of heat stress in dairy farming, microclimatic data were collected from 14 cattle farms across Serbia between 2014 and 2022. These measurements were recorded hourly, resulting in a dataset of over 650000 records detailing temperature and relative humidity levels within the barns. A striking trend observed in this data is the extended duration of heat stress (THI>72), which begins as early as mid-May and continues until mid-September. Additionally, during this period, the most critical hours for HF farms are between 09:00 in the morning and 21:00 in the evening, whereas Simmental farms experience an even longer risk period, lasting from 09:00 in the morning until 03:00 the following day. The likelihood of heat stress is particularly pronounced on medium-sized farms. Farmers often attempt to increase milk production by expanding their herd sizes, but this growth is not always accompanied by necessary adjustments to barn capacity. It is crucial for farmers to learn how to adapt to the challenges posed by climate change and extreme weather events to ensure the sustainability of their dairy operations.

Key words: climate change, dairy cattle, dairy farm, dairy production

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Session 1: Horticulture

Oral Presentations



Enhancing Crop Resilience to Climate Change, Adaptations and Solutions

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Abstract

Climate change poses a significant threat to global food security, with extreme weather events leading to reduced crop yields across agricultural systems. The sexual reproduction processes of these crops, sensitive to abiotic stresses such as temperature extremes and drought, face increasing risks under shifting climate conditions. This work aims to address these challenges by exploring innovative strategies to enhance crop resilience through advancements in genetics, genomics, chemical solutions, and precision agriculture. The initiative seeks to enhance crop resilience by leveraging advancements in genetics, cutting-edge genomic technologies, innovative chemical solutions, and precision agriculture. Key research areas include the critical role of reproductive processes in crop resilience; the effect of climate factors - particularly temperature and drought on reproductive success, and molecular approaches to bolster reproductive resilience under stress. Additionally, the research investigates agronomic techniques to adapt crops to changing environmental conditions, the role of chemistry to optimize reproductive resilience, and the application of artificial intelligence, machine learning, and deep learning technologies in strengthening crop resilience. By synthesizing current knowledge and integrating cutting-edge technologies, this initiative seeks to offer a holistic understanding of how agricultural practices and technologies can improve crop reproductive capacity under extreme climate conditions and ensure sustainable food production in the face of extreme climate conditions.

Key words: drought, temperature, genetics, reproductive, resilience

Acknowledgment

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Characterization of Autochthonous Balkan Sweet Cherry Genotypes for Temperature-Adaptable Reproductive Behavior

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Abstract

Sweet cherry is among the most popular temperate fruit crops due to the attractiveness of its fruits, their nutritive value and beneficial health effects, and their suitability for fresh consumption and processing. The reproductive phase is susceptible to temperature stress that, at blooming time, has a detrimental effect on fruit set in commercial sweet cherry orchards. Diversity plays a crucial role in adapting sweet cherries to environmental changes, making autochthonous genotypes exhibiting tolerance essential sources of potential temperature-tolerance genes. Within the CherrySeRB project, led by Fruit Research Institute, Čačak along with several partner institutions, the focus was characterizing autochthonous Balkan sweet cherry genotypes for desirable reproductive properties that can face warmer temperature conditions during the flowering. Our study aimed at the reproductive characterization of autochthonous sweet cherry cultivars originated from Serbia ('Canetova' and 'G-2') and North Macedonia ('Dolga Šiška' and 'Ohridska Crna'), and six commercial cultivars – potential pollinizers ('Burlat', 'Lapins', 'Kordia', 'Rita', 'Summit', and 'Sunburst'). Pollination experiments were performed at three Balkan localities (Čačak, Belgrade, and Ohrid) over two flowering seasons, with the fluorescence microscopy method used to assess the reproductive behavior of both autochthonous genotypes and pollinizers. The later-flowering 'Ohridska Crna' demonstrated the best adaptability to higher temperatures in terms of primary ovule longevity. This reproductive feature should be the basis for designing successful cultivar compositions in cherry orchards, with pollinizers chosen to support the main cultivars, considering various pollen-pistil interactions and fertilization efficiency. Such an approach can also facilitate the targeted use of well-adapted, high-quality fruited genotypes to develop new cherry cultivars that can respond to the challenges of global warming in the reproductive sense. The findings on male-female relationships and their temperature dependence open up possibilities for yield prediction and smart horticultural decisions to guide cherry production.

Key words: *Prunus avium* L., landraces, flowering temperature, fertilization efficacy, fruit set

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Multi-axis Training Systems – The End of Spindle Dominance in Pear Cultivation?

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Abstract

In Bosnia and Herzegovina, ‘Williams’ is the leading variety, primarily cultivated on wild pear seedlings due to specific soil conditions and compatibility with quince-type rootstocks. It is mostly trained in the spindle form, with varying degrees of success. Despite a lower level of innovation in variety development, various pear orchard systems have been developed worldwide, ranging from low to ultra-high planting densities. The possibility of using rootstocks with different levels of vigor, along with the pear’s inherent plasticity, allows for the formation of trees in various training systems. The choice of training system must be adapted to the variety’s characteristics to avoid drastic pruning interventions and delays in the onset of fruiting. Multi-axis training systems represent an innovation in pear cultivation and, regardless of modifications, are based on a two-dimensional tree architecture. To assess the feasibility of growing pears in multi-axis systems, a study was conducted in 2024 on the experimental farm of the Faculty of Agriculture, using the varieties ‘Williams’, ‘Butira’, and ‘Clapp’s Favorite’. The orchard was established in 2019 on wild pear seedling rootstock. All varieties were trained in the Bi-baum system, while ‘Williams’ was also trained in the Guyot system. The spindle form was used as the control training system. During the study, the number of fruits per tree, yield per tree and per unit area, as well as pomological fruit characteristics (fruit weight, height, length, and soluble solids content), were examined. In ‘Williams’ and ‘Butira’, multi-axis training systems resulted in a significantly higher yield per unit area compared to the spindle, while in ‘Clapp’s Favorite’, the yield was similar to that obtained with the spindle system. The marketability of the fruits of all varieties was higher in multi-axis training systems compared to the spindle.

Key words: spindle, Bi-baum, Guyot, yield, quality

01_04

Understanding the Response of Fruit Crops to Drought Stress and Irrigation Needs under Climate Change Conditions

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Abstract

Understanding the response of fruit crops to drought stress and irrigation needs under climate change conditions. Climate change has significantly altered weather patterns, increasing the frequency and intensity of drought events and posing serious challenges to agricultural production, particularly for fruit crops. Water scarcity and increased evapotranspiration demands, posing critical challenges to global agriculture and threatening the sustainability of fruit crop production. Understanding the response of fruit crops to drought stress and their specific irrigation needs is essential for developing resilient and sustainable cultivation systems. This work aims to consolidate existing research and provide a comprehensive analysis of strategies to mitigate the impacts of water scarcity on fruit crops. The paper focuses on the following key areas: (1) evaluating the growth and performance of fruit crops across diverse environments and cultivation methods; (2) assessing the water needs of fruit crops, including evapotranspiration rates, crop coefficients, and strategies for efficient water use; (3) identifying and recommending the most effective irrigation methods; (4) exploring advanced tools for real-time monitoring of plant water status; and (5) comparing and evaluating existing models for quantifying plant water requirements under drought conditions, with an emphasis on their potential integration into decision support systems (DSS). By addressing these critical aspects, it aims to provide actionable insights and foster the adoption of innovative irrigation and water management strategies to support sustainable fruit crop production in the context of climate change.

Key words: climate, fruits, irrigation, evapotranspiration, decision

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01_05

Apples put to the Test of Children's Taste: Which Varieties pass, and which do not?

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Abstract

Apple consumption per capita in Bosnia and Herzegovina is at a low level, similar to the situation in some leading European fruit-growing countries. The main reasons for this include the aging consumer population, low household incomes, high apple prices in markets, dissatisfaction with the quality of available varieties, and the perception that apples offer fewer health benefits compared to other fruit types. Consumer habits are formed at an early age, making their development during childhood crucial for the long-term increase in apple consumption. To assess children's preferences for apples, a sensory evaluation of six apple varieties available on the Banja Luka market was conducted. The study involved 40 primary school students, aged 10 years (25 boys and 15 girls). The evaluation covered external characteristics (size, shape, and color) and internal attributes (firmness, texture, juiciness, and taste) of the Red Delicious, Golden Delicious, Granny Smith, Story, Idared, and Gala varieties. Ratings were given on a scale from 1 (lowest) to 5 (highest). The results showed that the highest ratings for both external and internal characteristics were given to Golden Delicious, Story, and Granny Smith. The Idared variety was rated higher than Gala and Red Delicious. Participants preferred apples that were distinctly colored, oblate-conical in shape, and medium to large in size. Additionally, they showed a preference for apples with a well-balanced taste, slightly tart notes, firm and crisp flesh, and pronounced juiciness. These findings provide valuable insights into children's preferences and can aid in adjusting apple production and marketing strategies to better appeal to younger consumers.

Key words: perception, consumption, quality, evaluation

Effect of Bioregulators on Leaf Morphology and Nutrient Composition in Sour Cherry

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Abstract

To regulate excessive tree growth of sour cherry cv. *Oblačinska* grafted on generative mahaleb (*Prunus mahaleb* L.) rootstock, bioregulators have been applied. The aim of this study was to examine the impact of bioregulators on leaf morphology (leaf thickness, surface, and petiole length) and the macro- (N, P, K, Ca, Mg) and micro-nutrients (Fe, Mn, Zn, Cu) content. Paclobutrazol was applied through the roots (PBZ-R at 0.4, 0.7, 1.3 L ha⁻¹) and as a foliar treatment (PBZ-F at 1.0, 1.5, 2.0 L ha⁻¹). Prohexadione-calcium (PRO-Ca) was applied foliarly at 1.0, 1.25, 1.5 kg ha⁻¹. The treatments were applied in 2023 and 2024 on different tree rows. Leaves for leaf morphology were collected in 2024 from 2023 and 2024 treated trees, while the nutrient content analysis was performed only on 2024 treated trees. For 2023 treated trees, the highest leaf thickness was determined at the lowest concentration of PBZ-R, while the lowest leaf thickness was at the highest concentration of PBZ-R. The longest petiole length was measured at PBZ-R and PRO-Ca-F at lower concentrations. In the PBZ-R treatment at the highest concentration, a significant reduction in leaf surface compared to the untreated control was recorded. For 2024 treated trees, the highest leaf thickness was recorded in PBZ-R and PRO-Ca-F treatments, while the lowest was in the control group. The largest leaf surface was observed in PBZ-F at the highest concentration (19.63 cm²), while the smallest was observed in PBZ-R at the lowest concentration (12.99 cm²). PBZ-F treatments increased the content of P, Ca, and Fe, while PRO-Ca-F reduced their content. PRO-Ca-F increased Mn levels, while PBZ-F decreased them. PBZ-F also increased Zn content, while PBZ-R reduced it. These results point to the significant influence of growth retardants on leaf morphology and nutrient content in sour cherry leaves.

Key words: paclobutrazol, prohexadione-calcium, petiole length, leaf thickness, leaf surface area, growth retardants

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01_07

**Physico-chemical Evidence of Soil Quality from Southeastern part of
the Ovče Pole Wine Region**

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Abstract

This study summarizes the physico-chemical analysis of 18 soil samples collected from vineyards in the Southeastern part of the Ovče Pole wine region. The samples were collected from three different locations at the depth of 0-30 cm to determine their chemical, structural and nutritional properties. Basic soil parameters were analyzed, including pH, electrical conductivity (EC), organic carbon (OC), organic matter (OM), moisture, and carbonate (CaCO₃) content. Additionally, the analysis of macronutrients (N, P, K) and microelements was measured using (ICP-MS) technique. To determine the soil type, a structural analysis was performed. From the obtained results it can be observed that the soil is slightly alkaline (pH values range from 7,1 to 8,6), with moderate organic matter content and low nitrogen levels (average 1,10 g/kg). The carbonates content varies in the range of 0,31-40,8%. Phosphorus and potassium content varies between location in ranges from 24,5-50,1 mg/100g for K and from 8,44-42,9 mg/100g for P, while the content of microelements suggest potential limitation in the availability of certain essential nutrients. The soil in the studied region is moderately structured (varies from sandy soil to silty clay loam) which affects its water permeability and ability to retain nutrients. This analysis provides valuable information about soil fertility and structure in vineyards in the Southeastern part of the Ovče Pole wine region, which can be used for optimizing fertilization management and improving sustainable grape production.

Key words: soil, vineyard soil, soil analysis, soil health

Traditional vs. Modern Distillation and the Effects on Chemical Composition of Rakija

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Abstract

This study investigates the impact of traditional and modern distillation approaches on the chemical composition of rakija, a traditional alcoholic beverage in the Balkans. In this paper, we compared rakija made from grapes with traditional distillation, typically performed in traditional alembic copper stills, with modern column stills. The research focuses on the knowledge and experience of home producers, and comparing them with industrial production. Differences in the concentration of key chemical compounds, such as esters, aldehydes, and higher alcohols were analyzed, and were taken into as a benchmark for comparing the quality of the two products. In order to learn more about the producers preferences and methods for distillation, a questionnaire was additionally distributed to them. Questions regarding fermentation, the distillation process, capacity, and equipment used to produce the final product were all covered in the survey. Combined with the chemical analysis, the questionnaire answers gave a clearer picture of the quality of Rakija. The findings show that the presence of chemical compounds is higher using the conventional distillation techniques. The industrial distillation methods, on the other hand, provide more control over the distillation process and produce a product with less impurities. These results expand our knowledge of how distillation techniques affect the chemical content and general quality of rakija.

Key words: rakija, distillation, chemical composition, traditional methods, industrial production

Session 1: Horticulture

Poster Presentations



**Fruit Weight and Primary Metabolites Content of Plum Fruits
as Affected by Planting Density**

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Abstract

An experiment was conducted to evaluate the effect of different dense planting (4×1 m; 4×2 m and 5×3 m) on the fruit weight and contents of primary metabolites (soluble solids, total sugars, invert sugars, total acids, and pH) in the fruits of eight plum cultivars ('Čačanska Rana', 'Čačanska Lepotica', 'Timočanka', 'Krina', 'Mildora', 'Čačanska Najbolja', 'Čačanska Rodna' and 'Stanley'). During the three-year experimental period, results showed variability in fruit weight and chemical composition between different cultivars and planting densities. The highest fruit weight was recorded at the planting distance of 4×2 m in cultivars 'Čačanska Rana', 'Čačanska Lepotica', 'Krina', 'Mildora' and 'Čačanska Najbolja', while the cultivars 'Timočanka', 'Čačanska Rodna' and Stanley' had the highest value at the standard distance of 5×3 m. Regarding primary metabolites, in all tested cultivars, the accumulation and synthesis of soluble solids and sugars in the fruit increased with increasing planting density, while pH and total acids showed the opposite trend. The present results indicated that different planting densities have an important effect on fruit weight and plant metabolism, promoting the synthesis and accumulation of primary metabolites in the fruits, thus positively affecting the quality and commercial value of the fruit.

Key words: plum, planting density, fruit weight, primary metabolites

Acknowledgment

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**Phenological Characteristics of Some Cherry Varieties in
the Podgorica Region (Montenegro)**

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Abstract

The phenological characteristics of newly introduced cherry varieties in the Podgorica region were studied to determine their adaptability to local climatic conditions. The study included eight cherry varieties with different terms of ripening: Rita, Valery Chkalov, Burlat, New Star, Summit, Sunburst, Linda and Katalin. All varieties were grafted onto the generative rootstock of magriva (*Prunus mahaleb* L.). Among the phenological characteristics, the onset of vegetation, flowering time and ripening time were observed. The studies were carried out on trees randomly selected during the 2021 growing season. Among the varieties tested, the earliest onset of vegetation, flowering and fruit ripening was observed in the Rita variety and the latest in the Katalin variety. The difference for the onset of vegetation between the earliest (Rita) and the latest variety (Katalin) was 33 days. The range for the end of vegetation between the earliest (Rita) and the latest variety (Katalin) was 39 days. Transitional Mediterranean climate in Podgorica region caused earlier start of vegetation. Frost caused problematic flowering in Rita variety. Due to risk of spring frost causing flower bud freezing, early varieties are not recommended for cultivation in this region. These results can help producers to optimize the choice of varieties according to climate conditions and to better plan agricultural measures that optimize resource usage and reduce production costs.

Key words: cherry, phenology, Podgorica region, flowering, fruit ripening

Pollen Ultrastructure Characterization in Sweet Cherry Genotypes

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Abstract

To increase sweet cherry production, it is essential to develop and introduce new cultivars. Success in this effort depends on prior germplasm characterization, a crucial step in selecting genotypes for the breeding process. The aim of this study was to examine the dimensions, shape and surface morphology of pollen grains from various sweet cherry genotypes by scanning electron microscopy (SEM) in order to develop an additional alternative identification tool. Pollen grains of ten sweet cherry genotypes were analyzed, including one cultivar released in Republic of Serbia ('Canetova'); six introduced cultivars ('Burlat', 'Kordia', 'Lapins', 'Rita', 'Summit', 'Sunburst') and three local/autochthonous genotypes from Balkan region ('G-2', 'Dolga Šiška', 'Ohridska Crna'). For each genotype, the following characteristics were determined: pollen length (L), pollen width (W), L/W ratio, colpus length (CL), colpus width (CW), mesocolpium width (MW), number of ridges per 100 μm^2 of exine surface (NR), ridge width (RW), and furrow width (FW). All genotypes had elliptical, tricolpate pollen grains and striate exine ornamentation, with more parallel longitudinal ridges. Based on the coefficients of variation (CV), it can be noticed that characteristics related to pollen size showed lower variability (CV=1.7–4.3%) compared with exine characteristics (CV=5.5–12.1%). Principal component analysis (PCA) revealed that PW, L/W, MW, RW and NR are relevant tools to discriminate among the genotypes studied. The distribution of genotypes along PC1/PC2 scatter plot showed that there is considerable variation among them. Although measurements on pollen grains did not reveal individually big differences, when all characteristics were considered together, pollen of each genotype showed a unique pattern. This suggests that pollen grain morphology is to a large extent genetically determined which may be of great importance for the genotype characterization.

Key words: PCA, pollen morphology, *Prunus avium* L., SEM

Acknowledgment

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**Calcium Effect on The Pomological Properties of Cherry Fruits
– Measuring of Fruit Firmness**

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Abstract

Growing interest for the commercial production of sweet cherries around the world has stimulated research on the potential for supplementary applications of calcium (Ca) as a way to mitigate the risk of catastrophic loss, to improve fruit quality and to extend postharvest shelf life. The goal of this study was to examine the effect of calcium application on the pomological properties of two cherry varieties, with an emphasis on the fruit hardness parameter. The experiment was set up in a intensively cultivated cherry orchard, in the locality Jablanica, municipality of Gradiška. Spraying treatment with the preparation Calcinit was performed by using backpack atomizer Stihl SR 420, on three cherry trees of each variety. The age of cherry trees is 11 years. Bing and New Starr are varieties which were included in this experiment. Firmness of fruit flesh was determined by using table penetrometer type FT 327, with impact needle diameter of 3 mm, with a measuring scale on which penetration force is read in kg/cm². In time of harvest, samples were taken from the treatment and control cherry trees, after which they were transported to the laboratory for analysis. Fruit firmness measurements indicate that the average value for the Bing variety was 0.95 kg/cm², samples of New Starr variety show an average value of 0.80 kg/cm², while for the control samples, the average value of fruit hardness was 0.69 kg/cm². This indicates the importance of using calcium-based preparations in cherry production, because in addition to higher fruit firmness values, it can be concluded that other fruit quality parameters can be improved.

Key words: sweet cherries, calcium, fruit firmness

Acknowledgment

This research was supported by the Ministry of Scientific and Technological Development, Higher Education and Information Society of the Republic of Srpska, as part of the scientific-research project, entitled "Examination of the effect of cherry fruit treatment, with the aim of improving quality, suppressing fruit cracking and conditioning them for longer storage, with hormonal and mineral preparations".

The Effect of Microbiological Fertilizer Application on the Quality of Apple Fruits

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Abstract

The influence of the application of microbiological fertilizer on the quality of apple fruits: 'Granny Smith', 'Red Chief', 'Idared', 'Golden Delicious' in the Topola area (Republic of Serbia) was investigated. The uptake of macrolelements, microelements and some heavy metals in the fruits of the above apple varieties was monitored. The application of microbiological fertilizers in apple plantations influenced the higher uptake of P, Mg, K in 'Granny Smith', and the content of Ca and Na increased in the fruits of all other tested varieties compared to untreated plantations. Increased uptake of Mn and Fe was also determined, relative to the content of Cu. Compared to previous results, the application of microbiological fertilizers affected the reduction of Pb, Ni, Cr uptake. The ratio of K/Ca and K+Mg/Ca, which affects the preservation of fruit firmness in storage, was significantly more favorable in the treatments of 'Red Chief' and 'Idared'. The application of microbiological fertilizers favorably affected the quality of apple fruits, and the influence of agroecological growing conditions and assortment on the obtained research results was also noticeable.

Key words: apple, microbiological fertilizers, macro and microelements, heavy metals

Acknowledgment

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (grant number 451-03-136/2025-03/200011 and 451-03-136/2025-03/200215) and by Biofor System d.o.o.

Genetic Diversity of Macedonian Autochthonous Apple Accessions

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Abstract

Apple (*Malus x domestica* Borkh.) is one of the economically most important and widespread fruit plants grown in Macedonia. It is widely distributed all over the country. Throughout the centuries of cultivation, many autochthonous populations have been observed in different regions of the country, but molecular characterization were never conducted. Therefore, the aim of this study was to investigate the genetic diversity of 21 Macedonian autochthonous apple accessions, together with 6 standard apple varieties, using microsatellite markers. The total DNA was isolated from the collected leaf samples and analysed using 8 different primer pairs. Obtained results were processed in GenAlEx 6.51b2. A total of 34 alleles were amplified within Macedonian autochthonous genotypes, with an average of 4.25 per primer pair. The number of alleles varied from 16 to 48 in various accessions. Observed heterozygosity (Ho) ranged from 0.056 to 1.000, while expected heterozygosity (He) varied from 0.498 to 0.799. The effective number of alleles (Ne) ranged from 1.994 to 4.983 per locus for all genotypes. Cluster analysis and principal coordinate analysis were performed on data for all tested varieties and accessions, producing relatively similar grouping patterns. The clustering resulted in grouping the accessions in three clusters. The first cluster included two local genotypes and Golden Delicious variety, while the second cluster grouped the rest of the world recognized varieties and 6 Macedonian autochthonous accessions. The third cluster consisted only of Macedonian genotypes (13), identifying the same genetic fingerprint for two accessions. This study opens the door for further in-depth molecular examinations and emphasizes the importance of examining the autochthonous populations as a potential unexploited breeding material in future apple selection programmes.

Key words: genetic diversity, apple autochthonous genotypes, cluster analysis

New S-alleles Identified in Sweet Cherry Cultivars of Autochthonous Origin in the Balkan Countries

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Abstract

Sweet cherry (*Prunus avium* L.) is an economically important fruit species in the countries of the Balkan Peninsula. The gametophytic self-incompatibility system in sweet cherry prevents fertilization with its own or genetically related pollen and is controlled by at least two multi-allelic genes located at the *S*-locus. Therefore, determining *S*-alleles enables choosing compatible *S*-genotype combinations for successful fertilization. This study was primarily undertaken to identify *S*-genotypes in eight sweet cherry cultivars of autochthonous origin across Serbia ('Canetova' and 'G-2'), North Macedonia ('Dolga Šiška' and 'Ohridska Crna'), Romania ('Amar Galata', 'Amar Maxut' and 'Amaris') and Bulgaria ('Ranna Tchernia'). We employed the PCR detection method with various consensus and allele-specific primer pairs, combined with DNA fragment analysis and *S-RNase* sequencing, to identify 10 different *S*-alleles (*S1–S6*, *S12*, *S22*, *S39* and *S40*). The identification of *S*-genotypes allowed the classification of eight sweet cherry cultivars into six known incompatibility groups (I, IV, XV, XXII, XXIV and LXX) and the '0' group of universal pollen donors ('Amar Maxut' and 'Ohridska Crna'). Two novel *S-RNase* alleles, named *S39* and *S40*, were revealed in the cultivars 'Amar Maxut' and 'Ohridska Crna', respectively. The sequences of these alleles were deposited in the NCBI GenBank database. The newly identified alleles enable unique *S*-genotypes of 'Amar Maxut' (*S4S39*) and 'Ohridska Crna' (*S4S40*), classifying them as universal pollenisers. This study expands our knowledge of *S*-genotypes and provides valuable insights for breeders and growers. Since genetic diversity in cultivated sweet cherries is severely limited, and breeding programmes focus on a very small number of parental cultivars, a key challenge in developing future cultivars will be enlarging the genetic base to introgress new favourable alleles for various traits.

Key words: Prunus avium L., self-incompatibility, *S*-locus, PCR detection, sequencing

Acknowledgment

This work was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Grant numbers: 451-03-136/2025-03/200215 and 451-03-136/2025-03/200042) and the Science Fund of the Republic of Serbia (GRANT No7739716: Genetic potential of Serbian autochthonous cherry genotypes for temperature-adaptable reproductive behaviour and nutraceutical value – CherrySeRB).

**Treasures from Nature:
Wild Cornelian Cherry as a Source of Nutrients and Antioxidants**

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Abstract

This study investigated the physicochemical characteristics, mineral composition, polyphenolic components, vitamin C content, and bioactive potential of wild Cornelian cherry collected from four locations in Bosnia and Herzegovina (SCC1 and SCC2 from the southern and WCC1 and WCC2 from the western regions). Samples WCC1 and WCC2 had higher flesh weight, and total acidity, while samples SCC1 and SCC2 had significantly higher total dry matter and pectin content ($P \leq 0.05$). Sample SCC2 showed the highest total sugar content ($P \leq 0.05$), and L*, a*, b* color parameters. WCC2 exhibited the highest content of potassium, calcium, magnesium, and phosphorus. Sample WCC1 had the highest anthocyanin content and the strongest free radical inhibition (DPPH, ABTS, OH[•]), as well as significant antiproliferative effects on the breast adenocarcinoma cell line (MCF-7). Sample SCC1, with the highest flavonoid and flavonol content, showed the strongest antiproliferative effects on another breast adenocarcinoma cell line (MDA-MB-231). Sample WCC2 had the highest total polyphenol and vitamin C contents and effectively inhibited the growth of cervix epithelioid carcinoma (HeLa) and lung adenocarcinoma (A549) cell lines, and demonstrated a strong ability to inhibit α -glucosidase. There was no statistically significant difference ($P \geq 0.05$) in the anti-inflammatory activity between the investigated samples. Samples WCC1 and WCC2 had higher ($P \leq 0.05$) catechin, ferulic and coumaric acid, and quercetin, while samples SCC1 and SCC2 had higher rutin and kaemferol content. It can be concluded that chemical composition and bioactivity of Cornelian cherries depend on the growth region, highlighting their potential as a natural functional food with health benefits.

Key words: Cornelian cherry, nutritive composition, polyphenolic compounds, bioactivity

Acknowledgment

This study was financially supported by the Ministry of Scientific and Technological Development, Higher Education and Information Society, Republic of Srpska (19/6-020/961-75/18).

Impact of Freezing and Freeze-drying Processes on Phytochemical Contents and Antioxidant Capacity of Blackberry Fruit

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Abstract

Blackberry (*Rubus* subg. *Rubus* Watson) is highly valued for its nutritional content, and optimizing its production is crucial in temperate regions such as Serbia. This study evaluates the effect of freezing and freeze-drying processes on the phytochemical content and antioxidant capacity of the ‘Čačanska Bestrna’ blackberry cultivar, comparing these changes with the quality of fresh blackberry fruit. Primary metabolites, including soluble solids content (SSC), total and reduced sugars (TS, RS), total sucrose (TS), and total acids (TA) content, were determined using standard chemical laboratory methods. Secondary metabolites, such as total phenol content (TPC), were quantified using the Folin-Ciocalteu method, while anthocyanin content (TAC) was assessed using the pH-differential method, and antioxidant capacity was determined using the DPPH method. The results showed that the applied preservation methods positively affected the examined fruit parameters. Freeze-dried blackberry fruits from both localities showed superior levels of SSC (90.63%), SC (52.25%), RS (45.83%), and SC (6.30%) compared to frozen and fresh fruits. TPC values did not demonstrate significant variations between the two preservation methods and fresh fruit, whereas agro-ecological conditions of the locality led to significant differences in the TPC and antioxidant capacity of the blackberry fruit. In this regard, further research should be focused on increasing the efficiency of preserving beneficial phytonutrients in blackberry fruits for human health in final blackberry products, thereby ensuring better quality and nutritional value.

Key words: blackberry, freezing, lyophilization, sugars, acids, phenols

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Quality Monitoring of Apple Fruit during Long-term Cold Storage

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Abstract

This study aims to evaluate the post-harvest characteristics of two commercial apple cultivars ('Gloster' and 'Morren's Jonagored[®]'), examining their quality at harvest and after storage for different period (0, 2, 4, 6, and 8 months). Physical (fruit weight, weight loss, and firmness) and chemical traits (total sugars content (TSC), titrable acidity (TA), and TSC/TA ratio) were determined using standard laboratory methods. A comparison of the apple cultivars showed that 'Morren's Jonagored[®]' had a higher fruit weight (217.87 g), while 'Gloster' exhibited higher fruit firmness (10.18 kg cm⁻²). The TA content was higher in 'Gloster' (0.45%), while TSC/TA ratio was higher in 'Morren's Jonagored[®]' (32.96). No significant differences were observed in weight loss and TS content. At harvest, fruits of the apple cultivars exhibited the highest values for weight and firmness. During cold storage, a decrease was observed, and after 8 months, the investigated quality parameters showed the lowest values, along with the highest fruit weight loss (10.10%). The highest TSC content in apple fruit was recorded after 2 months of storage (10.33%), TA after 4 months (0.43%), while the highest TSC/TA ratio was observed at the end of the cold storage (35.03). A throughout analysis indicates that both cultivars are well-suited for long-term cold storage, as no significant changes were observed in the physical and chemical properties of the apple fruits throughout the storage period. This stability suggests their potential for extended shelf life and consumer acceptance.

Key words: apple, postharvest, weight loss, sugars, acids

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Effects of Modified Atmosphere Packaging (MAP) and 1-Methylcyclopropene (1-MCP) on Fruit Quality of Plum

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Abstract

The aim of the research was to examine the influence of post-harvest treatments, MAP and 1-MCP, on the fruits quality of “Čačanska lepotica” and “Čačanska rodna”, during 20 days of cold storage at 1 °C (20+1) and 3 days of shelf life (20+3). During a three-year study (2017, 2019, 2020), the effect of MAP and 1-MCP treatments on the fruit firmness, fruit color, soluble solids content (SSC), titratable acidity (TA), anthocyanins, and carotenoids was examined. After the shelf life period, the 1-MCP treatment increased the fruit firmness of the “Čačanska lepotica” from 0,7 N (2017) to 1,61 N (2020) compared to the control. However, for the “Čačanska rodna”, a bigger effect was observed with the MAP treatment, which significantly increased fruit firmness after storage (2019 and 2020) and shelf life (2017 and 2020). The application of MAP and 1-MCP treatments had a significant effect on increasing the intensity of red (a*) and blue (b*) colors in “Čačanska rodna”, while an increase in fruit lightness (L*) was observed only in the fruits treated with 1-MCP, with a 11% increase compared to the control. A positive effect on increasing the intensity of red color by 22.5% (20+1) and 48.1% (20+3), and blue color by 46.8% (20+1) and 60% (20+3) in “Čačanska lepotica” was achieved only with the 1-MCP treatment. The application of MAP and 1-MCP treatments significantly reduced the carotenoid content, while increasing the anthocyanin content in the fruits of the tested cultivars, although their effect on soluble solid content SSC and TA was not observed.

Key words: fruit firmness, fruit color, anthocyanins, carotenoids

Acknowledgment

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The Effect of Rootstock and Position on Fruit Color Expression during Pear Storage

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Abstract

During the ripening and harvesting period, the quality of the fruit, observed through skin color, can vary significantly among fruits from different trees grafted onto different rootstocks. The tree position is of crucial importance for fruit coloration, especially when considering the over color. The aim of this research is to monitor the color changes of pear fruits (Williams, Abate Fetel, Conference and Santa Maria) grown on the prairie pseudogley on two rootstocks (quince MA and seedling) on tree position on production plot (top, middle and base) during the storage period. Fruit sampling for analysis were sampled in the pear orchard "Agroimpex Nova" in Jablanica. For each combination of variety/rootstock/position, the determination of fruit skin color was carried out after harvest, after half period of storage and after full storage in a ULO chamber. Fruit skin color was measured with a colorimeter in the "Lab" digital color positioning system and color quantification and data processing were performed using SpectroMagic CR software. The research results indicate that Williams, Conference and Santa Maria grafted on the seedling rootstock had a more intense skin color compared to quince rootstocks, while Abate Fetel showed a slight advantage in coloration on quince, especially when considering fruits from the base on production plot. The effect of tree position was most pronounced in Santa Maria, where fruits on quince rootstocks from the top and middle of production plot had a better coloring compared with fruits from the base. During the storage period, Williams showed color stagnation during the first month of storage, but after two months in chamber, there was a significant change in color intensity. Santa Maria showed an increase in color intensity and lower storage capacity, while Conference and Abate Fetel didn't show significant changes in color expression throughout the storage period.

Key words: pomological characteristics, postharvest technology, ULO

**Vertical and Horizontal Distribution of *Xiphinema* spp. in
the Rhizosphere of Apple Orchards**

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Abstract

Nematodes of the genus *Xiphinema* (dagger nematodes) are obligate parasitizers of plants. Many of these nematodes can transfer NEPO viruses to plants during feeding. Nematodes of this genus can cause economic damage and death of host crops through feeding on the roots and also by spreading viral mosaic and wilting diseases. Dagger nematodes are widely distributed on all continents excluding Antarctica. Samples were taken from 12 years old apple orchards where we had previously determined the presence of dagger nematodes. Three trees were sampled at 3 different depths and at two different distances from the tree, for a total of 6 samples per tree or 18 total samples. Each sample consisted of four sub samples taken from four sides of the tree. Samples were taken at the edge of canopy and 50% from the trunk and at three depths: 0-10 cm, 10-20 cm and 20-30 cm. Nematodes were found in all samples. The highest abundance of the nematodes was found at a depth of 10-20 cm, and more nematodes were found on the edge of the canopy than closer to the tree trunk. The highest number of the nematodes was found at the edge of canopy at the depth of 10-20 cm, and the lowest at the edge of canopy at 20-30 cm. This research can contribute to understand better dagger nematode behavior in the rhizosphere of the fruits, enhancing better sampling efficiency

Key words: Xiphinema, dagger nematodes, vertical distribution, sampling

**Variable Symptomatology of Stone Fruits affected by
Xanthomonas arboricola pv. *pruni* in Montenegro**

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Abstract

During a survey in 2017/20, presence of *Xanthomonas arboricola* pv. *pruni* (Xap) has been confirmed on peaches, nectarines, sweet cherries, and apricots in Montenegro. From symptomatic samples collected in central and southern parts of the country, 47 strains were isolated and identified as Xap using biochemical and molecular methods. During the study, variation in symptomatology and disease severity was observed. Favorable climatic conditions during late spring and summer, followed by mild temperatures, frequent rains, wind, and dew, favored the development and spread of the disease. Intensive leaf-spotting was observed on peach trees, affecting 30-100% of the canopy. Severe infections resulted in defoliation and premature fruit drop, directly reducing the yield and quality of the fruits. The peach varieties Royal Bel and the nectarine Big Top showed the highest sensitivity. Unlike peaches and nectarines, no defoliation was observed in apricots. However, the pathogen caused an intense leaf-spotting and fruit lesions of the Robusta cultivar, reducing the marketability of the fruits. Intensity of the infection on leaves and fruits was over 70%. In sweet cherry orchards, main symptoms were dark, elongated, sunken cankers accompanied by gummosis, occurring on young twigs. However, no symptoms were observed on leaves and fruits. The presence of Xap has not been confirmed on plums, which are the most widespread stone fruit species in Montenegro. Therefore, proper reading of symptoms is of a great importance in pathogen detection and diagnosis. That is prerequisite for timely application of available control measures. Overall, the impact of Xap on the yield of stone fruit is profound, requiring integrated management strategies to mitigate its effects and protect the productivity of orchards.

Key words: *Xanthomonas arboricola* pv. *pruni*, stone fruits, 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; and the Ministry of Education, Science and Technological Development, Republic of Serbia and University of Belgrade, Faculty of Agriculture (Contract No. 451-03-137/2025-03/200116).

**Population Dynamics of Black Scale *Saissetia oleae* (Olivier) in Olive Groves
in Area of Bar and Ulcinj**

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Abstract

Saissetia oleae is a polyphagous species that causes economically significant damage to olives and other cultivated plant species. It causes direct and indirect damage that leads to a weakening of the plant and a decrease in yield, which is why it is necessary to take appropriate protective measures. Therefore, the research is focused on determining the population dynamics of this pest in order to determine the optimal timing for pesticide application. The research was conducted in the area of Ulcinj and Bar at seven localities. To determine the presence and abundance of *S. oleae* population, from one tree per locality 4 twigs 20 cm long were taken randomly from the lower part of the crown. Sampling was carried out every fifteen days in the period from December 2021 to the end of August 2022, and the collected samples were examined in the laboratory, under a stereomicroscope. Each twig, including the leaves, was examined on the presence of *S. oleae* and the number of females, the number of eggs under the shield as well as the number of larvae by stages of development were determined. Based on the obtained results, it can be concluded that black scale, *Saissetia oleae*, is present in olive groves in the area of Ulcinj and Bar throughout the year. It overwinters dominantly as 2nd and 3rd instar larvae on twigs and leaves, but also as a female on twigs. The maximum population abundance was recorded in the period from mid-May to mid-June, when the presence of females and eggs is dominant. The first 1st instar larvae were recorded in mid-July and are dominantly present until the end of August. The abundance of the black scale population is significantly higher in olive groves in the area of Ulcinj compared to Bar.

Key words: Black Scale, *Saissetia oleae*, olive, population dynamics

Testing the Germination of Seeds Obtained from Hybridization of Some Grapevine Varieties as a Basis for Obtaining Young Seedlings

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Abstract

Once a year, in the period from 2010 to 2024, experimental crosses of planned selected grape varieties *Vitis vinifera* L. were made, i.e. intervarietal hybridization was performed. The seeds obtained from the fruit (grapes) of the parental pairs were tested for germination using several methods and procedures for seed treatment. The most successful method for seed germination was the procedure where the seeds were immersed in water with a change in temperature every 12 hours (from high to low temperature). Several combinations were made between the varieties, such as: Vranec x Mavrud, Shasla x Belo Zimsko, Manastirsko belo x Čaush, Ohridsko crno x Crven valandovski drenok, Stanushina x Ohridsko belo, etc. The main goal was to provoke in vitro rupture of the hard seed coat characteristic of grapes. In general, the cracking of the coat and germination of the sprout was difficult and similar in all grapevine hybrids, but there was still a difference, especially in those parental pairs in which the variety - the female parent had hard seeds as a varietal characteristic. After germination, one part of the seeds was used for mitosis testing, and the others were planted to obtain grapevine seedlings - hybrids for further obtaining varieties with new properties. Young grapevine seedlings are delicate and fragile and require a special technique for their further cultivation.

Key words: hybridization, germination, seed coat, grapevine seedlings

**Characteristics of Grapes and Wine of Resistant Vine Varieties:
Quality, Specificities, and Future of Production**

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Abstract

Interspecific hybrids are increasingly used in the domain of ecologically sustainable grape production, based on cultivation of the disease resistant varieties. In Bosnia and Herzegovina, these varieties occupy insignificant areas, but there is a noticeable tendency of a slight increase in certain microregions. The aim of the research is to determine the technological and oenological properties of the interspecific hybrids Bačka and Morava, grown in the Prijedor mesoregion. The experimental part of the trials was realized in the conventional field vineyard of PZ "Smart Village" Knežica, as well as in the Laboratories of Faculty of Agriculture and Faculty of Technology UNIBL. The characteristics of grapes and berries, physio-chemical analysis of grape juice and wine were examined. The examination of the antioxidant activity of wine included the measurement of the content of phenolic substances, as well as the application of three tests: DPPH, ABTS and FRAP. The antimicrobial activity of wine was tested by the agar dilution method and measurement of MIC and MBC values and the effect on five pathogenic and conditionally pathogenic bacteria, one pathogenic yeast and two probiotic strains was tested. The Bačka variety had a higher average mass of bunch (214.75 g), as well as the sugar content in the grape juice (22.9 %) and the alcohol content (13.5 vol.%) compared to the Morava variety. The Bačka wine showed a significantly stronger antioxidant effect, where the values obtained using antioxidant tests were 2.5 to 5 times higher than Morava wine. Also, Bačka wine showed a stronger antimicrobial effect than Morava wine, and the strongest effect was shown against the bacteria *Pseudomonas aeruginosa*, while the wines did not show an effect on the yeast *Candida albicans* and the probiotic strain *Saccharomyces boulardii*.

Key words: interspecific hybrids, grape and wine quality

A Portugal Region: The Alentejo and Its Wine

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Abstract

This poster presentation provides an overview of the Alentejo wine region in Portugal, focusing on its grape varieties and wine regulations for wine blends. Alentejo is one of Portugal's most significant wine-producing regions, divided into eight sub-regions: Portalegre, Borba, Redondo, Reguengos, Vidigueira, Évora, Moura, and Granja-Amareleja. The central focus of this presentation is the grape varieties that define Alentejo's wines with the regulated proportions for use in winemaking, with main varieties, its minimum quantity and secondary varieties. The region is renowned for both red and white wines, with key national and international grape varieties contributing to its distinctive profile. Among the regulated prominent red varieties are Alfrocheiro, Alicante Bouschet, Trincadeira, Aragonez, and Castelão, while Antão Vaz, Arinto, and Roupeiro dominate white wine production. Each sub-region follows specific winemaking regulations that dictate the permitted grape varieties and their proportions in blends. These rules ensure consistency in wine quality while allowing for regional expression. Through a map, the poster visually represents the distribution of these sub-regions.

Key words: Alentejo, Portugal, enology, grape varieties

Yield and Cluster Characteristics of Grapevine Varieties Grown in the Gene Bank of the Experimental Vineyard Radmilovac (Serbia)

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Abstract

The selection of an appropriate variety is a key factor in achieving desired wine production outcomes. To properly identify and evaluate grapevine varieties, morphological and molecular characterization using appropriate methods is essential. Morphological characterization primarily relies on various types of descriptors, particularly OIV descriptors, which describe the most important organs of the vine, such as shoots, leaves, flowers, clusters, berries, and seeds. The study was conducted over two years at the “Radmilovac” Experimental Estate of the Faculty of Agriculture, University of Belgrade, one of the three existing grapevine germplasm collections in Serbia. Ampelographic characterization included thirty grapevine varieties, mostly intended for wine production (23 varieties) originating from *Vitis vinifera*, while seven varieties had combined properties. The analyzed varieties were planted between 1991 and 1993, with a spacing of 3 × 1 m and grafted on to Berlandieri × Riparia Kober 5 BB rootstock. The study examined cluster and berry characteristics and yield parameters, which are essential for selecting varieties in viticulture and improving cultivation techniques and breeding programs. The results showed significant variations in cluster and berry mass among the studied varieties. The average cluster weight ranged from 110 g to over 400 g, while berry mass varied from less than 1.4 g to over 3 g. Cabernet Sauvignon clones exhibited the lowest yield, while the Prokupac variety had the highest yield per vine. Additionally, significant differences were observed between the obtained results and data from the *Vitis* database for some varieties, particularly regarding cluster and berry weight. The obtained results highlight the importance of detailed ampelographic characterization for the conservation and utilization of genetic resources in viticulture, supporting the selection of varieties with desirable agronomic and technological traits.

Key words: yield, variety, OIV, *Vitis vinifera*

Effects of Climate Change on the Phenology, Yield, and Quality of the Panonia Grape Variety in an Organic Vineyard

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Abstract

Rising temperatures and changes in rainfall distribution patterns in recent decades have significantly affected viticulture across most wine-growing regions, accelerating grapevine phenology and causing earlier ripening. This shift influences grape composition, altering acidity, sugar content, and aromatic profiles. This study examines the impact of climate change on the phenology, yield, and quality of the Panonia variety over a ten-year period (2015-2024) in the Grocka wine region at the organically certified *Plavinci* Winery. Key phenological phases budburst (BBCH 01-03), flowering (BBCH 63-64), veraison (BBCH 81), and harvest (BBCH 89) were monitored, along with grape quality parameters at harvest. The earliest occurrence of all phenophases was recorded in 2024: budburst (March 1), flowering (May 3), veraison (June 23), and harvest (August 10). The latest budburst was observed in 2015 (April 10), while the latest harvest occurred in 2023 (September 9). The shortest interval from budburst to harvest was recorded in 2015 (132 days), whereas the longest was in 2019 (173 days). The highest yield per vine was recorded in 2022 (2.6 kg), while the lowest was in 2020 (0.6 kg). The highest sugar content was measured in 2015 (24.5%), and the lowest in 2020 (21.1%). The highest pH value was observed in 2017 (3.8), and the lowest in 2018 (3.1). Total acidity was highest in 2016 (9.5 g·L⁻¹) and lowest in 2022 and 2024 (5.7 g·L⁻¹). The results indicate an earlier onset of grapevine phenological phases, leading to earlier grape ripening. On average, phenophases occurred 30 days earlier in recent years of the study compared to 2015. These phenological variations, driven by high temperatures, resulted in a decrease in total acidity, an increase in pH, and fluctuations in sugar content, directly affecting the chemical balance of grapes and, consequently, the style and quality of the produced wine.

Key words: grapevine phenology, quality, yield, climate, Panonia

Correlative Dependencies between Monomeric Anthocyanins in Grapes and Wine of the Vranec Variety (*Vitis vinifera* L.)

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Abstract

The correlative dependencies between monomeric anthocyanins in grapes and wine of the Vranec variety grown in three micro-regions with different altitudes were investigated. It was found that correlations among anthocyanins in grapes vary from unproven negative to strong and very strong, proven at both levels of significance. In wine, strong and very strong correlative dependencies between individual monomeric anthocyanins are significantly more frequently represented. After fermentation, the correlative links between monomeric anthocyanins in wine are strengthened. The correlative dependencies between the studied monomeric anthocyanins in grapes and wine, on average from all variants, regions, and years, are strong only for peonidin-3-glucoside, cyanidin-3-glucoside, and malvidin-3-acetylglucoside. Among the -3-glucosides, the most significant and moderate correlative dependencies were found for peonidin-3-glucoside, malvidin-3-acetylglucoside, and petunidin-3-glucoside, followed by the -3-acetylglucosides, and the least for the group of -3-p-coumaroylglucosides, as well as delphinidin-3-glucoside and cyanidin-3-glucoside, where proven and unproven, negative and positive weak correlative coefficients prevail.

Key words: Vranec grape variety, correlative dependencies, monomeric anthocyanins

Effect of Harvest Time on the Antioxidant Profile of two Grape Varieties from Trebinje Vineyard Area

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Abstract

This study aimed to investigate how the timing of grape harvest affects the total phenolic and flavonoid contents, as well as the total antioxidant capacity in the berries of the Žilavka and Vranac varieties grown in the Trebinje vineyard area. Grape samples were collected at three chosen time points during the ripening process, comprising 10 bunches from 5 randomly selected vines of the Žilavka and Vranac varieties. The interval between the chosen harvest dates was set at 10 days, and the optimal harvest date for each grape variety was identified by assessing the sugar concentration in the grapes. Total phenolics, total flavonoids and total antioxidant activity of grape samples were determined by the Folin-Ciocalteu method, Aluminum chloride method and Ferric Reducing Antioxidant Power assay, respectively. Total phenolic and flavonoid content, as well as the total antioxidant capacity in grape of Vranac variety was increased from the first harvest date to the second one, but a decrease could be detected at the third harvest date. The Žilavka variety showed an increase in total phenolic and flavonoid content, as well as total antioxidant capacity from the first to the second harvest date; however, no decline was observed by the third harvest date. As expected, grape of the red grape variety Vranac contained much higher levels of phenolics and flavonoids than light-skinned grape variety Žilavka. The total phenolic content in Vranac varied between 102.16 and 135.52 mg of gallic acid equivalent (GAE)/100 g of fresh grapes, whereas in Žilavka, it ranged from 28.42 to 49.06 mg GAE/100 g. Additionally, the total flavonoid content for Vranac was found to be between 47.12 and 61.12 mg of catechin equivalent (CE)/100 g of fresh grapes, while Žilavka exhibited a range of 11.52 to 16.96 mg CE/100 g, influenced by the time of harvest.

Key words: grape, harvesting time, total phenolics, total flavonoids

Impact of Clonal Variability on Polyphenols and Antioxidant Activity in Prokupac Grapes

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Abstract

Prokupac is the economically most significant autochthonous Serbian grape variety for production of quality and authentic red wines. A problem for its expansion in production is the lack of high-quality clonal planting material for different growing conditions. Therefore, work on clonal selection is intense. The mass positive selection of the Prokupac variety was initiated by the Doja winery. After several years of mass positive selection, 16 clones of the Prokupac variety were isolated based on desirable morphological traits: smaller berries, loose bunches, lower vigor, and a good sugar-acid balance. Considering that the purpose of this variety is the production of high-quality red wines, the examination of polyphenolic composition is of utmost importance. Therefore, total phenolic content (TPC) and radical scavenging activity (RSA) were determined in different parts of the berry: skin, pulp, and seed for all 16 selected clones, and total anthocyanin content (TAC) was measured in the grape skin. Based on the obtained results, we selected six clones for further analysis of phenolic and anthocyanin profiles. In the grape skin TPC, RSA, and TAC were up to 7.28 g GAE/kg, 40.93 mmol TE/kg, and 3.84 mg malvidin 3-glucoside/g (respectively). Expectedly, higher values for total phenolic content and radical scavenging activity were obtained in grape seeds, with 55.99 g GAE/kg for TPC and 327.76 mmol TE/kg for RSA. The lowest TPC and RSA values were detected in grape pulps, up to 0.57 g GAE/kg and 16.06 mmol TE/kg, respectively. This work shows the existence of variation in the phenolic (phenolic acids, flavan-3-ols and some flavonols) and anthocyanin profiles among Prokupac clones. The anthocyanins in grape skins show a prevalence of malvidin derivatives. These results contribute to a better understanding of the enological potential of the selected clones and more precise selection of clones depending on the expected style of wine.

Key words: Prokupac, clones, TPC, TAC, RSA, phenolic profile

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Effect of Cold Storage and Shelf Life on Berry Physical and Chemical Parameters of two Resistant Table Cultivars

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Abstract

Keeping quality during the storage of table grapes depends from variety. The aim of this study was to examine the impact of storage duration on grapes in a cold storage facility with normal atmosphere, and on the physical characteristics and chemical composition of table grapes. Two fungus tolerant table grapevine cultivars were examined in this experiment: Nada - seedless and Ljana – seeded. The fruits were stored for 14 and 28 days in a cold storage (14+0 and 28+0) facility with normal atmosphere at temperature of 3±1°C and with relative humidity of 90% and exposed to additional three days i.e shelf-life conditions at 20°C (14+3 and 28+3). After storage, physical characteristics and chemical composition were measured at harvest, after storage and after shelf life. Results showed that during the storage of Nada the most significant weight loss was at 14+3 and 28+3 days. Nada fruit firmness increased during the cold storage and was the highest after 28+3 days, comparing to Ljana where it was after 28+0 days. Nada sugar content was the highest after 14+3 and 28+3 days and the lowest acidity content in Nada was after 28+0 days. Regarding Ljana cultivar the most significant weight loss was after 14+3 days. The highest sugar content and the highest acidity at Ljana was after 28+3 days.

Key words: shelf life, stone grapes, weight loss, sugar content, fruit firmness, acidity

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Effect of Fermented Pomace Pressing on The Phenolic Compounds Extraction in Red Wine

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Abstract

This paper examines the influence of pressing conditions during winemaking on the content of several representative phenolic compounds. The winemaking techniques used in red wine production, such as the pressing of fermented pomace, can have a direct impact on the quality of the final product. In this experiment, three phenolic compounds — catechin, epicatechin and *trans*-resveratrol that are important components of wine and influence both its sensory properties and its potential health benefits were investigated. After a 14-day maceration of the red grapes, three pressure levels (0.5 bar, 1.0 bar and 1.5 bar) were applied, resulting in three experimental wines, designated Wine 1, Wine 2 and Wine 3. In addition to these samples, one fraction was separated as free-run wine to compare with the others. After LC-MS/MS analysis, the results showed a higher phenolic content in wines exposed to a higher pressure of fermented pomace. In particular, the pressure of 1.5 bar led to the highest levels of these compounds in the wines analyzed.

Key words: grape pressing, maceration time, red wine, phenols

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The Effects of Artificial Lighting during the Seedling Stage on the Yield Structure of Sweet Pepper from a Single Harvest

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Abstract

Sweet pepper (*Capsicum annuum* L.) is a globally cultivated vegetable, whose yield is affected by light intensity and photoperiod. This paper aimed to determine the effects of the applied light treatments during the seedling stage on the pepper yield after being transplanted into a greenhouse. The study utilized a commercial sweet pepper variety known as the Morava cultivar. When the plants reached the phenophase of forming their first permanent leaves, they were placed in closed plant growth chambers and grown under the following light treatments: full-spectrum white light-emitting diodes (W-LEDs) as the control group, blue LEDs (B-LEDs), a combination of red and blue LEDs in a 1:1 ratio (RB-LEDs), and red LEDs (R-LEDs), with a photoperiod of 12 hours of light and 12 hours of darkness, at a temperature of $23 \pm 2^\circ\text{C}$. After 20 and 27 days of cultivation in these conditions, pepper seedlings were transplanted into bigger plastic pots and removed to the greenhouse, where plants were cultivated for the next 51 and 44 days, respectively. Fruits were picked in a single harvest, and the number of fruits, the yield and its structure, depending on the fruit color stages, were determined. Our results show that light treatments significantly influenced the total number of red fruits, while the length of exposure to light treatments significantly increased red fruit yield. The highest number of red fruits was observed in plants grown under RB-LEDs and R-LEDs, while the highest red fruit yield was achieved in plants grown under R-LEDs for 27 days. The number of yellow fruits was not affected by applied treatments, however, the interaction between light treatments and length of exposure to light treatments significantly influenced yellow fruit yield; it was the highest in plants grown under W-LEDs and B-LEDs for 20 days.

Key words: Capsicum annuum, yield, light-emitting diodes, vegetable, greenhouse

Acknowledgment

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**Morphological Characterization of Local Pepper (*Capsicum annuum* L.)
Landraces from Macedonia**

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Abstract

This study focuses on the phenotypic evaluation of 15 local pepper (*Capsicum annuum* L.) landraces from Macedonia, a country renowned for its agricultural heritage and crop diversity. The main objective was to assess morphological diversity based on nine quantitative and ten qualitative plant characteristics. The results of the quantitative traits were subjected to principal component analysis (PCA), where the first three principal components accounted for 85.76% of the total variability. Agglomerative hierarchical clustering grouped the accessions into four clusters. The first cluster comprised two accessions with the highest values for most of the examined traits, except for fruit length (FL) and pedicel length (PL). The second cluster included seven accessions with the lowest values for plant height (PH), leaf length (LL), and leaf width (LW). The two accessions in the third cluster were characterized by the highest values for fruit length (FL) and the lowest for fruit width (FW). The fourth cluster contained the remaining four accessions, which exhibited the lowest average values for fruit weight (FWg), pericarp thickness (PT), and days to fruiting (DFR). The frequency distribution of the qualitative traits was calculated separately for each cluster and for the entire collection. The results provide valuable insights into the genetic resources available for future utilization in genetic and agronomic research.

Key words: pepper, landraces, phenotypic, diversity

**Total Flavonoid Content in Fruits of Pepper Accessions from
the Gene Bank of the Republic of Srpska**

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Abstract

Pepper (*Capsicum annuum* L.), which originates from Central and South America and belongs to the Solanaceae family, was first used by indigenous people and was brought to Europe in the 15th century. It is rich in vitamins, especially vitamin C, provides health benefits such as strengthening the immune system, and contains antioxidants that help fight inflammation and oxidative stress. The purpose of this study was to evaluate the diversity of a pepper collection from the Republic of Srpska based on the overall flavonoid levels present in the fruit. A total of 13 pepper accessions (GB00026, GB00028, GB00863, GB00869, GB01091, GB01093, GB01111, GB01112, GB01115, GB01130, GB01133, GB01350, GB01351) were sourced from the Gene Bank of the Republic of Srpska, and the experiment was carried out in the field at the Institute of Genetic Resources using standard agricultural practices. Samples consisting of 10 fully ripe fruits from 10 plants within each accession were collected, homogenized, and stored at -20°C until analysis. The total flavonoid content was determined using spectrophotometry by measuring the absorbance at a wavelength of 510 nm. The results indicated that accession GB00026 (0.94 mg CE/g FW) had the highest total flavonoid content, while accession GB01133 (0.10 mg CE/g FW) exhibited the lowest total flavonoid content. The average flavonoid content in the pepper collection was 0.41 mg CE/g FW. These preliminary results highlight a significant diversity in the pepper collection from the Gene Bank of the Republic of Srpska regarding the fruit total flavonoids.

Key words: flavonoid, spectrophotometry, collection, pepper

Acknowledgment

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Assessment of Deltamethrin Efficacy and Residue Dissipation Dynamic in Paprika Fruits

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Abstract

Pyrethroid insecticides are still widely used to control *H. armigera* in paprika. Therefore, evaluating their efficacy, the presence of residues, and the dissipation dynamics is necessary. A field experiment was conducted according to standard EPPO methods, at the locality Gospodinci, Serbia. Insecticide based on deltamethrin (25 g a.i./l, EC), was applied foliar at the recommended dose of 0.7 l/ha in paprika (Elephant Ears variety) when the paprika was in the stage BBCH 81. The efficacy was evaluated through the number of damaged fruits 8 and 14 days after the application. Eight days after application, the efficacy was 93.1%, while after 14 days, it was 84.4%, with damage significantly lower than in the control. To analyze deltamethrin residue in paprika fruits, samples were collected one hour after the application and daily for one week. A method for the determination of deltamethrin residues has been validated, with satisfactory validation parameters in terms of linearity, precision, recovery and limits of detection and quantification. The highest amount of deltamethrin (0.37 mg/kg) in paprika samples was found 1h after the application, while between first and second day after the treatment residues were at the MRL level of 0.15 mg/kg. Results obtained for the dissipation dynamics experiment showed that deltamethrin degraded immediately, with a half-life of 1.92 days in paprika fruits. Thus, pyrethroid insecticides can be safely used for the control of *H. armigera* in paprika.

Key words: deltamethrin, paprika, efficacy, residues, dissipation dynamic

Acknowledgment

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Monitoring the Spread and Accumulation of Plant Viruses in Macedonian Major Pepper-Growing Regions

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Abstract

Pepper viruses represent a major constraint to open-field pepper production in the Republic of North Macedonia. This study aimed to assess the occurrence, distribution, and antigen accumulation dynamics of economically significant pepper viruses in the country. The study was conducted over a three-year period across eight major pepper-growing regions, focusing on pepper plants cultivated in open fields. Virus detection was performed using the Double Antibody Sandwich – Enzyme-Linked Immunosorbent Assay (DAS-ELISA) method. Findings from the trials confirmed that open-field-grown pepper plants are highly susceptible to viral infections. *Cucumber mosaic virus* (CMV) was the most prevalent virus detected across all analyzed years, with infection rates ranging from 34% to 61% of tested samples, followed by *Alfalfa mosaic virus* (AMV) and *Potato virus Y* (PVY). In most of the tested regions, CMV was the most widely distributed virus, either in single infections or in combination with other viruses. Analysis of optical density (OD) absorbance values revealed that virus antigen accumulation increased progressively during the growing season, peaking primarily during the second and third assessments, and less frequently during the first. Throughout the study, high OD absorbance values were recorded, reaching 2.575 for AMV, 3.526 for CMV, and 4.866 for PVY. To validate these findings, further research using advanced diagnostic techniques is recommended to better understand the dynamics of virus accumulation.

Key words: pepper viruses, serological detection, virus distribution, antigen accumulation

**Serological Analysis of Viruses Presence on Some Paprika Accessions stored
in the Gene Bank of the Republic of Srpska**

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Abstract

Testing for virus presence on paprika (*Capsicum* L.) collection from the Gene Bank of the Republic of Srpska was conducted during 2024 in greenhouse production of the Institute of Genetic Resources, University of Banja Luka. Thirteen samples were taken and preliminary tested for presence of 2 viruses: CMV (Cucumber mosaic virus, Cucumovirus) and AMV (Alfalfa mosaic virus, Alfamovirus Bromoviridae) with ELISA (Loewe) test. Three accessions were positive for CMV and one positive for AMV presence. One pepper accession (GB00869: Roga variety) tested as positive for the presence of both viruses. The previous investigations have been conducted on the presence of viruses on conventional paprika varieties in the open field and in the greenhouse. Conducting a virus screening study on paprika accessions from the Gene Bank of the Republic of Srpska would provide critical information on the health status and ensure the ongoing testing of all accessions in the collection.

Key words: CMV, AMV, *Capsicum*, ELISA, Loewe

Acknowledgment

This project was supported by Ministry of Scientific and Technological Development and Higher Education of the Republic of Srpska in 2023 (Grant No. 19.032/431-1-82/23).

Yield of Commercial Garlic (*Allium sativum* L.) Varieties at Three Locations in Slovenia over Two Growing Seasons

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Abstract

Garlic is an important crop for domestic consumption in Slovenia, used fresh or cooked in traditional and modern cuisine. However, there is little data available on the yield performance of commercial garlic varieties grown under different climatic conditions, which could help farmers to select the best-performing variety for cultivation. Field trials were conducted at three locations (Jablje, Ivanci, Šempeter) in Slovenia during two consecutive growing seasons (2020/21 and 2021/22) to evaluate the response of different garlic varieties. Ten commercial garlic varieties were used as experimental material: Ptujski jesenski, Garcua, Sabagold, Garpek, Gardacho, Germidour, Messidrome, Arno, Messidor and Ptujski spomladanski. The same cultivation method and fertilization regimes were applied in three replicates at each trial site. At Jablje, an unheated tunnel was used, while the trials at the other two sites were conducted under open field conditions. Marketable and non-marketable yields were determined five days after harvest. The total yield varied considerably from 3.13 t/ha for the Ptujski jesenski variety to 20.49 t/ha for Sabagold. The non-marketable yield was significantly higher (up to 40%) for the Slovenian varieties Ptujski jesenski and Ptujski spomladanski, due to their susceptibility to virus diseases and the lack of quality seed material. The best-performing marketable yields were recorded for the Sabagold, Messidrome and Gardacho varieties with an average of over 11.5 t/ha. Among the different locations, the sub-Mediterranean climate proved to be less favorable for the production of market garlic, especially for late varieties. Results of ANOVA showed that year, location and variety all had a significant effect on marketable yield. Each factor contributes independently to yield variation, with year having the strongest effect, followed by location and variety. The data clearly show that the choice of garlic variety is the key to achieving high marketable yields.

Key words: garlic variety, *Allium sativum*, marketable yield, climate, ANOVA

Acknowledgment

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**Characterisation of Local Population of Spring Galic (*Allium sativum* L.)
from Ljubinje, Republic of Srpska**

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Abstract

Genetic resources such as garlic (*Allium sativum* L.) play a crucial role in the preservation of agricultural biodiversity, food security, and breeding programs aimed at improving yield and resilience. Garlic is a vegetatively propagated crop with strong site-specific adaptation that often loses its typical morphological characteristics when transferred to a different agroecological zone. For the specified reasons, the aim of this study was to analyze the local population of spring garlic, which is of particular importance for the area of East Herzegovina, locally called Saransak, which is an important genetic resource as well. The results indicated an average bulb weight of 40.423 g, with an average of 15.3 cloves per bulb and 6.6 dry external scales. The bulb dimensions averaged 42.691 mm in height and 43.934 mm in diameter, whereas the clove characteristics included an average weight of 3.283 g, height of 36.136 mm, and diameter of 13.709 mm. Additionally, the soluble dry matter content was 15.733% Brix, suggesting a high nutritional potential and marketability. These morphological traits align with previous studies that have highlighted bulb weight and clove number as critical factors for improving garlic yield and quality. The high bulb weight and clove count suggest that Saransak could be a promising candidate for breeding programs aimed at enhancing commercial garlic varieties. Furthermore, the observed morphological variability underscores the adaptive traits of garlic and the influence of environmental conditions on phenotypic expression. This study provides valuable insights into the genetic resources of garlic and supports future breeding efforts to develop high yielding and environmentally resilient cultivars. Given its favorable agronomic characteristics, the Saransak variety warrants further research for its potential application in garlic cultivation and improvement.

Key words: genetic resource, garlic, bulb, clove, morphology, soluble dry matter

**Phytochemical Profile and Antioxidant Potential of Onion Cultivar Hamilton F1
grown through the Direct Sowing Method**

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Abstract

Due to its unique taste and aroma, onion (*Allium cepa* L.) is widely consumed in various forms, either fresh or processed, across the world. To identify compounds that contribute to its bioactivity and with the aim of informing onion breeding programs, this study analyzed the general phytochemical profile of the widely grown onion cultivar Hamilton F1 (Bejo Zaden B.V.) under the agroecological conditions of Vojvodina (Serbia). The onion was directly sown using the 4 × double row method in strips at the Gospođinci locality during the 2022 growing season, in a randomized block design with three replications. Extraction process was performed with 80% methanol in order to prevent protein extraction and possible interferences with phenolics. The results revealed that total phenolic content ranged from 0.717 to 0.808 mg/g GAE, while flavonoid content ranged from 0.291 to 0.297 mg/g QE while derivatives of hydroxycinnamic acids were below limit of quantification. The soluble sugar content was 106.89 mg/g glucose. Regarding antioxidant capacity, the TAC, CUPRAC and DPPH• assays exhibited values of 6.57 mg/g AAE, 0.315, and 3.67 μmol/g TE, respectively. Based on these findings, the Hamilton F1 cultivar is characterized by a respectable content of examined bioactive compounds, which contribute to better agronomic traits, including stress conditions, improving longer storage potential and disease tolerance, and from a consumer's perspective, these compounds provide positive health effects. These findings could inform future onion breeding efforts and enhance both agronomic and nutritional benefits.

Key words: food quality, bulb, antioxidants, sowing

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**Occurrence and Results of Five-Year Survey on the Presence of
Acidovorax citrulli in Republic of Srpska (Bosnia and Herzegovina)**

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Abstract

Acidovorax citrulli Schaad *et al.*, the causal agent of bacterial fruit blotch and seedling blight of cucurbits is categorized in EPPO A1 list no. 379. Today, this bacterium is present in Brazil, Costa Rica, Mexico, Trinidad and Tobago, USA, China, Republic of Korea, Malaysia, Taiwan, Thailand, North Macedonia, the Russian Federation and Australia. Symptoms can be present on plants and plant parts such as seed, seedlings, fruits, leaves, and vines. In 2019 a large number of watermelon production areas in Lijevče Polje area (municipalities of Srbac, Gradiška, and Laktaši) symptoms of wet rot of watermelon fruits were observed resulting in positive results for the presence of *A. citrulli*. Considering that during production, fields weren't under official surveillance, from 2020 up today program for the presence of *A. citrulli* in Republic of Srpska (RS) was suggested by the Commission for Plant Protection based on risk analysis and approved and financed by Ministry of Agriculture, Forestry and Water Management of RS. From 2020 until 2024 survey was performed in 6 regional units, as well from import. A total of analysed samples for 5-year period (2020-2024) was 276. Laboratory tests were carried out in accordance with the EPPO diagnostic protocols 7/127 (1): conventional tissue isolation method and a conventional polymerase chain reaction (PCR) method using SEQ ID no. 3: 5'-GGA AGA ATT CGG TGC TAC CC-3' SEQ ID no. 4: 5'-TCG TCA TTA CTG AAT TTC AAC A-3' primer pair. Nucleic acid extraction is done using the DNeasy Plant Mini Kit (Qiagen), following the manufacturer's instructions. During 2020 43 samples were analysed, respectively. Number of analysed samples for 2021 was 50, in 2022 and 2023-45, and in 2024-93. Based on the conducted laboratory analysis during 2020-2024, all tested samples were negative for the presence of *Acidovorax citrulli*.

Key words: *Acidovorax citrulli*, quarantine pests, symptoms, outbreaks, survey, Republic of Srpska

Acknowledgment

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**Efficiency of the Subirrigation System in Container Seedling
Production of *Levisticum officinale***

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Abstract

Levisticum officinale is a perennial aromatic plant from the *Apiaceae* family, widely used in the culinary, medicinal, pharmaceutical, and cosmetic industries. Its leaves, stems, and roots are utilized as a spice, while its extracts are applied for their antioxidant and diuretic properties. Essential oil is used in perfumery, and the plant is occasionally added to animal feed. The demand for *L. officinale* primarily comes from the food, pharmaceutical, and herbal industries, and it is particularly sought after in the organic market due to its application in natural medicines and nutrition. Given these factors, there is a need to improve seedling production methods. The aim of this research was to evaluate the efficiency of containerized seedling production of *L. officinale* using a subirrigation system, compared to traditional methods using transplant trays. The experiment was conducted in April 2024 at the Institute for Medicinal Plant Research “Dr Josif Pančić” in Pančevo, using seeds from its collection. The seeds were sown in containers equipped with a subirrigation system and in transplant trays using the misting method, both filled with the commercial substrate “Cultivo I SF.” The containers were placed in controlled conditions in a tunnel greenhouse with an average daily temperature of 24.5°C and relative humidity of 72%. The containers were equipped with an automatic subsurface irrigation system, while the transplant trays were fitted with a misting system. Both systems were programmed to maintain substrate moisture at 70%. The results showed that the number of emerged seedlings in the subirrigation system was 18% higher, while the seedling weight was 12% greater, primarily due to enhanced root development. Based on these results, the use of the subirrigation system for *L. officinale* seedling production is recommended.

Key words: seedling production, transplant trays, irrigation

Acknowledgment

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**The Impact of Sowing Density on the Productivity and Growth Dynamics
of *Ocimum basilicum* Grown as Microgreens**

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Abstract

The increasing interest in fresh, functional, and nutraceutical products has driven the demand for healthy and longevity-promoting foods, with microgreens gaining popularity due to their vibrant colors, delicate texture, and rich phytonutrient content. Among various microgreens, *Ocimum basilicum* is widely recognized for its aromatic, bioactive properties, and nutritional composition, making it a promising functional food. This study aimed to investigate the impact of sowing density on the productivity, growth dynamics, and quality of *O. basilicum* cultivated as microgreens, with a focus on improving production efficiency. The experiment was conducted in November 2024 in a controlled environment with three sowing densities: 2.5 g/m² (control), 3.5 g/m² (T1), and 4.5 g/m² (T2). Key parameters such as seed germination, plant height, leaf area, and fresh yield were evaluated throughout the growth cycle. Results showed that higher sowing densities (T2) positively affected seed germination and plant height during the initial growth stages. Although initial growth was more vigorous in the control treatment (K), the differences between treatments became less pronounced over time. The study concluded that optimizing sowing density is crucial for maximizing microgreens yield and improving the overall sustainability of basil production, providing valuable insights for commercial growers.

Key words: basil, germination, growth dynamics, nutraceuticals

Acknowledgment

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Antibacterial Potential of *Erigeron annuus* Essential Oil

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Abstract

The massive use of chemical preparations, preservatives and antibiotics in order to protect agricultural products has resulted in the emergence of toxic secondary compounds and resistant microorganisms, which have become a threat to general human health as the ultimate consumption of these products. Improper application of agrotechnical measures during cultivation, unhygienic measures in the process of production, packaging, transport and storage has led to the colonization of both fresh and final agricultural products by potentially pathogenic and pathogenic bacteria and of the genus *Pseudomonas* sp., *Staphylococcus* sp., *Salmonella* sp., *Shigella* sp., *Enterococcus* sp., and *Escherichia* sp. For these reasons, studies have been developed to find new, more effective and safe alternative biopreparations and preservatives, of natural origin, that have the potential to inhibit the growth of these bacteria. The aim of this study was to investigate the antimicrobial effect of essential oil of *Erigeron annuus* on the growth of the bacterial species *Escherichia coli* and bacteria of the genus *Salmonella* sp., *in vitro* conditions. Chrysooka oil was extracted by the Clavenger water distillation method, and the antimicrobial activity was determined by the Mueller-Hinton test-diffusion method. After incubation at a temperature of 37°C for 24 hours, the results were interpreted according to EUCAST (The European Committee on Antimicrobial Susceptibility Testing) and CLSI (Clinical and Laboratory Standards Institute) standards. The obtained results showed that the investigated distillate of this plant species has a stronger inhibitory effect on the growth of bacteria from the genus *Salmonella* sp., compared to the bacterium species *Escherichia coli*.

Key words: essential oils, test-diffusion method and inhibitory activity

Plant Extracts suppress *Meloidogyne chitwoodi*

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Abstract

Root-knot nematodes *Meloidogyne* spp. are one of the most economically significant plant-parasitic nematodes in the world. They have worldwide distribution, and they are obligate parasites of the roots of thousands of plant species. *Meloidogyne chitwoodi*, regulated quarantine species, has a wide host range including economically important crops potatoes, carrots, and tomatoes. Control measures are based on effective long term crop rotation or synthetic nematocides. They have a very short life cycle, in ideal conditions it is 3 to 5 weeks, and high reproduction potential. Infected potato tubers found in a sample of imported potatoes were used in the study. Four tubers without symptoms, 4 tubers with medium symptoms, and 12 tubers with severe symptoms. The aim of this research was to evaluate the effect of plant extracts AromaDEZ on development of populations of *Meloidogyne chitwoodi* from infested tubers. Three types of tubers were chosen, with strong symptoms, weak external symptoms and without external symptoms, but with low number of the nematodes within tubers. Two concentrations of powder formulation of plant extracts, 10 g/l and 20 g/l, were applied per pot. Each treatment consisted with four replicates, and negative control without extracts. In control at all three types of tubers there was multiplication whereas in treatments with bought concentration of the plant extracts there was no multiplication of the nematodes. These results reveal potential of AromaDEZ as a biological control agent against root-knot nematodes.

Key words: biological control, root-knot nematodes

Changes of Dendroflora Composition of the Park Complex of the Protected Area “University City”

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Abstract

The paper presents the results of dendroflora composition changes in the park complex of the protected area ‘University City’ in Banja. The introduction of new plant species results from management measures defined by the Management plan of the protected area „University City“. Management measures are carried out continuously as improvement and biodiversity preservation activities in this protected area. In 2018, the park complex dendroflora comprised 103 taxa (Kuzman, 2018). Between 2018 and 2024, the protected area “University City” park complex is enriched with a total of 72 new taxa. Plant nomenclature follows Atlas of Trees and Shrubs (Šilić, 1990), Ornamental Trees and Shrubs (Šilić, 1990), and the modern taxonomic bases of Euro+Med (Euro+Med, 2006), World Flora Online (WFO, 2021). A total of 620 individual plants were recorded, with 56 conifers and 564 deciduous trees. Of the 72 newly recorded taxa, there are 55 species and 17 varieties and hybrids, which include 7 conifers and 65 deciduous trees. Of all the recorded taxa, 24 were autochthonous and 48 allochthonous. A total of 50 genera were recorded; the most numerous genus was *Acer* (9 taxa). A total of 30 families were recorded; the largest number of coniferous species belonged to the family Cupressaceae (4 taxa), with the largest number of deciduous species belonging to the family Rosaceae (13 taxa). From 2018 to 2024, some of the following species were introduced: *Abies alba* Mill., *Acer heldreichii*, *Acer griseum*, *Carpinus betulus* 'Fastigiata', *Celtis australis* L., *Cornus kousa* Burger ex Hance, *Cotoneaster lacteus* W. W. Sm., *Cupressus arizonica* Greene, *Diospyros virginiana* L., *Sorbus aucuparia* L., *Sorbus torminalis* (L.) Crantz, *Staphylea pinnata* L., etc.

Key words: dendroflora, nature protection, urban green areas, genetic resources

Evaluation of Woody Species Biodiversity in the Bodani Monastery Garden

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Abstract

This study examines the biometric parameters of the vegetation within the Bodani Monastery complex, a historic and cultural landmark in the Bačka region of Serbia. The aim was to analyze the adaptation, decorative characteristics, and vitality of representative plant species in the garden. The research focused only on representative woody species (trees and shrubs) selected for detailed bioecological analysis. To ensure consistency, the evaluation focused on the most representative individual of each selected species, considering that the plants were planted at the same period. A bioecological analysis was performed, alongside biodiversity assessments using Shannon, Simpson, and Fisher's alpha indices to determine diversity and ecological value. The climatic conditions of the study area, characterized by a moderate continental climate, provide optimal growth conditions for both deciduous and coniferous species. Dominant genera include *Quercus*, *Tilia*, *Acer*, *Pinus*, *Abies*, and *Taxus*, with *Acer* showing the greatest species diversity. Biodiversity analysis revealed a Shannon index of 3.33, a Simpson index of 1, and a Fisher's alpha value of 17.07, reflecting high diversity and ecological importance. Bioecological evaluation showed that all observed individuals achieved the highest possible decorative score, reflecting their high aesthetic value. These findings show the garden's importance as a botanical collection that includes both native and non-native species, contributing to its ecological, aesthetic, and cultural significance. The study highlights the need to preserve this heritage site through conservation practices that consider its historical and ecological roles. Proper vegetation management will ensure the garden remains an example of biodiversity preservation within cultural heritage sites.

Key words: biometric analysis, biodiversity indices, bioecology

Acknowledgment

We acknowledge the Ministry of Science, Technological Development, and Innovation of the Republic of Serbia (Contract No. 451-03-66/2024-03/200117 and 451-03-65/2024-03/200117.) In addition, this abstract covered one of the research topics conducted by the researchers gathered in the Center of Excellence Agro-Ur-For at the Faculty of Agriculture in Novi Sad, supported by the Ministry of Science, Technological Development, and Innovation, contract number 451-03-4551/2024-04/17.

From Dormancy to Growth: The Key Role of Stratification in *Ginkgo biloba* Propagation

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Abstract

Ginkgo biloba L. seeds exhibit exo-endodormancy, requiring specific treatments to break dormancy and enhance germination. Due to its medicinal properties and ornamental value, *Ginkgo biloba* holds significant importance. However, its low germination rate presents challenges for successful propagation. Increasing demand for high-quality *Ginkgo* seedlings emphasizes the need for optimized germination techniques. Germination rate refers to the percentage of seeds that successfully sprout under specific conditions, while germination energy reflects the speed and uniformity of the germination process. These parameters are crucial for evaluating the effectiveness of propagation strategies. The aim of this study was to examine the effect of varying stratification durations and direct sowing on the germination rate and energy of *Ginkgo biloba* L. seeds. A total of 160 seeds were divided into four groups: one control group (direct sowing in pots without stratification) and three treatment groups subjected to dark stratification for two, three, and five months. Stratification was conducted in darkness at a cellar temperature of 4–12°C, with watering every two weeks or as needed. Germination rate and germination energy were measured. The results showed that seeds stratified for five months achieved the highest germination rate (85%) and germination energy (60%), while seeds directly sown had the lowest values (less than 10% for both parameters). Statistical analysis confirmed the significant influence of stratification duration on both parameters. The findings suggest that a minimum five-month stratification period is crucial for optimal germination of *Ginkgo biloba* seeds. These results contribute to the understanding of *Ginkgo* seed biology and provide practical guidelines for improving propagation techniques. Implementing the recommended stratification methods can increase germination rates and seedling quality, promoting the sustainable production of *Ginkgo biloba*.

Key words: dormancy, germination, stratification, ginkgo, propagation

Acknowledgment

We acknowledge the Ministry of Science, Technological Development, and Innovation of the Republic of Serbia (Contract No. 451-03-66/2024-03/200117 and 451-03-65/2024-03/200117.) In addition, this abstract covered one of the research topics conducted by the researchers gathered in the Center of Excellence Agro-Ur-For at the Faculty of Agriculture in Novi Sad, supported by the Ministry of Science, Technological Development, and Innovation, contract number 451-03-4551/2024-04/17.

Phytophthora Root Rot of Lavender in Montenegro

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Abstract

Lavender (*Lavandula angustifolia*) is an aromatic plant widely cultivated as an ornamental plant in Montenegro. In 2024, one of the lavender producers in the locality Martinići, municipality of Danilovgrad, reported a mass drying out of the plants. In a greenhouse where a total of 2,000 lavender plants were grown, more than 600 plants suddenly dried up, which is over 30%. The main symptom is the sudden wilting of apparently healthy plants in late spring or summer. The leaves of the lavender first turn gray, and then the affected parts of the plant decline permanently. In the phytopathology laboratory of the Biotechnical Faculty, several symptomatic lavender plants were examined for causal agent. The bark around the root collar was removed with a sterile scalpel and the presence of necrotic lesions or rot was detected throughout the root system. After removing the soil from the roots, the lavender plants were placed on sterile filter paper in a moist chamber. After 3 days of incubation at 25°C, white mycelium appeared on the surface of the symptomatic roots. Microscope observation of the mycelium revealed the presence of zoosporangia and oospores, indicating that the cause of lavender decline could be a fungus of the genus *Phytophthora*. In order to confirm this finding, fragments of the lavender root system at the transition between the diseased and healthy parts of the tissue were macerated with an extraction buffer and subjected to *Phytophthora* spp. Lateral Flow Test. Positive results of the serological testing confirmed the presence of *Phytophthora* spp. causing root rot on lavender. This finding indicates that *Phytophthora* spp. can cause severe damages in lavender production in Montenegro.

Key words: lavender, *Phytophthora* root rot

Acknowledgment

This work was realized as a result of the project "Biofungicides application in agriculture and urban areas (BIOAPP)" supported by the Ministry of Education, Science and Innovation of Montenegro.

Nematode Fauna Diversity in Different Soil Management Systems

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Abstract

Nematodes are the most numerous metazoans on Earth. Their abundance in response to environmental factors makes them excellent bioindicators. However, a major limitation in utilizing nematodes as bioindicators is the lack of taxonomic knowledge. The aim of this study was to determine nematode population composition at the feeding type level across four cropping systems. Samples were collected from the Experimental-Educational Center of the Faculty of Agriculture, University of Banja Luka. Four samples were taken from each cropping system: (1) a plum orchard with an herbicide strip in the row space, (2) a plum orchard with plastic mulch in the row space, (3) permanent grassland, and (4) an arable field with hemp. The highest number of nematodes was found in samples from permanent grassland, followed by hemp, the orchard with an herbicide strip, and the orchard with plastic mulch. A similar pattern was observed for plant-parasitic nematodes and root-lesion nematodes, the most economically significant groups present in the samples. Predatory nematodes were most abundant in hemp, while the lowest number was recorded in the orchard with plastic mulch. Bacterivorous nematodes were also most abundant in hemp, with the lowest numbers found in the orchard with an herbicide strip. The distribution of fungivorous and omnivorous nematodes followed the general pattern of total nematode abundance. The abundance and ratio of specific nematode feeding groups can reflect soil biological activity, soil health, and overall soil condition.

Key words: bioindicators, root-lesion nematodes, orchard floor management

Design of a Completely Eco-friendly Mulch Foil for Agricultural Production

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Abstract

Mulching is an ancient technique for covering the topsoil used in agriculture and gardening practice. It protects the plants from low temperatures, moisture loss, insects and pests, soil erosion, and weed growth. At first, it included materials like stones, pebbles, wood chips, straws, or leaves, but during the 1950s, plastic (especially polyethylene) gained popularity and became the most commonly used material for mulching. According to FAO, 2.5 million tons of plastic mulch films are used in agricultural production annually. The lack of their recyclability and their decomposition in the fields during tillage and under UV irradiation leads to the accumulation of microplastics in soil. The United Nations Environment Programme calls for a solution to reduce soil microplastic levels, as it poses a serious risk of pollution and harm to the ecosystem and human health. This work aims to synthesize new biobased and biodegradable mulches using renewable resources to replace the currently used plastic films. To achieve this, different natural polymers and their combinations are tested. The mechanical properties, permeability, and degradation rates of the obtained mulch prototypes are studied. For the validation of mulch efficiency experiments on plants cultivated with the prototype films, plants with plastic films and control plants, are conducted. Tomato and radish are chosen as model plants to monitor their morphological and physiological characteristics during biological study. Soil analysis before and after planting will assess the impact of foils on soil quality and active microbial population. This innovation will enable the replacement of the existing plastic and bioplastic mulches with a completely eco-friendly solution.

Key words: mulch, plastic, agriculture, pollution

Acknowledgment

This research was supported by the Science Fund of the Republic of Serbia, Grant No 14889, Fully biobased and biodegradable mulches for plastic-free agriculture – Bio4Future.

Session 2: Agricultural Economics and Rural Development

Oral Presentations



O2_01

Agri-food import dependency and certain determinants in the context of the EU integration processes: Evidence from Bosnia and Herzegovina, North Macedonia and Croatia

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Abstract

The agricultural sector is a cornerstone of economic and social development in Bosnia and Herzegovina, North Macedonia and Croatia, which are at different stages of EU integration: Croatia has been a member since 2013, North Macedonia began accession negotiations in 2022 and Bosnia and Herzegovina has not yet started the negotiations. Despite these differences, all face significant challenges, including small-scale rural holdings, land fragmentation, high migration, inadequate infrastructure and climate change impacts. These factors contribute to low productivity and sustainability, leading to increased agri-food imports. This study examines the dynamics of import dependency in the agri-food sectors of these countries and their relation to certain agro-economic indicators. Secondary data from the national statistical offices, FAOSTAT and the World Bank from 2010 to 2023 are used for the examination. The analysis employs descriptive statistics, trend analysis, Independent Samples T-Test and Person correlation coefficient, to evaluate the Import Dependency Ratio (IDR) and its relationship with key indicators: Gross Value Added (GVA), agricultural land area and rural/urban population share. Results show that Bosnia and Herzegovina has the highest IDR (mean 38.79%) with low variability, North Macedonia has the lowest but most volatile IDR (mean 15.71%, CV = 41.27%) and Croatia exhibits a moderate IDR (mean 31.93%) with notable increases post-EU accession. Trend analysis reveals a rising IDR in all countries. The T-Test confirms a statistically significant increase in Croatia's IDR after joining the EU ($p = 0.020$). The correlation analysis revealed a negative correlation between IDR and the share of the rural population in all three countries, while its relationship with Agricultural land and GVA varies. In conclusion, the findings highlight growing agricultural import dependency, particularly in the post-EU accession period. Strengthening domestic production and enhancing policy measures are essential to improve self-sufficiency and ensure sustainable rural development in the examined countries.

Key words: import dependency ratio, agri-food sector, gross value added, agricultural land, rural/urban population

**International Markets Influence on Cow's Milk in
The Republic of North Macedonia**

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Abstract

In last decade, the competitiveness of livestock production in Republic of North Macedonia is constantly decreasing, primary as result of negative trend and declining of livestock number, followed by decreasing in total production and productivity per animal. The livestock production has small (around 30%) participation to agriculture gross value added. The cattle and cow milk are the primary source of milk. The annual production of raw cow's milk in 2023 was around 2.4 million liters. The sheep and goats' milk have significant role as they are used for higher value-added milk products, but production of this milk is around 20% of the cow's milk. According to the Common Market Organization Rapid Market Assessment in North Macedonia, there are around 12 thousand specialized dairy producers, with rather small herds (less than 10 cows). This study is aiming to better understand the competitiveness of the milk sector and international markets influence on Macedonian cow's milk prices. The study uses the series of 204 monthly cow's milk price data from January 2005 to December 2021 for Macedonia, compared using statistical and mathematical methods with the EU and non-EU countries milk markets. In general, Macedonia has lower purchase milk prices (EUR 28.95), compared to EU (EUR 32.77) per 100 kg milk, but still prices follow the EU trend. The results present relatively low correlation of Macedonian milk prices with the EU prices (0.52). The prices in Macedonia react slowly on international markets changes with 3 months delay period, according to the lag tests (BIC, HQIC, AIC and FPE). The forecasting model (Granger causality test) can be used for prediction of the prices trends and clearly shows the impact of Covid-19 and Ukraine crises, on increasing of the milk prices and market disturbance.

Key words: cow's milk prices, international prices, agri-food prices, forecasting

Weather Influence on Yield, Sugar Content and Market Value of Sugar Beet

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Abstract

This study analyzes the impact of temperature, precipitation, sunlight hours, and humidity on the sugar content of major sugar beet varieties in Slovenia from 2017 to 2023, following the reintroduction of sugar beet production. We identify key weather factors influencing sugar content by examining correlation coefficients and applying machine learning models. A significant negative correlation was found between night temperatures in August–October and sucrose content. Based on the expected sugar content influenced by weather conditions, we also analyze the economic implications for sugar beet production. These findings help optimize cultivation practices, improving yield quality and economic viability in a changing climate.

Key words: sugar beet, sugar content, weather parameters, machine learning, predictive models

Acknowledgment

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O2_04

Sustainability and its Determinants for Farms Participating and not Participating in Short Food Supply Chains - Comparative Analysis from Poland

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Abstract

The impact of short food supply chains (SFSCs) on agricultural sustainability is not fully understood and the results of individual studies are ambiguous. Therefore, the aim of the research is to indicate how sustainable are farms participating in short sale systems compared to farms not participating. Three sustainability components were considered: economic, social and environmental, while simultaneously defining the significance of the individual variables differentiating farms of both types. The measures are based on primary data, originating from 199 in-depth interviews. 94 farms participated in the SFSCs and the remaining 105 did not. The surveys were addressed to small or medium farms; hence the following criteria were defined: agricultural area up to 30 ha UAA and Standard Output SO up to EUR 50,000. The study was conducted in three steps. In the first, synthetic measures of economic, social and environmental sustainability were constructed. In the second, the significance of differences between the mean values of the three sustainability components for SFSC-farms and non-SFSC farms was assessed. For this purpose, the nonparametric Mann-Whitney U test was used. In the third stage, the influence of selected variables shaping the components of sustainability on the probability of farms participating in short supply chains was determined. For this purpose, logistic regression was chosen. Results shows that the surveyed farms in Poland participating in SFSCs are clearly more sustainable in the social dimension compared to non-SFCS farms. In the case of the economic dimension, the differences were less marked but still statistically significant, while no clear differences were noted for environmental sustainability. Further results demonstrate that among social variables better housing conditions and higher socialization significantly increase the likelihood of participation in SFSC. For the economic dimension, output per hectare and farmer's subjective assessment of the financial situation have the highest impact.

Key words: sustainability, short food supply chain, socio-economic, environmental, Poland

Modeling the Development Goals of Agricultural Farms using the Delphi Method

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Abstract

The subject of this research is determining priority development goals of agricultural farms in the Middle Banat (Vojvodina, Serbia). The survey was conducted with students of the Agricultural School in Zrenjanin who are owners of agricultural farms. They ranked and assessed priority of ten development goals for agricultural farms using the Delphi method. The development goals offered in survey were: 1. Intensification of existing production (better and larger fertilization and investment in protection and care), 2. Renewal of machinery, 3. Expansion of capacity (purchase of new land), 4. Improvement of management (acquiring new knowledge in economics and entrepreneurship for better farm management), 5. Intensification of livestock production, 6. Processing of own products, 7. Change in production structure, 8. Development of agritourism on farm (and other production services), 9. Contracting sales before production (guaranteed placement), 10. Obtaining favorable financial resources for investment from the state or a bank. Survey was completed by 42 final-year students in two rounds. The proposed goals were rated from 1 to 10 (10 being the most important, 1 being the least important). An analysis of survey was conducted. The results showed that the most important development goal, according to surveyed farmers, was the expansion of land capacity (3), specifically the purchase of new land, with an average score of 7.81. The least important goal was "development of agritourism on farm" (8), with a score of 3.00. In the second round, when surveyed students were informed of the average opinion of the majority, they confirmed the previous view that expansion of farm capacity through purchase of new land is the most important development goal. Analysis results indicate that young agricultural producers are not ready for qualitative changes (to fundamentally change their activities), but rather see progress in quantitative changes (increasing capacity).

Key words: agricultural farms, development goals, Delphi method

O2_06

Needs Assessment of Gender Mainstreaming in Agriculture and Rural Development of Bosnia and Herzegovina

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Abstract

The objective of this paper is to identify gender gaps in policies relevant for the agriculture and rural development sectors and assess the vulnerabilities of rural women to climate change. In doing so, this document reviews the progress in gender equality since the release of the first comprehensive assessment of gender issues in Bosnia and Herzegovina agrifood system in 2021. This analysis is based on a desk review of the existing policy and legislative framework of all levels of government in Bosnia and Herzegovina, including the project areas, and a review of available statistical and other data related to demographic, socio-economic and rural development indicators. Additionally, the review integrates the finding of the mobile survey of 142 women in the Federation of Bosnia and Herzegovina and 109 women in Republika Srpska. Results of the research show that women's significant participation in agriculture is still underrecognized. Migration from rural areas, particularly among the youth, underscores deep-seated dissatisfaction with rural life due to poor job prospects, inadequate infrastructure, and a perceived lack of governmental support. Most rural households are not market-oriented in the project areas, and women face additional challenges such as smaller plot sizes and lack of asset ownership, which hinder access to financial resources and support programs. While there has been a small but not sufficient increase in women farm ownership and active participation in decision-making, women's representation in policy discussions remains low. Diversification efforts of agricultural households are common but limited by production capacities and market access. Women rely on direct sales with limited use of digital tools for marketing. There are significant gaps in advisory service access, particularly in the Federation of Bosnia and Herzegovina. Addressing these gaps through gender-responsive policies and improved access to resources and information is essential for sustainable rural development and effective climate change adaptation. A structured approach that combines various strategies should be in place to adequately address rural women's needs and concerns in the programming process. Organizing an umbrella federation and support network of rural women's associations at the entity level can be a way for their active involvement in the planning of policies and support measures in agriculture and rural development.

Key words: gender, agriculture, rural development, policies

Spatial Distribution of the Young Population in the Republic of Srpska

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Abstract

The main goals of the research were to determine: (1) the spatial distribution of the population (population density), (2) the share of young people in the total population, (3) the average annual growth/decline rate of the young population, and (4) relative change in the young people share in the total population in the Republic of Srpska (RS), one of the two entities in Bosnia and Herzegovina. Some data has been updated for 2022, and in case of changes, the data for 2022 was compared with 2013, the year of the last population census. All data were analyzed at the level of local self-government units, cities or municipalities, which enabled a more detailed analysis of spatial distribution and population changes. The research used methods of descriptive statistics, analysis of structure and rate of change, with spatial display of the results on a "blind" map of the Republic of Srpska. The results of the research showed that the Republic of Srpska is relatively sparsely populated, with high population density in only several cities, that young people are concentrated in the most populated areas of RS, that the annual growth rate of young people in many municipalities in the analyzed ten-year period (2013-2022) was negative, and that the number of young people in total population is decreasing in most municipalities. Such conditions and trends are worrisome, and economic and pro-natalis policy measures should be used to slow down the migration of young people from the demographically vulnerable parts of the Republic of Srpska. The results of this research can serve as a basis for analyzing the situation and planning future responses, not only at the level of entities but also at the level of cities and municipalities in the Republic of Srpska.

Key words: young population, spatial distribution, population density, migration

Preferences of Young Farmers in the Republic of Srpska

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Abstract

The aim of the research was to determine the preferences of young farmers regarding rural life and farming. The research was conducted using the online survey method, and data processing was done using descriptive statistics methods. The survey was conducted in the period October-November 2024. The sample had the characteristics of a randomly selected sample, and all responses were from municipalities in the Republic of Srpska. The opinions of 65 young farmers were collected in the aforementioned manner. The results confirmed that a high percentage of young farmers (85%) preferred life in the countryside and want to live there. The main reasons for their positive attitude towards the rural life are constant contact with nature, healthier environment, and less stress. The main demotivating factors are difficult conditions for raising children, alienation and loneliness, and poor physical infrastructure. A third of young farmers want to separate from their parents and set up their own farm. The young farmers rated possession of knowledge and the availability of incentives as the key preconditions for farming. They are followed by the lease or ownership of agricultural land, buildings and equipment. They rated the possibilities of securing additional labor and credit as the least important. Young farmers expect from the Government, first of all, the provision of additional incentives for youth and stimulating pro-natal policy measures. Skepticism prevails among young farmers regarding benefits of BiH joining the EU, 38% of them expect a worsening of their position, 33% do not expect significant changes, and 30% expect an improvement of their position. The conclusion and recommendation are that the government and other institutions should take into account these expectations of young farmers when creating and implementing agricultural and other policies, and that similar research be conducted more frequently and with a greater scope.

Key words: young farmers, preferences, rural life, farming, the Republic of Srpska

O2_09

**Development of Mechanisms for Successful Rural Active Generational Renewal –
Initial Case Study for Agricultural Sector of the Republic of Srpska**

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Abstract

Agriculture, as a strategic sector, plays a crucial role in ensuring food sufficiency. The most significant group ready to adopt new approaches in food production and rely on the use of new technologies is young agricultural producers. However, among the holders of agricultural farms in Europe, only 11% are under the age of 40. Agriculture as a profession ranks at the bottom in terms of attractiveness for young people in Europe, prompting numerous countries to seek ways to attract youth who will become the future leaders of the agricultural sector. In the Republic of Srpska, the percentage of young agricultural producers is 9.3%, while the average age of farm holders is 62 years. At the level of the Republic of Srpska, mechanisms for generational renewal have begun to develop thanks to the collaboration of the University, Ministry of Agriculture and the NGO sector. These mechanisms have social, demographic, and economic dimensions and collectively influence the environment. Following actions are observed within the study: i) a support measure for self-employment of agricultural engineers, food technologists, and veterinarians, offering an initial grant of 40,000 BAM, ii) over the past 18 months, the project "Village of the Republic of Srpska – My Place to Live" was launched, featuring subsidized purchases of "Belarus" tractors, iii) capacity building for organizations representing youth in agriculture, the field campaign "Youth in Agriculture," the annual Conference of Young People in Agriculture of the Republic of Srpska, the "Golden Ear of the Republic of Srpska" award, and a media campaign promoting youth. The synergy of all these activities aims to influence demographic trends, reduce the effects of migration within the Republic of Srpska from smaller to larger communities, as well as international migration, increase birth rates, and improve the age structure of the population in rural areas.

Key words: youth, agriculture, rural areas, the Republic of Srpska

Attitudes of Young Consumers toward Farm Animal Welfare

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Abstract

This study aimed to examine the attitudes of young consumers (18-35 years old) in the Banja Luka region toward farm animal welfare and their willingness to support products from systems with higher welfare standards. A total of 230 respondents who consume animal-based products participated in the survey. The results indicate that most respondents (79%) are familiar with the concept of farm animal welfare, while 98% consider animal welfare protection on farms important. Women are significantly more familiar with the concept and perceive it as more important compared to men ($p < 0.05$). Respondents identified farmers (71%) as the key stakeholders in ensuring animal welfare, followed by veterinarians (66%) and animal protection organizations (51%). In contrast, consumers were perceived as the least influential stakeholders (63%). Statistically significant differences in attitudes toward specific stakeholders were observed between women and men ($p < 0.05$) but not in relation to respondents' age, education, household income, or place of residence ($p > 0.05$). The vast majority of respondents (96%) support financial compensation for farmers due to increased production costs resulting from higher animal welfare standards. Additionally, 91% of respondents are willing to pay a higher price for products from farms that uphold animal welfare standards, with 29% willing to pay up to 10% more and 27% willing to pay over 20% more. Women expressed significantly greater willingness to pay a higher price compared to men ($p < 0.05$). These findings indicate a high level of awareness among young consumers regarding animal welfare and their willingness to support production systems that ensure better welfare conditions for farm animals.

Key words: animal welfare, consumers' attitude, willingness to pay

Quality and Diversity of Traditional East Herzegovina Fruit Distillates

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Abstract

East Herzegovina's fruit distillates represent a cultural cornerstone and agro-industrial heritage shaped by its Mediterranean climate and diverse fruit cultivars. Building on prior studies of Western the Republic of Srpska (WRS) production dynamics, this paper examines Herzegovinian rakija through the lenses of tradition, terroir, and modernization. The Republic of Srpska's region of East Herzegovina is research location. Fruit distillates are traditionally produced, presented with pride as an inseparable part of cultural and family events. The study examined predominantly small non-commercial producers, characteristic of the region. Unlike the WRS focus on plum and apple, Herzegovinian producers emphasize as expected grape, but also fig, cherry and some notable rare distillates like pomegranate, with presumable microclimatic conditions imparting distinct aromas characteristic for the region. Most producers rely on grape distillate i.e., 77%, followed by the cherry used by 17% of the distilleries. Interviews with 30 Herzegovinian artisans reveal 73% reliance on wild yeast fermentation, underscoring a regional commitment to spontaneous processes. Most frequently, still pot capacity is 120 liters which is somewhat larger than most frequent capacity in WRS, which was 100 liters. During the research identified were issues with the process of fermentation such as predominant use of so-called open fermentation. There is a potential issue with frequent malt mixing reported by waste majority i.e. all of the respondents, going up to several times a day. Fermentation length is in comparison to WRS much shorter, which is adequate and reportedly measured. Problems are identified also with head and tail separation. Speaking of raw material, it is superb as most fruit is locally produced on the farm. It is reported that production is relatively small, with most producers owning several hundred vines. Recommendations for further consideration target the process of fermentation and distillation with necessary insights for many producers related to improvements in aging processes.

Key words: rakija, survey, small producers, rural development

Agri-Photovoltaics as a Strategic Response to Land-Use Conflicts in the Energy-Food Nexus: Evidence from the HyPERFarm Project

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Abstract

The global transition away from fossil and nuclear energy sources is intensifying competition for land between energy generation and food production. Agri-Photovoltaics (Agri-PV) presents an integrative solution by enabling simultaneous agricultural cultivation and photovoltaic electricity generation on the same land area. The DIN SPEC 91434 standard defines these systems by stipulating that agricultural productivity must remain at or above 66% of conventional yields, with photovoltaic structures covering no more than 10–15% of the farmland. Within the framework of the EU-funded *HyPERFarm* project, pilot Agri-PV installations were implemented in Belgium, Germany, and the Netherlands. These included both vertically and horizontally oriented systems, under which diverse crops such as barley, spinach, cabbage, and clover-grass were cultivated. A key demonstration site in Straßkirchen, Bavaria, coordinated by Weihenstephan-Triesdorf University of Applied Sciences (HSWT) in partnership with Krinner and Fraunhofer ISE, comprises a 0.5-hectare Agri-PV installation delivering 302 kWp. Crops such as barley, wheat, potatoes, and cabbage were grown beneath the modules, and biochar applications were tested for agronomic performance. Analytical focus was placed on yield stability, economic performance, and system efficiency. Central economic parameters include the unit electricity price, annual solar radiation, installed capacity per hectare, and distance to grid infrastructure. Agronomic yields under Agri-PV conditions showed only marginal reductions compared to control plots. Biochar effects were crop-dependent, revealing potential for further agronomic optimization. These findings underscore Agri-PV's potential as a scalable and climate-resilient land-use model. Its long-term viability will be determined by energy market dynamics and regulatory conditions such as peak electricity pricing frameworks. Agri-PV systems represent a critical interface between renewable energy expansion and sustainable agriculture.

Key words: agri-photovoltaics, integrated land use, renewable energy policy, sustainable farming system

Status of Soils linked to Climate Change in Agriculture in Serbia

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Abstract

There is a significant influence of accelerated climate change on soils in Serbia. All the categories of climate hazards present in the territory of Serbia have an impact on soil health. In 2023, there were 60 thousand ha flooded areas by surface and groundwater, of which 86.7% referred to utilized agricultural land. Serbia has seen increased frequency and severity of drought. In the period 2021-2023, the area of eroded soils ranged from 3,912 km² in 2021 to 4,095 km² in 2023, which makes up 5.3% of the territory of the economy. Soil erosion caused by wind, due to dry and hot weather and increased climate aridity, may further increase in the future. The average soil organic carbon content in Serbia has decreased and reached the low category with a further tendency to decrease, and is mostly impacted by land use and climate change. Recent research shows that from 2001–2020, 29% of Serbia faced moderate and 28% high soil degradation risk. By 2041–2060, these figures will rise to 52% and 42%, making Serbia largely a high-risk area by mid-century. Some of the adaptation measures outlined in the adopted Program for Adaptation to Changed Climate Conditions with an Action Plan (2023) directly address soil-related challenges: solving regulatory issues related to intended land use for mitigation and prevention of degradation. There is a measure aimed at increasing the resilience of meadows and pastures and their capacity to adapt to climate change. While the Program acknowledges the importance of soil, there appears to be a gap in adequately representing adaptation measures for this critical natural resource. This oversight could potentially exacerbate pressures on the soil, hindering effective climate resilience. It is crucial to integrate a more comprehensive set of adaptation measures specifically focusing on enhancing soil health.

Key words: soils, climate change, degradation, adaptation, soil health

**Spatiotemporal Study of LST Response to NDVI and NDBI Changes in
Kabul (2000-2025): Remote Sensing and GIS**

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Abstract

Urbanization and land use change significantly affect land surface temperature (LST), which affects local climate dynamics and environmental sustainability. Kabul, as one of the most densely growing cities in Afghanistan, has experienced rapid urban development, which requires an in-depth analysis of its thermal landscape. Using a remote sensing and GIS-based approach, this study conducts a spatiotemporal analysis of LST changes in response to vegetation (NDVI) and built-up areas (NDBI) in Kabul from 2000 to 2025. This research is critical for understanding the effects of the urban heat island (UHI), environmental degradation, and climate adaptation strategies in the region. MODIS satellite data are used to extract LST, while Landsat 7 images are used to calculate NDVI and NDBI, which allows for a comprehensive assessment of land cover changes. GIS techniques are used for spatial mapping, identifying temperature distribution patterns and their relationship with vegetation loss and urban sprawl. In addition, Excel is used for statistical analysis, establishing relationships between LST, NDVI, and NDBI over time. This study integrates multi-temporal satellite datasets to identify spatial trends, seasonal variations, and long-term changes in urban thermal behavior. Expected outcomes include identifying high-risk thermal areas, quantifying the impact of urban sprawl on temperature increases, and assessing the role of vegetation in reducing heat stress. These findings provide essential insights for urban planners, environmental policymakers, and climate adaptation strategies that contribute to sustainable urban development and climate resilience in Kabul. By establishing a data-driven understanding of the interactions between LST, NDVI, and NDBI, this research provides a foundation for mitigating urban heat impacts and improving urban environmental conditions.

Key words: LST, NDVI, NDBI, relationship, remote sensing, GIS, Kabul city, 2000-2025

O2_15

Particulate Matter (PM2.5) Spatiotemporal Analysis and Health Risk Assessment over Kabul City for 2024: A Remote Sensing and GIS Approach

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Abstract

Air pollution, especially PM_{2.5}, is a serious environmental and public health challenge in Kabul city, where rapid urbanization and industrial activities have exacerbated air quality problems. This study analyzes spatial and temporal changes in PM_{2.5} concentrations in Kabul for the year 2024 using MODIS satellite data, GIS techniques, and statistical analysis in Excel. The research aims to provide important insights into seasonal pollution trends and their potential health risks. The results show significant seasonal fluctuations, with the highest PM_{2.5} concentrations recorded in summer and winter due to meteorological factors such as temperature inversion, dust resuspension and increased warming emissions. Spatially, the central, southern and eastern regions show the most severe pollution levels, which are associated with high population density, traffic congestion and industrial activities, while the northwestern regions show relatively lower PM_{2.5} levels due to vegetation cover and fewer emission sources. Health risk assessment using the Ostro formula shows that exposure to PM_{2.5} significantly increases the risk of cardiopulmonary mortality and lung cancer, with the highest risk in April (RR: 1.6308 for cardiopulmonary mortality and 2.0790 for lung cancer). Furthermore, comparison with international and national air quality standards shows that PM_{2.5} levels throughout the year significantly exceed the WHO (5 µg/m³ annual average) and the Afghan ANAQS (35 µg/m³ annual average), classifying most months as hazardous. These findings underscore the urgent need for targeted air quality management strategies in Kabul, including tighter emission controls, improved urban planning, and increased green spaces. Future research should integrate predictive modeling and ground-based monitoring to refine air quality assessments and support evidence-based policymaking to protect public health and the environment.

Key words: PM_{2.5}, spatiotemporal vaiation, remote sensing, GIS, AOD, Kabul City, health risk

Session 2: Agricultural Economics and Rural Development

Poster Presentations



The Process of Creating a Business Idea in Agriculture

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Abstract

The process of creating a business idea is the first, but also one of the most important parts of the entrepreneurial process. An idea is a thought that actually leads to the world of entrepreneurship and the fulfillment of entrepreneurial dreams. Essentially, an idea is a brief description of the actions of a future business venture. There are different ways to come up with business ideas, and one of them is to identify a gap in the market, on which the idea discussed in this paper is based. The subject of the research paper is the author's own entrepreneurial idea of garlic production, cleaning, packaging and its marketing as a processed product, and the goal of the research paper is to find a way to turn the created idea into a business opportunity, so that the entrepreneurial venture is successful. Through the survey method, we collected the attitudes and opinions of respondents about the quality, consumption, production of garlic, as well as the attitudes and opinions about the conceptual product and the justification of the entrepreneurial idea. Three groups were examined, namely: end consumers / buyers, restaurant owners / representatives and store chain owners/representatives. The questionnaire included a sample of 151 customers/consumers, 10 restaurants and 4 retail chains within the Banja Luka region, i.e. cities, Banja Luka, Gradiska, Laktasi and Prijedor, and the municipalities, Mrkonjic Grad, Prnjavor, Srbac, Knezevo, Kotor Varoš, Sipovo, Celinac, Ribnik, Novi Grad, Kozarska Dubica, and other municipalities located in the territory of the Banja Luka region. The research concluded that, despite certain risks and threats, the idea has potential and that it has met with the agreement of the surveyed groups, and that with organized management it can become an opportunity for self-employment or an additional source of income.

Key words: creation of a business idea, production of garlic, packaging of peeled garlic, Banja Luka region

P2_02

Impact of Size, Type of Production, and Allocated Incentives on the Productivity and Profitability of Agricultural Enterprises in Republika Srpska

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Abstract

This paper investigates the impact of farm size, type of production, and allocated incentives on the productivity and profitability of agricultural enterprises in the Republic of Srpska. Using a sample of approximately one hundred enterprises from financial reports and agricultural databases between 2020 and 2024, the study employs variance analysis (ANOVA) and regression analysis to examine variations in Total Factor Productivity (TFP), Partial Factor Productivity (PFP), and profitability metrics. Results indicate that neither farm size nor type of production significantly affects productivity, with larger enterprises generally showing higher profitability per hectare. Future research should explore the specific factors influencing productivity, such as management practices and technology access. This study contributes to a deeper understanding of agricultural dynamics in the Republic of Srpska, emphasizing the need for comprehensive databases and tailored policies that address the diverse needs of agricultural enterprises to enhance economic viability and growth.

Key words: agricultural productivity, farm size, production type, profitability, incentives

Millet Market in the World

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Abstract

Millet is a collective term for the most important species are pearl millet, finger millet, proso millet and foxtail millet. Pearl millet accounts for almost half of global millet production. Millet is a gluten-free cereal. In the world, in the last years, growing interest in gluten-free grains is increasing, together with major incidences of celiac disease. Cereals like millet, maize, sorghum, and pseudocereals like buckwheat, amaranth, quinoa, and teff are the main ingredients for a gluten diet. The estimated prevalence of Celiac disease is around 1 % of the population in the western world and medical nutritional therapy is the only accepted treatment for celiac disease. To date, the replacement of gluten in bread presents a significant technological challenge for the cereal scientists due to the low baking performance of gluten-free products. The consumer's growing demand for high-quality gluten-free bread is in the world. The production of millet in the ten years (2014-2023; 29.48 million tons) shows a growth trend at a rate of 0.91%. However, millet production records a downward trend of 6%, from 32.1 million tonnes in 2022/2023 to 30,26 million tonnes in 2023/2024. In Asia and Africa, account for about 94 percent of global output, estimated at some 30 million tons (2023/2024 average). Of this, pearl millet accounts for about 15 million tons, foxtail millet for 5 million tons, proso millet for 4 million tons and finger millet for over 3 million tons. The major producers of millets in 2023/2024 were India (42%; 12,84 mil t); Niger (10%; 3,16 mil. t); China (9%; 2,7 mil. t); Mali (6%; 1.94 mil. t); Nigeria (5%; 1.56 mil. t); Senegal (4%; 1,35 mil. t); Ethiopia (4%; 1.1 mil. t); Burkina Faso (3%; 861000 t), Sudan (2%; 684000 t), and Chad (2%; 634000 t).

Key words: millet, gluten-free product, worldwide millet production

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Plum Market Trends in Serbia

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Abstract

The authors used a quantitative research method to analyze the market trends of fresh plums in Serbia. For this purpose, they used competitiveness parameters that were processed using standard descriptive statistics tools. The goal was to review the foreign trade of plums, as well as to determine the trend of competitiveness indicators for this fruit. The results show that during the analyzed ten-year period from 2014 to 2023, there was a slight downward trend in all production parameters of this fruit, but Serbia was self-sufficient in its production, as well as price-competitive on the world market. Also, a downward trend in certain competitiveness indicators was observed, which indicates a further strengthening of the market position of this fruit species. Further research should be focused on determining the causes of the trend in competitiveness indicators, as well as ways to strengthen them.

Key words: plum, market, competitiveness, export, import

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Market Potential of Common Buckwheat - *Fagopyrum esculentum* Moench.

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Abstract

The annual pseudocereal known as common buckwheat (*Fagopyrum esculentum* Moench.) is gaining popularity due to its use in modern diets and as a honey plant. Southwest China is where buckwheat originated and was domesticated. About 500 years ago, buckwheat is thought to have been brought to Europe via the Silk Road from northern China. Buckwheat can be included into some innovative culinary products made in Serbia and Montenegro for distribution both nationally and regionally. Buckwheat can be used in baked goods like bread, cookies, crackers, biscuits, as well as pasta, noodles, and other expanded items. It is possible to malt buckwheat and use it as a beer ingredient. Additionally, buckwheat products are being marketed to gluten-free consumers. The market for gluten-free products is increasingly being targeted by buckwheat products. To prevent and lessen small intestinal damage that results in nutrient loss, people with autoimmune celiac-disease must follow a rigorous gluten-free diet. Buckwheat is gaining popularity among gluten-free food developers due to its high protein, dietary fiber, and antioxidant content. Gluten-free product consumption has skyrocketed and is predicted to keep rising. Worldwide, buckwheat production is trending slightly upward. Approximately 5% of the 1.9 mil. ha of common buckwheat cultivated worldwide are currently planted in North America. Europe and Asia produce over 94% of the world's buckwheat, with Russia being the largest exporter (40% of worldwide export), and China and Japan being the largest importers. By combining conventional and contemporary breeding and selection methods, the factors limiting buckwheat production can be addressed. Buckwheat is a type of useful food item. When frequently ingested, functional foods - which can be either raw or processed - can have health benefits that go beyond those of basic nutrition. Buckwheat production may have a profitable marketing possibility in all surrounding areas with access to natural grocers and health-food merchants.

Key words: buckwheat, functional foods, gluten-free product, worldwide importers and exports

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**Socioeconomic Factors Influencing Rural Youth's Preferences on
Rural or Urban Way of Life in North Macedonia**

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Abstract

As rural communities face demographic shifts, including youth migration to urban centers, understanding the factors influencing these decisions is crucial for policy development. This research explores the preferences of rural youth in North Macedonia regarding living in rural versus urban areas and examines the influence on several key socioeconomic aspects such as gender, age, marital status, having children, employment, education, ownership of a family agricultural holding and overall rating of the quality of life in rural areas. A survey involving 550 young people living in rural areas was carried out by using a customized questionnaire, where data collection ensured nationwide representation across all Macedonian planning regions, nationalities, genders and types of villages. Data analysis included the use of standard descriptive statistic methods and a correlation analysis. Results indicate that in general, 52% of the rural youth prefers rural over urban life, which is also reflected in the percentage of migration. Agricultural households prefer rural life more than urban (59%), while non-agricultural households vice versa (33%). Key findings also show that young people who have and do not yet have children prefer rural life, especially those who don't have children (60%), assuming they still don't have a greater need for health services, kindergartens, schools, etc.). These findings suggest a complex interplay of the socioeconomic factors that influence the preferences of rural youth, highlighting the need for tailored development strategies that balance urban and rural needs. Ultimately, the study offers valuable insights for policymakers, crucial for retaining rural youth while promoting sustainable development in both urban and rural regions of North Macedonia.

Key words: rural youth, preferences, socioeconomic factors, correlation analysis, North Macedonia

BEAMING Project – Promotion of Bioeconomy and Valorization of Bioeconomy Knowledge

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Abstract

This abstract and poster presentation aim to announce BEAMING (Bioeconomy Excellence Alliance for Stimulating Innovative and Inclusive Green Transition) project, its objective and expected results to the academic and wider audience. BEAMING (www.beamingproject.eu) is a Horizon Europe project under the WIDERA work program which seeks to promote innovation and valorization of knowledge in the field of bioeconomy through cooperation between higher education and research institutions, with a special focus on widening countries in Central, South and Eastern Europe and the Western Balkans. With the shift of development goals to a sustainable and circular economy, the term bioeconomy started to be used. The bioeconomy encompasses the production, transformation, use and conservation of resources of biological origin. For the area of BiH and the Western Balkans, the bioeconomic approach is still relatively new, so it is necessary to clarify and promote this concept. The project aims to foster a systemic transformation by integrating innovative bioeconomy solutions, strengthening research and innovation capacities, and enhancing policy frameworks across the region. BEAMING project connects stakeholders from academia, industry, and government (in total 17 partners from 13 countries) to co-develop strategies that promote resource efficiency, climate resilience, and sustainable rural development. The expected result of BEAMING project is to create a knowledge-driven ecosystem that supports local bio-based industries, facilitates knowledge transfer, and empowers regional actors to implement sustainable practices. BEAMING is structured from 12 working packages under five pillars (Research excellence with societal impact; Open science practices; Knowledge valorization; Inclusive institutional culture; and Research support, management and QA assessment) which are being implemented following the quadruple helix methodology. The project is still in the initial phase of its implementation (its first year has recently passed) and more visible results coming in the remaining period.

Key words: bioeconomy, BEAMING, knowledge valorization, knowledge transfer, innovation

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**Modernization of Agriculture:
Impact on Rural Development and Environmental Aspects**

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Abstract

Modernization of agriculture brings significant changes to rural areas, affecting economic development, demographic trends and environmental challenges. The paper analyzes the process of implementing modern technologies in agricultural practice in Serbia, compared with European standards. Special attention is paid to the impact of modernization on productivity and environmental aspects, as well as on socio-economic effects such as employment and migration trends. Results show that the application of technologies such as precision agriculture, automation and digitization in Serbia lags behind the European Union average. While in the EU, modern technologies have a share of over 70% in agricultural production, in Serbia that percentage is around 25%. This gap indicates the need for additional investment and institutional support. The study also explores the negative aspects of modernization, such as deagrarianization and depopulation of villages, with recommendations for revitalization through sustainable practices. The conclusion is that it is important to align with European policies and use funds for rural development in order to overcome current challenges. Aim of this paper is to investigate the contribution of modernization to the revitalization of villages through innovation and the application of modern technologies, emphasizing the need for sustainable approaches to minimize the negative consequences on the environment.

Key words: modernization of agriculture, rural development, ecological aspects, sustainable agriculture, EU policies

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Evaluation of Land Suitability for Agricultural Production in Slovenia based on Natural Factors

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Abstract

Regionalization of agricultural land and agricultural zoning are processes of classifying and evaluation of the land suitability for different types of agricultural production based on an analysis of natural conditions and economic factors. Their main tasks are the optimisation of land use, the sustainable use of resources and the adaptation of agricultural production to climate change. The RajonSI project, which started in autumn 2024 and will last three years, focuses on improving agricultural production and sustainable spatial planning in Slovenia by analysing the suitability of land according to the type of production. Input variables include several data sets, namely soil data (pH, organic matter, texture parameters, bulk density, skeletonization), climate data (precipitation, temperature, evapotranspiration), topographic data (elevation, topographic wetness index, aspect, slope) and other environmental and spatial data (flood areas, water protection areas, land use). Climate data will be prepared for multiple climate scenarios which will lead to multiple classification scenarios. The suitability of agricultural land will depend on the type of production (general arable land use, general intensive orchard use, general viticulture use, and general permanent grassland use) and for major agricultural species/crops in plant production (maize, cereals – wheat and barley, potatoes, apples and pears, strawberries, American blueberries, pasture cut grassland, and pasture grassland). The project will use GIS data and algorithms to create agricultural suitability maps for Slovenia. The aim of the RajonSI project is to identify key factors for successful production and to develop information layers that will support decision-makers (Ministry of Agriculture, Forestry and Food) and farmers and will contribute to the sustainable use of resources and create a basis for increasing productivity in agriculture.

Key words: regionalization; agricultural zoning; natural resource; agricultural land

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Circular Economy of Agro-energy Crops

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Abstract

Plant biomass is a renewable source of energy. Serbia ranks among the top European countries in terms of the amount of available and unused biomass. The fact that agricultural production is declining in Serbia and that there is a large share of uncultivated agricultural land, as well as a significant share of degraded land, is a significant factor contributing to the orientation of growing agro-energy crops. The paper deals with the possibilities of developing and expanding bioenergy crops, which will contribute to the reduction of anthropogenic impact on the environment with their entire life cycle. Although the development and spread of these crops has been accelerated under severe criticism and doubts about their validity and economic justification, the last two decades have been marked by the establishment of a large number of plantations of agro-energy crops. The share of the use of biomass as a renewable resource in the energy sector from the aspect of environmental protection, under conditions of adequate use, contributes to a significant reduction of net CO₂ emissions compared to the use of fossil fuels for energy purposes. Ideally, energy crops should provide a high yield of dry biomass at a low cost, produced with the least pressure on the soil resource and with low nutrient and energy requirements. In addition, it should offer low susceptibility to diseases and pests and have good ground cover without reducing biodiversity. Improving the biomass yield of dedicated energy crops on a limited cultivation area is cited as one of the possible strategies for achieving effective and sustainable use of bioenergy.

Key words: agro-energy crops, biomass and bioenergy, energy sector, degraded land, circular economy

Acknowledgment

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Sustainable Management of Offshore Freshened Groundwater, Environmental Risks and Stakeholder Perspectives

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Abstract

Offshore Freshened Groundwater (OFG) presents a promising unconventional water resource to address growing freshwater scarcity in coastal regions. However, its extraction poses complex environmental challenges that require assessment to ensure sustainable utilization. This study explores key environmental risks associated with OFG exploitation, including sub-seafloor subsidence, alteration of submarine groundwater discharge, seawater intrusion, and potential impacts on marine ecosystems. An integrated Environmental Impact Assessment (EIA) framework was employed to quantify these risks. A quadruple helix assessment approach was utilized, incorporating perspectives from four stakeholder groups. A total of 84 stakeholders participated in the study, including representatives from civil society (10), governmental authorities (16), the private sector (14), and research institutions (49). Stakeholder input was collected through a structured questionnaire, which assessed both experienced and perceived environmental impacts across various stages of OFG operations, including drilling and completion, extraction and pumping, transportation, treatment, and distribution. Findings from stakeholder consultations highlight the necessity of ecosystem-based management strategies and robust monitoring frameworks to minimize environmental risks. While OFG resources present a potential alternative water supply, their viability depends on cost-effectiveness and environmental sustainability. The study aims to foster dialogue among researchers, policymakers, and industry stakeholders to develop sustainable strategies for OFG resource management in the face of environmental and climate-related challenges.

Key words: climate, change, adaptation, environmental, impact

Acknowledgment

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The Role of Women in Rural Areas of The Western Balkans

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Abstract

The Role of Women in Rural Areas of the Western Balkans study, prepared by the Standing Working Group for Regional Rural Development (SWG RRD), examines the socio-economic roles, challenges, and empowerment of rural women in the Western Balkan countries and territories, where gender disparities and rural underdevelopment persist as significant issues. This topic is crucial in development economics, gender studies, and rural policy, as rural women are vital contributors to agricultural production, environmental sustainability, and community welfare. Despite their contributions, they continue to face marginalisation in accessing land, credit, and decision-making opportunities. The research addresses a notable gap in gender-disaggregated data. It provides a regional analysis of the roles of rural women, particularly within the context of circular, green, and social entrepreneurship. The study aims to explore the conditions faced by rural women and identify policy measures that could enhance their empowerment and socio-economic inclusion. A mixed-methods approach was utilised, which included desk research, stakeholder interviews, focus group discussions, case studies, and a structured survey conducted across the Western Balkan countries and territories. The findings highlight various structural challenges, including patriarchal norms, inadequate infrastructure, gender disparities in property ownership, and a high representation of women in informal employment. Additionally, issues such as rural depopulation and youth migration further exacerbate the vulnerabilities faced by women. The key finding of this study is that while rural women in the Western Balkans exhibit moderate levels of empowerment, systemic barriers, particularly those related to land ownership, time burdens, and leadership opportunities, continue to impede progress. This research contributes to the field by providing the first cross-regional synthesis using the Female Empowerment Index (FEI). It offers concrete policy recommendations to enhance the roles of rural women as catalysts for sustainable rural transformation.

Key words: depopulation, migration, gender disparities, inclusion, entrepreneurship

Session 3: Crop Science

Oral Presentations



Data Management prior Statistical Processing in Multi Environment Yield Trial Analysis

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Abstract

The existence of genotype-environment interactions imposes the necessity of testing newly created genotypes of cultivated plants in multiple locations, years, and replicates. This is an expensive and demanding process, and the success in maize (plant) breeding depends on the results obtained. Therefore, breeders are fundamentally interested in the reliability of biometric analysis results, which is not possible without high-quality input data. Inadequate input data gives misleading results, causing inefficient use of significant resources. It has been shown that up to 30% of the sample data can be replaced with a calculated without significant loss of quality (Woyann et al., 2017). If it is a matter of replacing "bad" data, the quality and accuracy of the analysis results are significantly increased. In general, data can be considered high quality if they realistically reflect the performance of the genotype under study. Data cleaning should be based primarily on breeder notes, which relate to the plot assessment and in this sense, in the case of maize, at least two field assessments are necessary. Potentially unrepresentative data values can be indicated by Box plot analysis. Modern statistical programs have defined algorithms for calculating missing (inadequate) data. The importance of input data quality is also demonstrated by the fact that a good researcher spends more than 75% of his time on collecting, organizing and cleaning data and developing hypotheses, and only up to 25% on the actual processing of statistical data and deriving results. A typical result of data cleaning is a reduction in variance, standard deviation, coefficient of variation and least significant differences between genotypes. It is especially significant that the variance of the environment and the variance of the error in the ANOVA tends to decrease significantly compared to the raw data.

Key words: field evaluations, corn breeding, plot evaluation, reliability of results, raw data cleaning

Acknowledgment

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O3_02

Genetic Resources of Barley from the Balkans: Valuable Assets in the Era of Pan-Genomics and Gene Editing for Modern Breeding

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Abstract

Barley (*Hordeum vulgare* L.) is a key cereal crop, ranking fourth globally and was the third in ex-Yugoslavia. To preserve its genetic diversity, a collection initiative (1960-1980) established a gene bank with 150 landraces and 80 cultivars. In 2000, 106 spring barley landraces were evaluated for agronomic traits and disease resistance. Two genotypes (MB530, MB532) exhibited resistance to Barley Mild Mosaic Virus (BaMMV), while MB1012 was resistant to leaf rust (*Puccinia hordei*). Genetic diversity analysis confirmed their breeding potential. In recent years (post-2020), further characterization of these genotypes has been conducted within the IdeMoDeResBar project using advanced sequencing technologies (PAC Bio, RENSEQ, MutRESEQ). Genetic analysis of MB1012 identified resistance loci on chromosomes 1HS, 2HL, and 5H. Functional validation is ongoing using Cas endonuclease gene editing and virus-induced gene silencing (VIGS) to facilitate precise resistance gene integration into elite cultivars. For Barley Yellow Mosaic Virus (BaYMV) and BaMMV resistance, recent gene-editing efforts generated novel alleles of *rym4/5* and *rym1/11*, bypassing the need for lengthy introgression breeding. KASP genotyping linked East Asian resistance genes with Montenegrin landraces (MBR530, MBR532), suggesting a bi-phyletic origin. These findings, achieved in the last few years, support marker-assisted selection and accelerate breeding for resilient barley varieties. By integrating pan-genomics and gene editing, these Balkan genetic resources provide crucial tools for modern barley breeding, enhancing disease resistance.

Key words: barley genetic resources, BaMMV/BaYMV, Leaf rust, gene isolation, gene editing, pangenome

**Molecular Confirmation of Resistance to ALS Inhibitors
in *Sorghum halepense* L. (Pers.)**

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Abstract

Johnsongrass (*Sorghum halepense* L. (Pers.)) is a perennial species, which is found as a weed in over 30 different crops in 53 states. It is propagated by seeds and rhizomes. One plant can develop up to 90 m of new rhizomes in one year. The competitive ability of johnsongrass is associated with its extremely accelerated growth, high biomass accumulation, and its enormous reproductive capacity. It's even greater expansion is expected as a result of climate change characterized by high intensity of solar radiation, which favors C-4 plants. In the last decade, cases of weed resistance to ALS (acetolactate synthetase) inhibitors have been confirmed in Serbia, including johnsongrass. The detection of mutations responsible for the resistance of johnsongrass to ALS inhibitors was performed by analyzing 28 samples collected in different localities of Serbia. The primers specific for previously identified mutations in grass weeds were used. PCR amplification conducted in a 10 µL final volume mixture including 5 µL Final Assay Reaction (containing KASP master mix and primers) and 5µl DNA and PCR reaction conducted in real-time PCR. Based on fluorescence detection, in 20 analyzed samples a point mutation (at the second base of codon Trp-574 (TGG)), responsible for substitution of Trp-574 by Leu (TTG) in the ALS enzyme was detected. The Trp574-Leu (TTG) substitution is one of the most common ALS amino acid substitutions, which confers high levels and broad-spectrum ALS target-site resistance to all chemically dissimilar classes of ALS-inhibiting herbicides in many weed species.

Key words: Johnsongrass, molecular analysis, herbicide, resistance

Effect of Crop Diversification on Weed Biodiversity

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Abstract

In the last fifty years, crop rotations have become increasingly simplified, relying on just one or two crops. This simplification presents challenges for weed management, as it continuously exposes weeds to the same ecological and agronomic conditions, leading to dominance of certain species that are harder to control and quickly adapt to new management practices. Implementing a well-planned crop rotation alters the selection of applied agrotechnical measures specific to a particular crop and weed, influences the herbicide spectrum, and positively contributes to maintaining habitat biodiversity. We conducted a study to evaluate how crop diversification effects on weed biodiversity, using soil weed seed bank analysis across three different long term management systems: monoculture, 2-year crop rotation and 3-year crop rotation. The monoculture of winter wheat stood out as a plant crop production system with disrupted biodiversity (only 17 species) and the highest number of dominant species (*Bilderdykia convolvulus* (L.) Dum., *Papaver rhoeas* L., *Consolida regalis* Gray., *Veronica hederifolia* L., *Heliotropium europaeum* L.). In particular, segetal weeds dominate, serving as remnants of cultural heritage and indicators of traditional crop management. In the monoculture of maize, 18 species were recorded with *Sorghum halepense* (L.) Pers. being the absolutely dominant species. In monoculture of soybean, 22 species were recorded, with two most abundant: *Chenopodium album* L. and *Ch. hybridum* L. In the most commonly applied 2-year crop rotation (winter wheat–maize), weed diversity is significantly richer with 33 species, while in the traditional 3-year crop rotation (winter wheat–maize–soybean), as many as 39 species were observed. It is concluded that, in addition to increasing yield and profit and enabling sustainable production, crop diversification through the introduction of different crops and their corresponding management practices can help control weeds and reduce the selection pressure for herbicide resistance.

Key words: weed, biodiversity, crop rotation

Acknowledgment

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Heating Treatments for Increasing the Phytochemical Content?

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Abstract

Sweet maize and popcorn (maize with specific traits) are widely consumed in human nutrition. However, there is a lack of data on the impact of cooking, freezing and popping on the content of phytochemicals, highlighting the need for more intensive research. Sweet maize is a rich source of health-promoting phytochemicals, while popcorn has a high nutritional value as a whole-grain snack. This study aimed to examine the effects of microwave popping on the phytochemical content of popcorn and the impact of different cooking and freezing conditions on the phytochemical content of sweet maize. The content of carotenoids, tocopherols and phenolic acids was determined by liquid chromatography, while the essential minerals were quantified by inductively coupled plasma. Total phenolic compounds, total glutathione content, phytic acid and free radical scavenging activity were evaluated by UV/VIS spectroscopy. The principal component analysis revealed a distinct relationship between the changes in phytochemical content in response to the applied treatments, which varied depending on the tested hybrid. The results showed that blanching before freezing, immediate cooking with crystal sugar addition, and the combination of blanching before freezing with one-month storage followed by crystal sugar addition during cooking significantly increased the content of glucose, fructose, α -, β -, γ -, and δ -tocopherols, p-coumaric and ferulic acids in the sweet maize. Additionally, it was observed that microwave popping resulted in a notable increase in the levels of α -tocopherol and β -carotene in certain popcorn hybrids, while in certain popcorn hybrids resulted in decreased phytic acid content, enhancing the bioavailability of essential elements. The results of this study highlight the potential of various preparation methods for popcorn and sweet maize, under home conditions to enhance the content of health-promoting compounds, while also paving the way for new opportunities in breeding maize with specific traits.

Key words: sweet maize, popcorn, vitamin E, HPLC, cooking, freezing

Acknowledgment

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Mining Maize Gene Bank Diversity for Desirable Alleles

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Abstract

Modern agriculture combats a dual challenge-meeting societal demands for eco-friendly practices and diverse, healthier products and sustaining production in the face of climate change. This combination of factors raises unprecedented questions about how to identify and improve suitable plant materials that can be delivered to farmers and other end users. In this context, understanding the role of seed gene banks is crucial. They serve multiple functions - collecting new plant materials, conserving them under controlled environments, testing seed health, conducting research to characterise and evaluate these materials for breeding important traits and resilience against abiotic and biotic stresses, and distributing them to plant breeders, researchers, farmers, and the food industry. The vast array of traits found in cereal genetic resources maintained in *ex situ* collections - gene banks, along with their adaptability - is vital for enhancing the resilience of agricultural production systems and advancing innovative, efficient agro-food systems and other bio-based value chains. Thus, they represent a key form of natural capital necessary for stability and adaptability in agriculture and for fostering a sustainable bio-economy. Despite the importance of genetic diversity in plant breeding, most cereal *ex situ* collections are underutilised, with less than 5% actively used. Despite efforts over the past few decades to expand cereal *ex situ* collections globally, their size complicates the maintenance and evaluation of the genetic diversity they encompass. Many accessions lack sufficient evaluation data, hindering effective responses to user needs. Typically, only minimal passport data is available, and detailed information on unique traits is often missing. Significant gaps in documentation and characterisation hinder breeding programs. Only 64% of accessions are morphologically characterised, 51% agronomically, 14% biochemically, and about 22% for biotic traits. Hence, comprehensive characterisation is essential for maximising the value of cereal genetic resources and helping users select appropriate germplasm.

Key words: agro-biodiversity conservation, crop resilience, *ex situ* collections, trait evaluation, *Zea mays* L.

Acknowledgment

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Production Potential of Permanent Grasslands in the Republic of Srpska and Related Employment Opportunities

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Abstract

Aim of this paper is to provide a new perspective on the exploitation of local resources and employment of the population in the rural area of the Republic of Srpska. The paper focuses on permanent grasslands, which are now largely neglected production resource. The research was conducted using mathematical projections based on literature data. The projection showed that around 650,000 ha of permanent grasslands in the Republic of Srpska (RS) have an annual production potential of around 1.14 million tons of dry matter of forage (pasture and hay). Assuming that forage production from permanent grasslands is allocated into equal thirds, each third to lamb production, beef fattening and dairy cattle farming, permanent grasslands in the RS could support an annual production of around 610,000 lambs, 29,500 fattened two-year-old steers and 132,500 kg of saleable cow's milk. The total value of the potential of livestock production on permanent grasslands is estimated at around 415 million KM. If the average family farm needed an annual income from the sales of livestock products of around 100,000 KM, then the permanent grasslands of the RS could employ around 4,150 families. New jobs in the rural areas of the Republic of Srpska would lead to the settlement of new families in the rural areas and the generation of new and greater demand for a variety of goods and services, which has the potential to cause the so-called "multiplier effect", where one new job enables the creation of a number of other new jobs (in trade, service activities, social activities such as sports, culture, recreation and others). The activation of large neglected areas of permanent grasslands in the Republic of Srpska would enable the revitalization of the rural area, stopping labor emigration, returning the labor emigrants to their homeland, and increasing the well-being of the people.

Key words: local resources, permanent grasslands, extensive livestock farming, grazing

**Antioxidant Potential of Wheatgrass Juice from the Ancient Brkulja Wheat Variety:
Antiradical Activity Analysis and Bioactive Compound Correlation**

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Abstract

The antioxidant potential of wheatgrass juice derived from the ancient Brkulja wheat variety was investigated to assess its functional and nutraceutical value. As a heritage landrace, Brkulja wheat showed genetic resilience and great antioxidant and nutritional values making it a promising source of bioactive compounds. Wheatgrass was harvested at the early jointing stage, and the extracted juice was analyzed for total phenolic content, flavonoid concentration, and antioxidant activity using DPPH radical scavenging assay. Results demonstrated that Brkulja wheatgrass juice possesses strong antioxidant capacity with an IC₅₀ value of 0.75 µg/mL. The DPPH inhibition percentages ranged from 88.83% at the highest concentration to 23.75% at the lowest concentration, showing direct relationship between juice concentration and inhibition percentage. Total phenolic content ranged from 25.8 to 42.5 mg GAE/g, while flavonoid concentration ranged from 9.7 to 18.3 mg QE/g, both showing strong positive correlations with DPPH inhibition ($r > 0.9$). These findings support the use of Brkulja wheatgrass juice as a natural antioxidant source and emphasize the importance of preserving ancient wheat varieties for health-promoting applications.

Key words: old wheat variety, antioxidant, juice wheatgrass

Acknowledgment

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Session 3: Crop Science

Poster Presentations



Prediction of HHV (Higher Heating Value) of Different Biomass Samples

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Abstract

The primary indicator of the fuel value of a biomass sample is its heating value. Based on the chemical and elemental composition results, it is possible to calculate the approximate calorific value of any fuel using the appropriate formulas. The aim of this study was to predict the HHV (Higher Heating Value) of various biomass samples (tobacco stems of the Berley type, soybean stems, wheat straw, sunflower head residues, corn cobs, and beech wood sawdust) based on their chemical and elemental composition. The HHV was computationally determined using formulas proposed by different authors. The lowest HHV based on ash content was found in sunflower head residues (17.08 MJ kg⁻¹), while the highest was in beech wood sawdust (19.79 MJ kg⁻¹). The highest HHV calculated based on lignin content was found in corn cobs (19.19 MJ kg⁻¹), and the lowest in soybean stems (18.10 MJ kg⁻¹). Determining the HHV of biomass based on the elemental composition (C, H, N, S, O) of the tested samples showed that the highest value was in beech wood sawdust (19.48 MJ kg⁻¹), and the lowest in wheat straw (17.41 MJ kg⁻¹). The chemical composition of biomass is also influenced by its origin, as well as the geographical climate where the plant grew, and a significant role is played by the timing of raw material harvest. The results obtained indicate that using tobacco stems of the Berley type for biofuel production could be cost-effective, as they have a high heating value, which does not differ significantly from other tested forms of agricultural biomass.

Key words: HHV, biomass, chemical composition, ash, lignin

The Importance of using Biopesticides in Organic Farming

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Abstract

Biopesticides, natural origin products, represent a significant tool in sustainable and environmentally friendly agriculture, particularly in organic farming. Derived from microorganisms, plant extracts, and natural minerals, biopesticides offer an eco-friendly alternative to synthetic pesticides. Their application enables effective control of pests, diseases and weeds with minimal impact on the environment, biodiversity, and human and animal health. This paper examines the advantages and limitations of biopesticides, highlighting their potential in ecosystem preservation and productivity improvement in organic farming. The aim of this paper is to point out the importance of the use of biopesticides in organic agriculture based on the available literature. In the paper, the method of data analysis was applied, which were collected from scientific studies, published in scientific works and at scientific conferences, including scientific publications of the authors of the paper. The results of numerous scientific research, including the research of the authors of this paper, indicate that, in addition to being used as biofertilizers, microorganisms also produce biologically active substances with pronounced antimicrobial and antifungal effects, so they can also be used as biopesticides, which significantly contribute to food safety. The role of biopesticides in reducing carbon dioxide emissions and contributing to global efforts in combating climate change underscores their importance as an indispensable tool for sustainable agriculture in the future. The specificity of biopesticides in targeting harmful organisms makes them safe for beneficial insects, such as pollinators, and contributes to the preservation of natural resources like soil and water. Their use in organic farming reduces the negative effects of synthetic pesticides and aids in maintaining ecological balance. However, the effectiveness of biopesticides often depends on ecological factors, formulation, and proper application. Despite these challenges, their contribution to sustainable production is significant, as they help reduce the use of chemicals, preserve food quality, and support sustainable development goals. Based on the review of scientific research, it can be concluded that development of new formulations, increased market availability of biopesticides and farmer education on their proper application are crucial for broader adoption of these solutions in organic agriculture.

Key words: biopesticides, organic farming, crop protection, biodiversity, human health

Acknowledgment

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Biomass as a Renewable Energy Source

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Abstract

Renewable energy sources (RES) refer to energy sources that are found in nature and are fully or partially replenished. The most significant renewable sources are solar energy, wind energy, hydropower, geothermal energy, and bioenergy (biomass). Biomass is the energy source with the longest history of use. Given that there are numerous different types of biomasses that can be used as biofuels, the aim of this paper was to highlight the main aspects of using biomass as a renewable energy source. The energy stored in biomass is the result of natural chemical processes, which means that during its exploitation, there are no interruptions typically associated with other RES, such as solar or wind energy. By plowing biomass instead of removing or burning it, combined with the use of organic and mineral fertilizers, there is a significant increase in the content and availability of nutrients, an increase in the humus content in the soil, and, therefore, an improvement in its overall fertility and crop yield. One of the main advantages of biomass over other renewable fuels is its ability to be stored, preserved, and specifically used to meet current energy needs. Furthermore, the broader social and economic benefits of using biomass are reflected in the creation of new jobs and the promotion of rural area development, which are involved in the cultivation, collection, and distribution of biomass as fuel.

Key words: energy, fuels, biomass, standardization

***Fagopyrum esculentum* Moench. Production and Its Importance for Health**

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Abstract

Buckwheat belongs to the genus *Fagopyrum* (*Polygonaceae*), it is native to Asia (China). It is a promising pseudo cereal, that is a symbol of healthy life because of its rich nutritional and pharmacological properties. Seed has 9.1% protein, 70.98% BEM, 3.7% cellulose, 1.73%, oil 1.72%, mineral salts, 12.8% water, and vitamins group B - B1 (thiamine), B2 (riboflavin), B3 (pantothenic acid), vitamin E (tocopherol) and ferments. It has a balanced amino acid content, is rich in lysine and arginine. Buckwheat plants and groats are rich in flavonoids: rutin, orientin, vitexin, quercetin, isovitexin, and isoorientin. Due to its favorable chemical composition, and the absence of gluten, buckwheat is suitable for the diet of people suffering from Celiac disease and diabetes. Buckwheat food products affect the reduction of sugar and fat concentration in the blood, which contributes to the regulation of cholesterol levels and used as an auxiliary remedy in folk medicine. In this study, the buckwheat production in the world, were analyzed. Due to all of the above, there is a need to increase buckwheat production in world due to increased demand. According to FAO data, buckwheat was grown on 1,855,059 ha in 2020, and on 2,187,546 ha in 2023. Seed production in 2020 was 1,805,936 tons and 2,204,015 tons in 2023, and grain yield was 976 kg ha⁻¹ (2020) and 1,007 kg ha⁻¹ (2023). Evident is an increase area, production and yields in the period from 2020 to 2023. The analysis of production by continent shows that the largest areas were in Europe (with Russia) 933,658 ha and Asia (760,545 ha). In the light of climate change, the improvement of buckwheat production technology is of great importance in order to increase yield. Promotion of buckwheat improving productivity will be an important trade-off between food security and improving population health.

Key words: Fagopyrum esculentum Moench., health

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Reduced Heavy Metal Accumulation in Maize and Sunflower: The Surprising Role of Brassinosteroids

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Abstract

Environmental pollution with heavy metals is a growing concern that undermines soil health and agricultural productivity. This study evaluates the impact of brassinosteroids (BRs) on the phytoremediation potential of maize (*Zea mays*) and sunflower (*Helianthus annuus*), focusing specifically on their ability to manage the uptake of heavy metals such as lead (Pb), cadmium (Cd), and chromium (Cr). Brassinosteroids, natural plant hormones, have been suggested to play a key role in modulating plant stress responses and enhancing detoxification processes. Field trials were conducted using two BRs variants: 24-epibrassinolide and 28-homobrassinolide, applied at different stages of plant growth. Maize and sunflower plants were cultivated in controlled plots contaminated with known concentrations of Pb, Cd, and Cr. Plant responses were monitored by measuring growth rates, photosynthetic activity, and metal accumulation levels in plant tissues, analyzed using Atomic Absorption Spectroscopy (AAS). Contrary to expectations, the application of brassinosteroids resulted in a significant reduction in the accumulation of heavy metals in both maize and sunflower. Plants treated with BRs showed a 40% decrease in Pb, 33% in Cd, and 28% in Cr uptake compared to the control groups. Additionally, BRs treated plants exhibited enhanced chlorophyll content and overall healthier physiological profiles, indicating an improved resistance to metal-induced stress. The findings suggest that brassinosteroids may inversely affect the phytoextraction capabilities of maize and sunflower when exposed to heavy metals, reducing their accumulation within plant tissues. This unexpected outcome highlights the complex nature of BRs' interaction with plant metabolism under stress conditions. Further research is necessary to unravel the underlying mechanisms of BRs' influence on heavy metal uptake and to assess their practical applications in phytoremediation strategies.

Key words: brassinosteroids, phytoremediation, heavy metals

Acknowledgment

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Restriction Profiles of Ara h 8 show Stability in Peanut Genotypes

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Abstract

Arachis hypogaea L., the groundnut that yields peanuts, is a significant crop, especially in the Americas. The primary allergen of the birch is homologous to a particular peanut minor allergen, Ara h 8, which is a member of the PR-10 protein family. Bet v 1 is renowned for its responses to a range of fruits and vegetables across species. Because of their comparable structures and homologous sequences, Ara h 8 and Bet v 1 cross-react. The restriction analysis of peanut (*Arachis hypogaea* L.) Ara h 8, a mild allergen, is the main goal of this paper. The restriction site polymorphisms are evaluated using four different restriction endonucleases, which were chosen based on the *in silico* production of restriction fragments. In contrast to the other enzymes, the *Bsa*II enzyme's cleavage resulted in a monomorphic profile that was even resistant to bioinformatic analysis. Mutations in the allergen's nucleotide sequence cause variations in fragment length and number, which may be mirrored in how the allergic reaction manifests. The known sequence was compared with the genotypes' sequencing data. They had 97.88 to 98.74% similarity between genotypes 4, 6, and 20, and their identity ranged from 96.02 to 96.86%. The number of fragments for the restriction endonucleases *Hae*III and *Hpy*CH4IV and the length of the bands up to a maximum of 21 bases for all enzymes varied in the simulated cleavage profiles while using the enzymes. In this discipline, the restriction and genetic data gained are unique outcomes.

Key words: restriction profiles groundnut genotypes, Ara h 8

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The Influence of Mineral Fertilizers on the Maize Hybrids Yield and Grain Quality

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Abstract

In the study examines the influence of the form and amount of nitrogen on the morphological and productive properties of maize production. Trials were conducted during the 2024 year on a private property in Novi Kozjak and on land of the degraded chernozem type with maize hybrid P0 216. The mineral fertilizers UREA (46% N), CAN (27% N) and AN (34.4% N) were used as a form of nitrogen for feeding maize in amounts of 50 and 100 kg ha⁻¹ of active matter. The obtained results showed a significantly greater influence of the amount of nitrogen compared to the form of nitrogen, on all parameters included in the research. With the use of a larger amount of nitrogen (100 kg ha⁻¹), the increase in the values of the examined parameters of maize productivity varied in the interval from 2.1% to 5.8% compared to a smaller amount of N (50 kg ha⁻¹). The highest values of morphological characteristics were determined in the treatment where AN, as a form of nitrogen, was applied. On the other hand, the highest yield of maize grains (12.81 t ha⁻¹) was obtained on the variant where UREA was used for feeding.

Key words: maize grain yield, UREA-CAN-AN

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Organic Production - A Leading World Trend

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Abstract

Crop production is conducted in open fields, making it essential to follow regional climatic characteristics and know edaphic factors, which significantly influence the success of production. It encompasses multiple systems: traditional and conventional production, sustainable production, good agricultural practices, organic farming, and others. Organic farming promotes ecosystem preservation by integrating biodiversity and biological cycles, using methods that exclude external synthetic inputs. Under favorable environmental conditions, cultivated plants are more productive, while in unfavorable conditions, the application of adequate cultivation technology is necessary. The total area of Serbia is 7,747,400 ha (1,984,513 ha - forested, 709,930 ha - unproductive land, and 5,052,957 ha - agricultural land). Arable land accounts for 3,398,700 ha or 66% of the total agricultural land, grasslands and pastures cover approximately 1,455,589 ha (28%), fruit orchards and vineyards occupy 298,667 ha (6%). In 2021, areas under organic agricultural production take place in 191 countries (76 mil. ha, only 1.6% of total agricultural land) were 11% larger compared to 2017 (69.8 mil. ha). Serbia has favorable conditions for the development of organic production. The largest areas under organic production are in Vojvodina (45.07%), followed by Southeastern Serbia (33.88%), Šumadija and Western Serbia (20.74%), while the smallest areas were in Belgrade (0.31%). In 2023, organic farming in Serbia covered 29,002 ha (18,086 ha - organic status and 10,916 ha - conversion period), with the most represented crop types being cereals (5,372 ha), forage crops (3,006 ha), industrial crops (2,286 ha), followed by fruits (4,393 ha), medicinal, spice, and aromatic plants (352 ha), while the smallest areas were under vegetables (223.7 ha) and other crops (430 ha). Organic production in Serbia shows a growth trend in cultivated areas. The market for organic products remains insufficiently supplied, with demand exceeding production. Organic agriculture represents a leading global trend as it generates significant economic profit, positively impacting the trade balance of every country.

Key words: organic production, health, safe product

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Mineral Matter of Biomass and Heavy Metals

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Abstract

The mineral matter of biomass consists of metal quantities found in biomass during the growing season, in the form of inorganic and organic salts, complex compounds, or existing as ions. The presence of alkaline and earth alkaline metals, silicon, and other metals varies. The aim of this paper was to highlight that the determination of the mineral matter (ash) content in biomass obtained through combustion is one of the key analytical parameters for assessing the class of biofuel that could be derived from a specific biomass. The mineral matter content in plants is influenced by various factors, the most important of which are: plant species, plantation age, climatic conditions, soil characteristics, and the application of agronomic measures. The use of intensive agronomic practices in modern agricultural production, the proximity of industrial plants, thermal power plants, mines, and transportation routes inevitably leads to soil and plant contamination with heavy metals. Exceeding heavy metal content in soils leads to phytotoxicity. To date, 53 elements have been classified as heavy metals. The concentration of heavy metals, particularly Cd and Zn, should be limited in ash, especially from an ecological perspective. Agricultural biomass shows much lower concentrations of heavy metals compared to woody biomass, which can be explained by the shorter growing period as well as the higher pH value of agricultural land compared to forest land. For ecological reasons, the content of heavy metals in pellets and briquettes must be strictly controlled if the ash from biofuels is planned to be used in any form for fertilizing soil.

Key words: soil, plant, biomass, heavy metals, biofuel

**The Effect of Maize Landraces and Testers on the Number of Leaves
above the Ear in Test Cross Hybrids**

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Abstract

The variation of the number of leaves above the ear in maize test cross hybrids was analyzed to identify superior combinations for this trait. The experiment involved crossing 31 maize landraces with three testers (L217, L73B013, and L255/75-5), representing different heterotic groups (*Iowa Dent*, *BSSS* and *Lancaster*). The general mean for the number of leaves above the ear was 6.18 leaves. The analysis of variance revealed that all sources of variation, including the environment, tester, landrace, and their interactions, were highly significant ($p \leq 0.01$), except for the triple interaction ($p = 0.964$). The coefficient of variation was 6.00%, indicating low within-group variability. Maize landrace AN1569, across all testers, exhibited the highest number of leaves (6.72), suggesting its superior general combining ability for this trait. Other landraces, such as AN877, AN288, and AN197, also showed high values, predominantly belonging to dent maize types from late maturity groups. In contrast, the maize landrace AN1890, in test cross hybrids, produced the lowest number of leaves above the ear (5.76). Tester L73B013 contributed to hybrids with the highest number of leaves above the ear (6.31), compared to L217 and L255/75-5, which were statistically similar to each other. A positive correlation ($r = 0.782$) was observed between the number of leaves above the ear in landraces per se and their general combining ability, emphasizing the additive genetic effects in the inheritance of this trait. These results emphasize the importance of specific landraces and testers in breeding programs aimed at improving the number of leaves above the ear, with potential implications for yield and adaptability.

Key words: maize landraces, testers, number of leaves above the ear, combining ability, genetic variability

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Application of Microorganisms in Environmental Protection

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Abstract

Microorganisms are a very significant factor that affects the bio-productivity of agroecosystems and the production of healthy food. Also, they find significant application in the recultivation of polluted ecosystems. The goal of the manuscript is to show the possibilities of using microorganisms in environmental protection. In the manuscript, the method of data analysis was applied, which were collected from scientific studies, published in scientific journals and at scientific conferences, including scientific publications of the authors of the manuscript. The results of numerous research indicate that microorganisms can be successfully applied instead of mineral fertilizers, which cause pollution of the environment. "*Nitragin*" is a biopreparation used to increase the symbiotic biological nitrogen fixation in plants. "*Azotobacterin*", a biopreparation based on the bacterial genus *Azotobacter*, isolated from natural ecosystems, is used for the same purpose. The biopreparation "*humivorin*" contains different groups of microorganisms, which carry out processes of decomposition of organic matter, thus enabling effective nutrition of plants. The soil is very rich in the mentioned taxons of microorganisms. The results of the research, published by the authors of this manuscript, indicate that the number of *Azotobacter* sp. in soil type "chernozem" ranged from 100.4-182.7 (10^2g^{-1}), and in "gajnjaca" from 45.7-119.2 (10^2g^{-1}), while the highest determined number of aminoheterotrophs in the soil, among which *Bacillus* species dominate, was $671.5 \times 10^5\text{g}^{-1}$. Numerous scientific studies, including the scientific publications of the authors of this manuscript, also indicate that microorganisms find significant application in the purification of polluted soils and waters, as well as the precise bioindication of all environmental components. Based on the analysis of the results of published scientific research, it can be concluded that microorganisms can be used very successfully in the production of healthy food, purification of polluted environments and bioindication.

Key words: microorganisms, biopreparations, application, environmental protection

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NS Marko Linseed and Health Benefit

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Abstract

Linseed - *Linum usitatissimum* L., is a “super food” with numerous health benefits since it includes large concentrations of biologically active components such lignans, dietary fiber, and α -linolenic acid. Interest in linseed-based food has increased because of its nutritional composition and many beneficial properties for human health. The aim of the study was to examine the potential of two linseed cultivars and brings studies on linseed into a new larger perspective combining current knowledge about linseed as well as possible benefits to human health. The two linseed cultivars, NS Marko and NS Primus, were tested in Bački Petrovac on chernozem in 2022 and the seed yields and tocopherol content in the seeds were examined. Cold pressed linseed oil is obtained on a manual press. The prepared oil samples were analyzed by normal phase liquid chromatography with a fluorescent detector. The variety NS Marko has brown, while NS Primus has golden seed colors and they achieved high seed yields, 1700 kg ha⁻¹ and 1500 kg ha⁻¹ and good quality grain. In a dry year, on average, high average seed yields were produced, 1600 kg ha⁻¹. The content of total tocopherols in the oil was 280 mg/L. γ -tocopherol accounted for 100% of the total tocopherols present. Niacin and tocopherol, which have potent antioxidant qualities, are abundant in linseed. An adequate intake of vitamin E reduces the risk of Alzheimer's disease, cardiovascular disease, and several types of cancer. Consuming linseed may help lower blood pressure, fasting glucose, and the insulin resistance index as well as enhance lipid profiles. Because linseed provides so many nutritional benefits, its manufacturing is justified. It is advised to include linseed on a regular basis in the diet to maintain good health.

Key words: linseed NS Marko and NS Primus, health benefit

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Cultivation of Alfalfa as Possible Plant for Plant Nutrition and Soil Conditioners

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Abstract

The primary use of alfalfa is in feeding livestock in a fresh state and the preparation of canned feed. Unfortunately, the reduction of livestock causes the producer to lose interest in its further cultivation. However, the advantages achieved by growing alfalfa make this plant species one of the most important cultivated plant species. The paper examined some parameters of alfalfa biomass that would be used in plant nutrition as an organic fertilizer. The terrain on which the research was conducted was the atar of the Banatsko Novo Selo settlement with a carbonate chernozem type soil on a loess terrace. Research was carried out in the period from 2018 to 2023 with alfalfa plants of different growing ages. During the research, the content of total nitrogen (N) and its easily accessible forms (NH₄-N and NO₃-N), as well as the C:N ratio, were measured. Plants need nitrogen (N) for rapid growth and development. Plants adopt it in ammonia (NH₄) and nitrate (NO₃) form. The ratio of carbon to nitrogen, gives information about the decomposition of fresh organic matter in the soil. The overall average values for all analyzed plants, that is, their above-ground masses, had values of total nitrogen (N) in the interval from 2.1 to 3.7%. NH₄-N content varied from 105.6 to 392.4 mg/kg, while NO₃-N content ranged from 10.7 to 21.6 mg/kg. The C:N ratio had values in the interval from 13:1 to 23:1, which represents a good ratio of carbon to nitrogen (in the range of 25 to 35) for them to remain active and decompose fresh organic matter. The obtained results create a good basis for the use of alfalfa above-ground biomass as organic fertilizer in the form of pellets, briquettes, compost or as green manure with the aim of substituting synthetic nitrogen fertilizers.

Key words: alfalfa, cultivation, plant nutrition products, plant conditioners

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***Phacelia tanacetifolia* Benth. NS Priora Forage and Honey Plant**

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Abstract

Phacelia tanacetifolia Benth. is an annual fodder plant that originates from North America and is grown as an ornamental (decorative), honey and medicinal plant in the *Hydrophyllaceae* family. This species' physiologically active chemicals make it a potentially powerful material for medicinal and cosmetic purposes. *Phacelia tanacetifolia* is utilized as a mulch because of its high soil absorption of calcium and phosphate, as a fodder plant because it inhibits erosion and acts as a nematode-free soil biocleaner, and as a monoculture or in 1:1 combination with other plants, such as field pea (*Pisum sativum* ssp. *sativum* var. *arvense* L.). Honey, pollen, venom, and other goods made by bees are becoming more and more popular. A wealth of nutrients and biologically active substances, including antioxidant, antifungal, antibacterial, antiviral, anticancer, anti-inflammatory, immunostimulant, antiallergic, and analgesic properties, can be found in honey and bee pollen. This study aimed to assess the productivity of a *Phacelia tanacetifolia* Benth. NS Priora cultivar was cultivated in Serbia. The Institute of Field and Vegetable Crops' experimental plots at Bački Petrovac, close to Novi Sad, were used for the experiment. The phacelia NS Priora productivity parameters, biomass yield (t ha⁻¹), grain yield (kg ha⁻¹), and honey yield (kg ha⁻¹), were measured. All of the parameters that were examined showed high values for variety NS Priora (9 t ha⁻¹; 815 kg ha⁻¹ and 780 kg ha⁻¹). Phacelia is a popular plant to grow because it produces high-quality pollen and nectar. The results show that NS Priora can be successfully grown and is a great bee pasture.

Key words: *Phacelia tanacetifolia* Benth NS Priora, fodder, honey and medicinal plant

Acknowledgment

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Impact of Temperature and Flooding Duration on The Germination and Seedling Mass of *Amaranthus retroflexus*, *Sorghum halepense* and *Xanthium orientale*

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Abstract

Weed species *Amaranthus retroflexus* L., *Sorghum halepense* (L.) Pers., and *Xanthium orientale* L. are widely distributed in Bosnia and Herzegovina and produce a significant number of viable seeds each year. This study evaluated the effects of temperature and flooding duration on the emergence and seedling mass of these species. Temperature regimes of 20, 30 and 40°C were maintained alongside four flooding durations of 0, 10, 20, and 30 days, using four replicated pots. Seed germination was recorded daily throughout the 10-day experiment, and at the conclusion, the fresh seedling mass was measured. For *A. retroflexus*, the highest germination percentage (98.25%) was observed at 40°C with a flooding duration of 30 days; however, the greatest seedling mass was recorded at 30°C after 20 days of flooding. Seeds of *S. halepense* germinated only in the control treatments (0 days of flooding), with the greatest seedling mass measured at 30°C. For *X. orientale*, the highest germination percentage (72.75%) occurred at 30°C with a flooding duration of 30 days, while the greatest seedling mass was also recorded at 30°C without flooding (0 days). The temperature had a significant impact on both observed parameters (total germination and seedling mass) for all examined species. However, in species *A. retroflexus* and *X. orientale*, flooding duration did not affect germination, although it caused a significant reduction in seedling mass. These findings enhance our understanding of the biology, germination capacity and environmental requirements of *A. retroflexus*, *S. halepense*, and *X. orientale*, providing valuable information for more effective weed control strategies.

Key words: weed biology, seed germination ecology, weed management

Agronomic Practices in the Production of Buckwheat - *Fagopyrum esculentum* Moench.

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Abstract

Buckwheat (*Fagopyrum esculentum* Moench.) has important agrotechnical value in addition to its important nutritional and therapeutic qualities. Although it may adapt to Mediterranean temperatures, buckwheat has historically been grown in temperate climes. High temperatures (>30°C) can promote floral sterility and cause lodging by decreasing stem diameter, that's why is necessary to be increase it by investigating the optimum agronomical practices and creating new cultivar selection. Buckwheat's a honey plant and has an extended flowering season and nectar-rich blooms make it a useful species for beneficial insects. Under ideal meteorological circumstances, it has been observed to be a species that effectively improves pollination services. The pseudocereal buckwheat is appreciated crop because of its short growth period, moderate requirements for growth conditions, and high adaptability to adverse environments. Trials with the Novosadska buckwheat variety were conducted in Bački Petrovac in 2021 under irrigated conditions, during three-sowing seasons. The aim of this study was to examine the influence of irrigation in three sowing dates: early sowing (mid-April), mid-season sowing (April 25) and late spring sowing (May 10) and to determine the potential of buckwheat as an agricultural crop and brings studies on buckwheat into a new larger perspective combining current knowledge in agricultural practice and increasing production. Early spring was the best time to sow dry biomass (4.3 t ha⁻¹) and grain yield (1.4 t ha⁻¹), while late spring sowings yield the highest dry biomass/forage yield when irrigated (6.5 t ha⁻¹), but they were not suitable for producing grain due to the negative effects of high summer temperatures on seed set and seed filling. Buckwheat may be successfully introduced as a second summer crop. It would be grown in the early spring to produce grain and in the late spring to produce fodder crops, in dry years it is preferable to irrigate crops.

Key words: buckwheat, Novosadska variety, agrotechnical practices, grain yield, fodder crops

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The Effect of Tillage Systems on the Weediness of Winter Wheat

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Abstract

This paper deals with result of the effects of tillage systems on weediness of different winter wheat cultivars in investigated period (2020/21–2021/22) on the chernozem luvisc soil type in Faculty of Agriculture Belgrade-Zemun Experimental field trial. "Radmilovac". For the technology of growing winter wheat with different levels of intensity of application of agrotechnical measures, varieties for low input (NS Pobeda and NS Zvezdana) were carefully selected. Conventional technology, which includes basic tillage with plow and high level N had better effect than both investigated conservation tillage systems (mulch tillage and no-tillage). Good results with mulch tillage means that may be one of possibilities for crop technology rationalization for winter wheat and soil conservation. No-tillage with no fertilization increase weediness especially in first year of investigation. Fertilization with high nitrogen level (120 kg ha⁻¹) causes less weediness compared with the other level (60 kg ha⁻¹). Top dressing fertilization in each tillage system had an effect on the increase in the number of weeds, but at the same time it also affected the stronger competitive ability of the wheat crop against weeds. The obtained results shows that the dominant species in weed synusia were from annuels *Chenopodium album* L. and *Agropyrum repens* (L.) Beauv., *Convolvulus arvensis* L., from perennials. Tillage systems and fertilization with nitrogen fertilizers have a big influence on weed control and floristic composition, number of species and individuals and biomass of weeds of winter wheat. Conventional tillage and mulch tillage systems had better effect on weed control than no tillage systems. The number of weed individuals and biomass were highest in NT systems especially in drought year.

Key words: tillage systems, fertilization, nitrogen, cultivar, weed

Acknowledgment

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Determining the Nicotine Content in Tobacco Stems and Smoke during the Combustion of Tobacco Stem Briquettes

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Abstract

Nicotine is an alkaloid that originates in the root of the tobacco plant (*Nicotiana tabacum*), from where it is further transported throughout the plant in the form of salts of malic or citric acid. The nicotine content varies depending on the tobacco species and the part of the tobacco plant. The highest concentrations are found in the leaf blade (the part of the leaf without the main vein), ranging from 0.3% to 10%, depending on the type and variety of tobacco. Global research regarding the potential use of tobacco waste, particularly tobacco stems, is limited. The aim of this study was to determine the nicotine content in tobacco stems and smoke during their combustion using high-performance liquid chromatography. Nicotine was identified at UV wavelengths between 210 and 400 nm, and quantification was performed at 254 nm. The examination of tobacco stem biomass revealed that it contains 715.6 ppm of nicotine, calculated on a dry substance basis. The analysis of the combustion products of the briquettes showed that the nicotine content in the smoke was significantly lower (<10 ppm), which is well below the prescribed limits. According to European Union regulations, tobacco waste with nicotine content over 500 ppm is classified as hazardous waste. The low nicotine content in the smoke during combustion found in this study gives a positive evaluation for the use of tobacco stem briquettes from an ecological perspective.

Key words: Nicotiana tabacum, nicotine, combustion, briquettes, smoke

**Enhancing Phytoremediation Efficacy in Wheat:
The Impact of Brassinosteroids on Heavy Metal and Arsenic Absorption**

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Abstract

The increasing prevalence of soil contamination with heavy metals and metalloids, such as nickel (Ni), cadmium (Cd), and arsenic (As), due to rapid industrial development and inadequate waste management, poses significant risks to both plant and human health. This study explores the efficacy of brassinosteroids (BRs), a class of plant hormones, in enhancing the phytoremediation capabilities of wheat (*Triticum aestivum* L.) for these contaminants. Phytoremediation, an eco-friendly strategy using plants to detoxify pollutants, offers a viable solution to mitigate soil contamination. The experimental study involved treating wheat plants with varying concentrations of 24-epibrassinolide (24-EBL), specifically focusing on its impact on the uptake of Ni, Cd, and As. The treated plants were compared against control groups to assess the BRs' effect on metal accumulation and plant biomass sustainability. Growth parameters were monitored, and metal concentrations were quantified using ICP-OES after microwave digestion. The results indicated a significant increase in the uptake of Ni, Cd, and As in BR-treated plants without adversely affecting plant biomass. This suggests that BRs not only enhance the phytoremediation capacity of wheat but also confer increased stress tolerance to the plants. Additionally, BRs were found to upregulate the expression of metal transporter genes and boost the synthesis of metal-binding compounds, facilitating greater metal accumulation in the plant tissues. The study demonstrates that brassinosteroids can substantially improve the phytoremediation efficiency of wheat by enhancing the uptake of harmful metals and metalloids. The application of BRs in contaminated fields can lead to dual benefits: effective soil detoxification and maintenance of agricultural productivity. This research supports the potential of using BRs in phytoremediation strategies, promising a sustainable approach to managing soil contamination while ensuring food security. Future research should evaluate the long-term impacts of brassinosteroids on plant health and soil ecology.

Key words: brassinosteroids, phytoremediation, heavy metals

Acknowledgment

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Progenitor Role of the PH207 Inbred Line in Expanding the Iodent Heterotic Pool for Maize Breeding

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Abstract

Modern maize breeding relies on heterotic pairs, local germplasm, and their general and specific combining abilities. The *Iodent* heterotic group, alongside *SS* and *non-SS* groups, plays a key role in hybrid breeding, with the *Lancaster* group remaining relevant in our region. Pioneer Hi-Bred International strengthened the *Iodent* base by developing the PH207 inbred line in 1983, derived from PHG3BD2 × PHG3RZ1. PH207 has since served as a progenitor for numerous inbreds now present in leading hybrids. This study aims to analyze the genetic relationships and distances between PH207 and selected inbreds to assess their role in expanding *Iodent* genetic variability. Inbred parents and hybrids in the U.S. are protected by patents or the Plant Variety Protection Act (PVPA) for 20 years, after which they become available for public and private breeding programs. Using bioinformatics tools, the genetic structure of 484 samples from various heterotic groups was analyzed. The study confirmed the genetic origin of tested inbreds, showing that 27 lines had a genetic distance from PH207 ranging from 0.073 to 0.278, indicating strong genetic similarity. The shortest genetic distance was observed for PHG29 (0.073). The PH806 line, which originated from a broad-based population, contributed to the development of four foundational lines: PHN11, PHG29, PHH93, and PHK42. Among these, PHG29, in combination with PHG44 (which is 50% derived from PH207), created the progenitor line PHP02, which exhibited minimal distances to PH207 (0.083) and PH12J (0.098). Furthermore, the genetic distances of PH1CP (0.099) and PH1MR (0.102) confirm PH207's influence. The PHJ90 line (0.115) originated from PHG50 and PHK42, while PH1W0 (0.129) was derived from PHP02 and PHAP9. These findings confirm PH207's key progenitor role within the *Iodent* heterotic pool. However, the success of ex-PVP materials depends on genetic background, environmental adaptation, and combining ability, necessitating multi-year field trials to ensure breeding efficiency.

Key words: maize, Ex-PVP material, PH207, Iodent, genetic distance

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Mycotoxins Content in Organic and Conventional Cereal Grains and their Products

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Abstract

Despite numerous studies comparing the mycotoxin content between organic and conventional cereal grains, there are still controversies and doubts. The assumption is that there is a greater amount of mycotoxins in organic cereal grains due to the impossibility of using classic fungicides to protect against phytopathogenic fungi. Consumer awareness about the health risks from mycotoxins is still relatively low. Using a review of the relevant scientific literature, an analysis of the frequency and concentration of the most common pathogenic fungi (*Fusarium*, *Claviceps*, *Penicillium*, and *Aspergillus* species) in organic and conventional cereal grains and products was performed. Contamination of cereals with mycotoxins is influenced by a number of factors, such as climatic conditions during the growing and harvest season, variety choice, agrotechnical measures (tillage, fertilization, rotation design/pre-crop, crop protection), as well as postharvest management (drying and cleaning of harvested grains and storage conditions). Contamination with mycotoxins produced by *Fusarium* sp. decreased between the 1990s and 2020. Significant effects of production system on the incidence and/or concentrations of T-2/HT-2 toxins, zearalenone, enniatin, beauvericin, ochratoxin A (OTA), and aflatoxins were observed. Also, 50% higher concentrations of deoxynivalenol were observed in conventional than organic cereal grains and products. It can be concluded that no significant difference was found in the content of mycotoxins between organic and conventional cereals and their products. Contamination levels are similar in organic and conventional cereals.

Key words: mycotoxins, cereal, grain, products, fungi

Influence of Genotype on Wheat Yield Components and Importance for Health

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Abstract

Due to its dominant role in world nutrition, wheat has acquired the character of a strategic product. Its participation in human nutrition is gradually decreasing in developed countries where changes in the structure of the diet have given priority to proteins of animal origin. In underdeveloped countries where the phenomenon of hunger is present in a severe form, the basic aspiration is to provide a sufficient quantity that will ensure the population's nutritional needs. Wheat is regarded as excellent source of dietary fiber, B-group vitamins, minerals, and protein, making it a great food for promoting health. Constipation, cardiovascular diseases, diverticulum disease, obesity, diabetes, and ischemic heart disease are among the illnesses that whole wheat help prevent. The paper examined the influence of varieties of different lengths of the growing season, namely: Sothys - an early variety with axils and Sosthene - a mid-late variety without axils on the following components of the winter wheat yield of different lengths of the growing season, during 2022/2023, namely: spike length, number of spikelets per spike, number of grains per spike and mass of grains per spike. Within the components of wheat yield in Sothys varieties, the largest spike length (8.96 cm) was measured. In addition, the largest number of spikelets in the spike (19.60) was counted in these varieties. On the contrary, the number of grains per ear, as well as the mass of grains per ear did not vary significantly depending on the genotype. Both tested varieties are characterized by high fertility potential, but also certain genotypic and phenotypic specificities, so it is up to the wheat producers to choose the variety depending on their own needs.

Key words: wheat, yield, varieties

Acknowledgment

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Antioxidants in Cereal Grains

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Abstract

Antioxidants are molecules that can prevent the oxidation of other molecules. They prevent chain reactions that damage other molecules in cells. Antioxidants oxidize themselves - they give one or more electrons to a free radical, which leads to stabilization and prevention of potential oxidative stress, which is the main cause of cellular damage. With this effect, antioxidants affect the health of the body: they slow down aging, lower cholesterol, protect the heart and blood vessels, prevent the formation of tumors, protect the skin from UV radiation, reduce the risk of arteriosclerosis and stroke. They help detoxification, prevent damage of eye structures and the process of macular degeneration, protect the lungs from asthma and bronchitis, exhibit antibacterial and antiviral effects. In this regard, the aim of this work was to present, through a review of the literature, the most important antioxidants in cereal grains and their importance in human nutrition. Fibre and micronutrients in the outer layer and germ fractions of the grain acting together to combat oxidative stress, inflammation, hyperglycemia and carcinogenesis. High antioxidant activity in whole-grain cereals possess chemical ingredients: vitamin E, folates, phenolic acids, carotenoids, phytic acid, lignins, lignans, alkylresorcinols, zinc, iron, selenium, copper and manganese. They are also a good source of betaine, choline and sulphur amino acids. During digestion, the antioxidant capacity of cereals is increased. Reports of numerous epidemiological studies indicate that the consumption of grains protects the human body from numerous diseases associated with aging, especially from cardiovascular diseases, cancer, diabetes, etc.

Key words: antioxidant potential, cereal, grain, diseases

Importance, Assessment and Protection of Biodiversity

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Abstract

Biodiversity represents the diversity of all living organisms on planet Earth and includes three levels: the level of genes, biological species and ecosystems. Genetic diversity is the set of genes of all existing living beings on Earth, while all biological species, from the beginning of life until today, represent species diversity. Ecosystem diversity represents the diversity of biotopes, biocenosis, as well as all biogeochemical cycles carried out by organisms within the ecosystem. The aim of the manuscript is to show the importance, assessment and protection of biodiversity. In the manuscript, the method of data analysis was applied, which were collected from scientific studies, published in scientific journals and at scientific conferences. The results of scientific research indicate that biodiversity enables biogeochemical cycles to occur in ecosystems on the entire planet, which form the basis of life. Also, it affects all the components of the environment. From the aspect of providing food for the growing human population, the preservation of the diversity of Magnoliophyta (angiosperms) is particularly important. Angiosperms are the main source of food for humans and animals. Balkan Peninsula is very rich in terms of species biodiversity, which is especially contributed by the diversity of angiosperms. The results of the research, which were published by the authors of this manuscript, indicate a significant diversity of plant species within the taxon Magnoliophyta. It was also found that numerous identified species exhibit pharmacological activity. Numerous scientific studies also indicate that, based on the state and assessment of biodiversity, bioindication of the environment can be carried out. In addition, biodiversity affects the composition of the atmosphere and the global climate. Based on the analysis of the results of published scientific research, it can be concluded that the protection of biodiversity is a key factor that enables the survival of life.

Key words: biodiversity, levels of biodiversity, importance, protection of biodiversity

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Occurrence of Insect-transmitted Cereal Viruses infecting Wheat in Serbia

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Abstract

Wheat (*Triticum aestivum*) is one of the first domesticated food crops and has been one of the most important crops worldwide for centuries. In Serbia, it is the second most cultivated cereal after maize with a production of more than 2.7 million tonnes. More than 50 viruses are known to infect wheat and can cause significant yield losses. The number and spread of wheat viruses have increased significantly, especially those transmitted by insects, due to the general trend and efforts in the EU to reduce the use of insecticides, combined with global climate change. The most important are two soil-borne viruses vectored by *Polymyxa graminis* (cereal mosaic virus and barley yellow mosaic virus), then insect-transmitted (wheat dwarf virus, WDV and barley/cereal yellow dwarf viruses, BYDVs/CYDVs), and mite-transmitted wheat streak mosaic virus (WSMV). In a five-year survey (2019-2023), 324 samples were collected and analyzed using RT-PCR or PCR to determine the presence and distribution of wheat viruses. Of the 10 viruses tested, WDV, WSMV and BYDV-SGV were detected in 64.55, 14.93 and 14.44% of the total tested samples, respectively. Molecular characterization based on the complete genome sequence showed that the Serbian WDV isolates were grouped in clade E within wheat-adapted forms. Phylogenetic analysis of the CP gene sequences revealed that WSMV isolates from Serbia grouped into clade B together with other European isolates. The results show that leafhopper-transmitted WDV is the most common in Serbia, followed by aphid-transmitted BYDV-SGV and mite-transmitted WSMV. The abundance of vectors in the early stages of cereal growth is directly related to epidemics caused by insect-transmitted viruses. Additionally, the risk of virus infection is increased by the prolonged flight activity of vectors due to the longer, warmer periods in autumn. Therefore, field management should primarily aim to suppress the vector population and eliminate any bridge hosts.

Key words: wheat dwarf virus, barley yellow dwarf virus - SGV, wheat streak mosaic virus, molecular detection, phylogenetic analyses

Acknowledgment

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Essential Oils as Bioinsecticides

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Abstract

Essential oils are products of the secondary metabolism of aromatic plants. Particularly notable are families such as *Lamiaceae*, *Asteraceae*, *Lauraceae*, *Zingiberaceae*, *Myrtaceae*, *Rutaceae*, *Apiaceae*, and *Pinaceae*. These are more or less complex mixtures of fragrant and highly volatile, lipophilic compounds, predominantly various monoterpenes, sesquiterpenes, and phenylpropanoid compounds. Plants of interest for pharmacy are those that yield over 0.01% essential oil through steam distillation. In recent decades, the antimicrobial, antifungal, antioxidant, antiviral, and anti-inflammatory effects of essential oils have been extensively studied, while their impact on harmful insects in crop production has been less explored. Therefore, the aim of this study is to highlight the importance and potential of essential oils in combating harmful insects. The composition of essential oils depends on numerous factors, such as genotype, the processing method of plant material, methods of obtaining essential oils, origin, climate, and whether the leaves were obtained from the first or second harvest. Due to their high volatility, essential oils are non-persistent, with a half-life of less than 24 hours. These properties make essential oils environmentally safe. The various effects essential oils exhibit on insects form the basis for their application as biopesticides. The advantages of using these preparations over conventional pesticides include the absence of negative environmental impacts, a high degree of biodegradability, non-toxicity or low toxicity to mammals and beneficial entomofauna, greater selectivity, and the reduced likelihood of insects developing resistance.

Key words: essential oils, toxicity, insects, bioinsecticides

**Biological Spectrum of Weed Flora in Winter Small Grains in
The Northwestern Region of The Republic of Srpska**

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Abstract

The article presents an overview of the weed flora in winter small grains crops within the lowland and hilly-mountainous regions in the northwestern part of the Republic of Srpska. A total of 76 weed species from 28 families have been identified. The composition of the weed flora in the hilly-mountainous region is influenced not only by specific climatic factors but also by the fact that the land has been used as natural meadows for several years. The analysis of the life form representation within the weed flora of cereal crops reveals a hemicryptophyte-therophyte character, with a ratio of (h = 38.15%: t = 25%). Although geophytes are less represented by number of species (17.11%), their significance in the weed flora is considerable due to their intense vegetative reproduction and herbicide resistance. Based on the analysis of the areal spectrum of the weed flora in the studied area of cereal crops, it was determined that the most numerous groups belong to the cosmopolitan areal type (39.49%), followed by Euro-Asiatic (34.20%), Sub-Mediterranean (11.84%), Boreal (9.20%), Adventitious (3.94%), and Pontic-Central Asian (1.31%). The analysis of ecological indices showed significant variation across the key ecological factors. According to the classification of environmental indices for plant species, moderately moist habitats with neutral to slightly alkaline reactions were dominant. Most recorded species exhibit high ecological index values for soil nitrogen content and are present in mesothermic to thermophilic habitats, with moderate to high light requirements. The diversity of the weed flora primarily depends on the intensity of agricultural practices and the applied herbicides. An analysis of the biodiversity of the weed flora and their specificities points to a complex problem regarding their control.

Key words: weed diversity, life forms, small grains crops, herbicides

The *in situ* Klečac - Popovopoljac Landrace is a True Descendant of the Early Maize Introductions in the Former Yugoslavia

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Abstract

The introduction of hybrid varieties into agricultural practices, coupled with the significant depopulation of rural areas, has led to a decline in the cultivation of maize Open Pollinated Varieties (OPV). Despite being considered custodians of nutritional quality and ideal for preparing traditional maize dishes, these varieties are now seldom grown. In collaboration with the Center for the Development of Herzegovina, we obtained a sample of an *in situ* OPV landrace known as *Klečac-popovopoljac*, which has been cultivated on a family farm of Anđelko Dolina in Tuli, Popovo Polje, for generations. The local residents use its grain to make polenta and maize bread, which are integral to the authentic culinary offerings of the City of Trebinje. The Maize Research Institute Zemun Polje Gene Bank (MRIZP) maintains a collection of 2,217 ex-Yugoslav maize landraces, including 324 from Bosnia and Herzegovina. From the entire MRIZP collection, we selected 16 accessions that contain *klečac* or *popovopoljac* in the names, including six originating from Trebinje, regardless of the name. Based on morphological data, these landraces were grouped into three clusters and one branch. The results, along with passport data, suggest that these landraces likely evolved from three different types of germplasm. By comparing grain reference samples from the MRIZP with the *in situ* landraces, we found the closest similarities with AN1972 - *domaći tvrdunac* and AN1335 - *sitnozrni popovac*, both of which were collected in Trebinje during the 1970s. Ongoing morphological and molecular analyses aim to assess the genetic relationships among the examined landraces and to examine any potential changes in the *in situ* landrace during a long-term and continuous cultivation in the isolated region of Popovo Polje.

Key words: local landraces, origin, morphological characterization, *Zea mays* L.

Acknowledgment

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The Importance of Secondary Biomolecules in Allelopathy and Weed Control

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Abstract

The term allelopathy is used to describe chemical interactions between two plants, as well as chemical communication between plants and microorganisms, plants and insects, and plants and herbivores. Plants synthesize a large number of secondary biomolecules, which are subsequently released into the environment through root exudates, evaporation from above-ground parts, or the decomposition of fallen, dead parts. These biomolecules influence the germination, growth, and development of surrounding plants by affecting their photosynthesis, respiration, water and hormonal balance, enzyme activity, as well as the structure and permeability of cell membranes. The aim of this study was to highlight the importance of secondary biomolecules in allelopathic relationships, particularly in weed control. Allelochemicals are classified into water-soluble organic acids, unbranched alcohols, aliphatic aldehydes and ketones, simple lactones, long-chain fatty acids and polyacetylenes, benzoquinones, anthraquinones and complex quinones, phenols, cinnamic acid and its derivatives, coumarins, flavonoids, tannins, steroids, and terpenoids (sesquiterpene lactones, diterpenes, and triterpenes). Among these, phenolic acids play a leading role in allelopathy compared to other classes of compounds. In weed control strategies, allelopathy can serve as a key component, representing a significant step in developing sustainable farming systems with reduced reliance on synthetic herbicides. Allelopathic substances isolated from plants that exhibit inhibitory effects on seed germination and weed growth include isothiocyanates from radish, sorgoleone from sorghum, momilactone from rice and moss, artemisinin from wormwood, sarmentine from pepper, essential oils from eucalyptus, and aqueous extracts from sunflower. By applying natural herbicides derived from plants, soil fertility and microbiological activity are preserved and protected.

Key words: allelopathy, herbicides, plants, weeds

Impact of Water Depth Regulation on Weed Suppression in Direct Wet-seeded Rice

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Abstract

Weed infestation remains a significant challenge in rice cultivation, leading to substantial yield and quality losses. In the Republic of North Macedonia, persistent weed growth continues to be a major concern in rice fields, with yield reductions ranging from 40% to 70%, depending on weed density and species composition. This highlights the urgent need for effective weed management strategies. Water depth regulation plays a vital role in suppressing weed growth and optimizing rice yield in direct wet-seeded rice. This study assessed the impact of water depth on weed control in rice fields in the Kochani region. The findings indicated that maintaining a water depth of 10-15 cm significantly suppressed weed infestation, achieving control efficiencies between 60% and 90%. These depths effectively inhibited weed seed germination and eliminated most weed seedlings. Weed species composition varied with water depth. At water depths of up to 10-15 cm, *Cyperus* spp., *Scirpus* spp. and *Echinochloa* spp. were the dominant weeds, while at greater depths, aquatic plants became more prevalent. Furthermore, the study identified *Eragrostis pilosa* (Indian love grass) as a non-typical weed in the Kochani rice fields, spreading due to water scarcity and reducing rice yields by 25% to 55%. The study also found that the most effective approach to maximizing herbicide efficiency is to apply water 2-4 days after treatment, maintaining a depth of 10-15 cm and keeping this level until harvest. Conversely, delaying irrigation for 7-10 days after herbicide application reduced its effectiveness by 30% to 60% and resulted in increased weed infestation. Overall, these findings underscore the importance of proper water depth management as a key strategy for effective weed control, reducing dependence on herbicides, and ensuring sustainable rice production. The results emphasize the need for balanced irrigation practices to maximize yields while minimizing weed competition.

Key words: wet-seeded rice, weeds, water depth

**Control of *Ostrinia nubilalis* and *Helicoverpa armigera* in
Maize using of Insecticide Chlorantraniliprole**

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Abstract

Ostrinia nubilalis and *Helicoverpa armigera* represent one of the most important maize pests in Serbia and Europe. Due to the pronounced polyphagy and the larger number of generations per year, their control is challenging. In addition to integrated pest management, insecticides application is usually inevitable. During 2023, the efficacy experiments of the insecticide chlorantraniliprole (200 g/l a.s., SC) were conducted for the control of *O. nubilalis* and *H. armigera* at two localities in Vojvodina according to EPPO methods, in the maize varieties DKC4098 and Pioneer 9911. The insecticide was applied at 0.15 l/ha when the maize was in the BBCH 65-67. The treatment was performed foliar, during moth flight, egg-laying of the second generation, when larvae are present and active. Three evaluations were performed. The first evaluation was conducted immediately before the treatment when the number of eggs and larvae was determined (25 plants per repetition). In the second evaluation 15 days after the treatment, the number of damaged plants and cobs was determined. The third evaluation, slightly before harvest, determined the number of stem-broken plants above/below the cob and the number of damaged cobs (20 plants per repetition). The results were analyzed using one-way ANOVA and LSD tests, and the efficacy was calculated according to Henderson-Tilton. Immediately before the treatment, the average number of *O. nubilalis* egg litters ranged from 5.0 to 8.5, while the *H. armigera* eggs were not found. The number of borer larvae of *O. nubilalis* before the treatment 1.75-3.0, and 2.25-4.0 of *H. armigera*. After 15 days, the efficacy of the chlorantraniliprole was 80-85.3%. Chlorantraniliprole significantly reduced the number of broken plants and damaged cobs compared to the control, based on the assessment right before harvest. The efficacy ranged 82-95.4%, indicating the significant sensitivity of the populations of the mentioned pests to chlorantraniliprole.

Key words: maize, *O. nubilalis*, *H. armigera*, chlorantraniliprole, efficacy

Acknowledgment

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The Content of Total Lipids and Phytosterols in Soybean Seeds

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Abstract

Soybean seeds are a valuable nutritional and industrial resource due to their rich content of lipids and bioactive compounds, including phytosterols. Phytosterols, plant-derived sterols structurally similar to cholesterol, contribute to the nutritional profile of soybeans, enhancing their value as a functional food ingredient. This study aimed to evaluate the differences in total lipid and phytosterol content between organically and conventionally produced soybean seeds. Samples were collected during the 2016 season from the experimental field of the Maize Research Institute (Zemun Polje, Serbia). The total lipid content was determined using AOAC method no. 963.15, with results expressed as a percentage. In order to quantify phytosterols extracts in chloroform were prepared and resulting products of the Lieberman-Burchard reaction was obtained as green colored. The absorbance of obtained green complexes was determined on a spectrophotometer at 640 nm and results expressed in mg kg⁻¹ dry weight (DW). Conventional soybeans exhibited higher lipid content (8.35%) compared to organic soybeans (6.29%). In contrast, organic soybean seeds had significantly higher phytosterol content (161.85 mg/kg DW) than conventional soybeans (9.32 mg/kg DW). These findings highlight the nutritional and functional potential of organic soybeans due to their higher phytosterol content, which contributes to health benefits such as cholesterol reduction. The variations in lipid and phytosterol content underscore the importance of cultivation methods in determining the nutritional and industrial value of soybean seeds.

Key words: seeds, total lipids, phytosterols, production

Evaluation of Yield Stability and Regionalization of Hybrids under Different Agroecological Conditions in Republic of Serbia

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Abstract

This study presents the results of evaluating yield stability for seven maize hybrids (ZP 427, ZP 457, ZP 555, ZP 5601, ZP 606, ZP 6263, and ZP 707) conducted in 2020 and 2021, across nine distinct locations in Serbia. The aim of the research was to evaluate yield differences and stability between hybrids under varying agroecological conditions and to perform regionalization to optimize hybrid deployment in specific production areas. The experiment was carried out using a Randomized Complete Block Design (RCBD) with plots of 30 m² and three replications. The hybrids were tested across different maturity groups and analyzed in relation to planting density, harvested plant density, moisture content, and yield across four locations in Vojvodina and five in Central Serbia. The results showed that the average yield in Vojvodina was 9.20 t/ha, while the average yield in Central Serbia was lower at 8.54 t/ha. The hybrid ZP 5601 achieved the highest average yield in both regions (9.43 t/ha) with good stability under various ecological conditions. Similarly, ZP 6263 reached an average yield of 9.28 t/ha, demonstrating better adaptation to favorable conditions. On the other hand, ZP 606, despite yielding lower (8.96 t/ha), exhibited exceptional stability, making it suitable for production environments with higher variability. Analysis of yield stability using the Francis, Kannenberg, and Eberhart & Russell methods showed that ZP 5601 had the lowest coefficient of variation (CV = 31.8%), while ZP 606 had the lowest S²di (109039.8), making it the most stable hybrid across different locations. The hybrids ZP 427 and ZP 457 exhibited the highest variability (CV = 34.6% and 36.1%, respectively), with ZP 427 showing the lowest stability (S²di = 525656.0). Based on these findings, ZP 457, ZP 5601 and ZP 6263 are recommended for intensive production, ZP 427 and ZP 606 for less favorable environments.

Key words: yield, stability, hybrids, regionalization, environments

Acknowledgment

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Taxon *Papaver somniferum* - Biological Properties and Possibilities of Application in Pharmacy

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Abstract

Papaver somniferum is an annual plant, about 50 cm in height. The stem is hairless. The ground leaves are long-stalked, the middle leaves are short-stalked, and the upper sessile leaves enclose the stem. The flowers are large, single, white, pink or red. The fruit is a spherical capsule with many seeds. The plant blooms from June to August. *Papaver somniferum* is a pharmacologically active plant taxon, which produces alkaloids in secondary metabolism, so it is intensively used in pharmacy. The alkaloids are concentrated in the milky fluid (*opium*), which is obtained by cutting the immature pods of the plant. *Opium* is obtained by cutting the green pods of the opium poppy at a certain stage (the stage of *opium* maturity). It is a shiny, hard, resinous mass, it is dark red in color, bitter and pungent in taste, and has a specific narcotic smell. In addition to alkaloids, *opium* contains sugars, fatty compounds and minerals, resins and water. The main alkaloids extracted from *Papaver somniferum* are morphine, papaverine and codeine. Morphine has a pronounced effect on the nervous system, acts as a strong analgesic, causes behavioral changes and addiction. Papaverine causes smooth muscle relaxation and exerts spasmolytic action, while codeine acts as a depressant on the respiratory center and the cough center. The seeds of the plant species *Papaver somniferum* do not contain *opium* and are used in the food industry. The seeds and the fatty oil obtained from the seeds are used.

Key words: *Papaver somniferum*, biological properties, pharmacological activity, significance

Acknowledgment

Research was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Grant numbers: 451-03-66/2024-03/200032; 451-03-65/2024-03/200116; 451-03-136/2025-03/200053; 451-03-136/2025-03/200032) and Bilateral Project Serbia and Croatia (2024-2025): Alternative and fodder plants as a source of protein and functional food; and Bulgarian Project (2024-2027): "Intercropping when growing maize for sustainable agriculture."

The Effect of *Angelica archangelica* L. Hydrolate on Wheat Seeds Germination

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Abstract

Angelica archangelica L. belongs to the genus *Angelica* and the family *Apiaceae*, which comprises about 90 species of biennial and perennial plants that are widely distributed. *A. archangelica* is often used in traditional medicine for various purposes. Essential oils (EO) from various *Angelica* species exhibit significant antioxidant, antimicrobial, insecticidal and anti-inflammatory activities. The aim of the research was to investigate the effects of hydrolate from *A. archangelica* on the germination of wheat seeds in vitro. The experiment was carried out with a one wheat variety soaked with previously prepared concentrations of hydrolate (0.25%, 0.5%, 1%, 5% and 10%) for 10 minutes. Distilled water was used as a control treatment. Seeds were placed in petri dishes lined on both sides with filter paper and soaked in sterile distilled water to maintain moisture. The experiment was carried out with five replicates of 50 seeds for each concentration. After 7 days, the length of the seedlings was measured in comparison to the control and the mean values were calculated. The highest seedling length value (3.13 cm) was recorded in the 10% treatment, which was a statistically significant difference to the other treatments and the control. Almost equal values were obtained in the treatments with concentrations of 1% and 5% (2.85 cm and 2.86 cm), while the values were lower in the treatments with 0.25% and 0.5% (2.64 cm and 2.68 cm). The lowest seedling length was obtained in the control treatment (1.48 cm). The obtained results indicate the potential possibility of influencing the germination of wheat seeds through the use of *A. archangelica* hydrolate and provide a starting point for further investigations and possibilities to improve the germination of seeds in field crops.

Key words: hydrolate, *A. archangelica*, wheat seeds, germination

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The Possibility of Residual Herbicide Application in Late Planted Bean Seed Crop

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Abstract

The field experiment was conducted at the experimental field of the Institute for Vegetable Crops Smederevska Palanka in Smederevska Palanka, Serbia. Beans were planted on July 1st 2024, after which herbicides were applied. The goal of this study was to evaluate the efficacy of 5 treatments and their crop selectivity. Herbicides used in this study were 1) dimethenamid-P 864 g a.i. ha⁻¹ plus flumioxazin 40.8 g a.i. ha⁻¹; 2) dimethenamid-P 864g a.i. ha⁻¹ plus metobromuron 1000 g a.i. ha⁻¹; 3) aclonifen 1800 g a.i. ha⁻¹ plus metobromuron 1000 g a.i. ha⁻¹; 4) clomazone 96 g a.i. ha⁻¹ plus metobromuron 1000 g a.i. ha⁻¹ plus dimethenamid-P 720g a.i. ha⁻¹. Visual efficacy and crop injuries were rated on every 7 days after treatment (DAT), whereby 21 DAT weed density and biomass were measured. Weed species present in the study were *Ambrosia artemisiifolia*, *Hibiscus trionum*, *Polygonum lapathifolium* and *Portulaca oleracea*. By using Tukey test, all treatments showed statistically very significant differences compared to control. The best efficacy (100%) on all 4 weed species was reached in treatment clomazone 96 g a.i. ha⁻¹ plus metobromuron 1000 g a.i. ha⁻¹ plus dimethenamid-P 720 g a.i. ha⁻¹. Treatment aclonifen 1800 g a.i. ha⁻¹ plus metobromuron 1000 g a.i. ha⁻¹ showed lowest efficacy in *P. oleracea* control. All treatments showed excellent efficacy in *H. trionum* control. Visual crop injuries were only observed in treatment dimethenamid-P 864 g a.i. ha⁻¹ plus flumioxazin 40.8 g a.i. ha⁻¹ due to application of flumioxazin. Crop injuries were visible 14 DAT, but not 21 dat. Based on this research, all treatments can be applied in Galeb bean variety which was planted in this study, but the choice should be based on the weed spectrum.

Key words: efficacy, selectivity, soil applied herbicides, beans, weeds

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The Effect of Applied Fertilization Treatments on Grain Yield and Harvest Residues of Broad Bean (*Vicia faba* ssp. *eufaba* var. *major* Harz.)

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Abstract

The experiments were conducted on the demonstration field of the Agricultural Institute of the Republic of Srpska, from 2021 to 2023. The aim of research was to examine the effect of applied fertilization treatments on the yield of grain and harvesting residues of broad beans under the agro-ecological conditions of the Banja Luka region. The experiment was set up in four replications using a randomized block design, with the size of the basic plot being 10 m². For these trials, seed from the broad bean population from the Institute's collection was used, with a sowing rate of 220 kg ha⁻¹. Four fertilization treatments were tested: control (T1), NPK 15:15:15 at a dose of 300 kg ha⁻¹ (T2), biostimulator Slavol S at a dose of 250 ml ha⁻¹ (T3), and NPK 15:15:15 at a dose of 300 kg ha⁻¹ + biostimulator Slavol S at a dose of 250 ml ha⁻¹ (T4). The following parameters were monitored during the study: grain yield per unit area (kg ha⁻¹), harvesting residue yield (kg ha⁻¹), biological yield (kg ha⁻¹), the share of empty dry pods in the harvesting residues (%), the share of dry matter in the plant in the harvesting residues (%), and the harvest index (HI, %). During these experiments, the grain yield of beans ranged from 1,096.7 kg ha⁻¹ in treatment T1 (2021) to 3,240.0 kg ha⁻¹ in treatment T4 (2023). The highest average grain yield during these studies was achieved with treatment T4, amounting to 2,679.9 kg ha⁻¹. The average yield of harvesting residues during the study ranged from 3,049.7 kg ha⁻¹ (T1) to 3,986.8 kg ha⁻¹ (T4). The share of empty dry pods in the total harvesting residue yield varied from 25.5% in treatment T1 (2022) to 36.5% in treatment T4 (2021).

Key words: broad bean, fertilization treatments, grain yield, harvesting residue yield, harvest index

Wheat Straw Mulching with Fertilizer Nitrogen: An Approach for Improving Soil Water Storage and Maize Crop Productivity

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Abstract

Field studies using wheat straw mulching effects on soil water storage and maize development were conducted in China. The studies contained four treatments during three years (2014–2016): CK (no straw and no nitrogen); N (no straw mulching with 172 kg N ha⁻¹); HS + N (half straw mulching at the rate of 2500 kg ha⁻¹ with 172 kg N ha⁻¹), and FS + N (full straw mulching at the rate of 5000 kg ha⁻¹ with 172 kg N ha⁻¹). The FS + N treatment significantly increased soil water storage in a drought period during crop growth stages and promoted plant growth along with increased evapotranspiration. The FS + N treatment increased the soil water storage (26.5, 19.9 and 11.1 mm), grain yield (28.7, 6.93 and 2.4%), and water use efficiency (26.6, 6.64 and 2.40%) compared to CK, N and HS + N, respectively. In conclusion, compared to N, HS + N or FS + N increased the biomass (11 and 19%) and water use efficiency (4 and 5%), respectively, and are considered beneficial in Guanzhong, China. Mulching levels were superior to N and compensated the wheat nitrogen requirements. Thus, further studies with minimum fertilizer nitrogen for an environmentally friendly and effective approach are recommended in semiarid regions of China.

Key words: semi-arid region, *Zea mays* L., rainfall, soil temperature, crop yield

**Contribution to the Knowledge on the Distribution of *Aristolochia clematitis*
in Riparian and Roadside Habitats of Serbia**

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Abstract

Aristolochia clematitis L., belonging to the Aristolochiaceae family and commonly known as common birthwort or Dutchman's pipe, is a rhizomatous perennial herb best known for its unpleasant odor. It is widespread in Serbia, favoring warm, nutrient-rich soils in sunlit areas. It thrives in habitats such as floodplain forests, riverbanks, embankments and roadsides. This species is also significant from a plant, animal and human health perspective, as a phytopathogenic virus host, poisonous plant and producer of aristolochic acid I (AAI), a nephrotoxic and carcinogenic compound linked to Balkan endemic nephropathy. Field studies in Serbia were conducted along 236 riparian and 180 roadside field sites, where its presence and abundance were recorded along 100 m long vegetation transects. RDA analyses were performed using Canoco 5.0, with *A. clematitis* cover as a response variable and selected habitat features as explanatory variables. Generalized additive model (GAM) was done to fit a response curve of *A. clematitis* on the elevation gradient. *A. clematitis* was documented in 42 field sites, with the highest number of field sites being in the Danube catchment area (riparian) and along the E-75 highway (roadside). The cover of *A. clematitis* varied, equaling the cover of cca. 5% in 66.67% of riparian field sites, with some roadside sites reaching 30% cover. Analyses show that the presence and cover of *A. clematitis* was positively associated with lower altitudes and the presence of some anthropogenic features (e.g. debris) within the studied reach of the river. The study highlights the need for targeted control measures, considering the cover and abundance of *A. clematitis* in specific locations.

Key words: common birthwort, Danube catchment area, highway, Serbia

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The Impact of Irrigation on Yield Components of Maize

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Abstract

Maize is the most widely cultivated crop on arable land in Bosnia and Herzegovina. Yields are quite inconsistent due to several factors, with one of the most significant being the lack of moisture during the growing season, particularly during the pollination period. Irrigation is a measure taken to mitigate the harmful effects of drought. A maize field trial was conducted over two growing seasons (2022/2023) with three replications. The local hybrid BL-43 was sown in three irrigation treatments and two fertilization variants. During the season, morphometric parameters of maize plants were measured. Statistically highly significant differences were observed between yields and yield components. The greatest differences were found in plant height among the irrigation treatments, as well as between the two years of study. Maize yield showed high variability under the influence of the applied treatments. The highest yield (11,031 kg ha⁻¹) was achieved with the 100% irrigation treatment combined with a higher rate of mineral fertilizer. Irrigation treatment had a much greater effect on yield components and total maize yield than fertilization. Applying irrigation at 50% and 100% of the required norm increased the values of yield components and overall maize yield in 2023 by about 27%. In the drought year (2022), the increase was 27% with 50% irrigation and 37% with 100% irrigation. In the dry year of 2022, when total precipitation was 35% lower compared to the multi-year average, irrigation had a strong effect on maize yield components.

Key words: *Zea mays* L., yield components, irrigation, interaction effects

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Assessment of Heavy Metal in Cultivated Soils of the Čačak–Kraljevo basin

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Abstract

Heavy metals are one of the largest groups of pollutants. They are found in the natural environment, mostly in water and soil, as a result of mining and leaching of ores, industrial production, urban activities, use of artificial fertilizers in agriculture and other human activities. The concentration of toxic metals varies depending on the geological base, soil type, geographical area and climatic factors. In order to determine the distribution of the studied heavy metals and to study the physical and chemical properties of the soil of the Čačak–Kraljevo basin (Čačak and Kraljevo), soil samples were collected in the period from December 2020 to December 2021 from depth 0-20 cm. The concentrations of heavy metals (Fe, Mn, Zn, Cu, Ni and Pb) in the prepared soil samples were determined by the ICP-AES method on the device Vista - Pro, Axial, Varian (an Inductively Coupled Plasma-Optical Emission Spectrometer). Result showed that pH levels (H₂O) ranged of 5 to 6, indicating acidic soil. The Fe content ranged from 1.8 to 126 µg g⁻¹, suggesting high variation across samples. Manganese levels also varied significantly from 4.6 to 136 µg g⁻¹ and Zn concentrations were generally low (0.44 to 10 µg g⁻¹). Cu levels varied between 0.52 and 15.8 µg g⁻¹, with higher values indicating potential contamination or rich natural deposits. Ni concentrations were generally low (0.76 to 13.56 µg g⁻¹), Pb levels indicating minimal contamination (0 to 5.7 µg g⁻¹) and Cd level was uniformly low (0.1 µg g⁻¹) across all samples. Most Cr values were zero, suggesting negligible Cr content in the soil. The average concentrations of heavy metals in the tested soil samples of the Čačak–Kraljevo basin were lower than the average values found in other regions of Europe and the world. Knowledge of the mobility of heavy metals is one of the goals of protection, arrangement and rational use of agricultural land from the point of view of production of healthy food.

Key words: heavy metals, soil, Čačak–Kraljevo basin

Acknowledgment

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The Impact of Different Doses of Mineral Fertilizers on The Yield of Potatoes Grown on Ilimerized 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, luvisols, potato, varieties, yield

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**The Effect of Nitrogen Fertilization on the Productivity of
Natural Grassland *Agrostietum vulgaris* Type**

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Abstract

In the hilly and mountainous area of Republic of Srpska natural grasslands (meadows and pastures) represent significant grazing resource and production bulky livestock food. However, in addition to the big one importance and available surface production bulky livestock food on natural grasslands are relatively low. Limiting production factors of feed in mountainous areas are the quality of the soil and the climatic conditions, which to the greatest extent limit the production of forage from alfalfa and silage corn. In addition to traditional fodder production on natural grasslands, agricultural producers often opt for growing grass-clover mixtures that tolerate such soil and climate conditions. Low yields hay natural and shining lawn can be improved by application mineral fertilizers. In addition to the application mineral fertilizers, which should be one from implementation of basic agrotechnical measures more profitable plant-based, ultimately and animal production it is necessary to apply appropriate quantities fertilizers at the most suitable time growing season herbal type. Goal this one research was to determine influence different quantity mineral fertilizers (nitrogen) on productivity natural lawn type *Agrostietum vulgaris*. This study is realized in two vegetation seasons (2018 and 2019). The application of mineral fertilizers had a positive impact on grassland productivity. The highest average green mass yield of 13.15 t ha⁻¹ and hay yield of 3.48 t ha⁻¹ was achieved with the application of 94.5 kg ha⁻¹ nitrogen, and the lowest was achieved with the control variant. The average increase in hay yield in the first year was 37.6% and in the second year it was 5.6% higher than in the first year. The application of mineral fertilizers on natural grasslands is an important agrotechnical measure aimed at obtaining higher yields of green mass and hay.

Key words: natural meadow, fertilizer, yield, hay

**Ethnobotanical and Agronomic Insights into
Traditional Maize-Bean Intercropping Systems Across Montenegro**

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Abstract

Maize-bean intercropping is a long-standing agricultural practice in Montenegro, contributing to food security, biodiversity, and cultural heritage. This study examines traditional farming methods, seed selection, and the agronomic practices of local maize and bean landraces. Through field surveys and interviews with farmers across multiple regions, we document intercropping strategies, seed-saving practices, and the role of vernacular crop naming in preserving traditional knowledge. Local knowledge suggests that landraces may exhibit distinct characteristics adapted to local conditions, with most farmers cultivating these crops for household consumption and occasional market sales. While traditional seed-saving and exchange networks support genetic diversity, modernization and reduced farmer-to-farmer exchanges threaten their continuity. Integrating traditional knowledge with sustainable agricultural strategies can enhance resilience, maintain genetic diversity, and ensure the viability of intercropping systems in the face of agricultural changes.

Key words: maize, bean, intercropping, conservation, Montenegro

Session 4: Animal Science

Oral Presentations



O4_01

Artificial Meat: The Story behind – Innovation or Illusion?

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Abstract

Artificial meat is promoted as a sustainable and ethical alternative to traditional livestock farming, claiming to reduce environmental impact and address global food challenges. However, behind this narrative is a powerful lobbying effort by biotech corporations, investors, and organizations advocating for the reduction of animal farming. These groups drive aggressive marketing campaigns while funding initiatives that depict conventional animal production as unsustainable and harmful. The negative portrayal of animal farming often exaggerates its environmental impact while ignoring its socio-economic role, especially in rural communities. Meanwhile, artificial meat raises concern due to its highly processed nature, reliance on synthetic additives, and potential long-term health risks. Its production requires complex biotechnological processes, including fetal bovine serum, artificial growth factors, and extensive energy use, raising ethical and sustainability questions. Despite claims of being a sustainable alternative, artificial meat remains a controversial product with insufficient independent research on its long-term health and environmental effects. A critical and science-based debate is needed to assess the true consequences of replacing traditional livestock farming with lab-grown alternatives.

Key words: artificial meat, livestock production, biotechnology, sustainability, health risks

Assessment of Microclimate and Greenhouse Gas Emissions in Dairy Farms

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Abstract

This research was conducted to determine greenhouse gas (GHG) emissions and air quality parameters on dairy farm in Slovenia. A total of 48 measurements were taken, including 40 inside the barn at two different heights (1.5 m and 0.2 m) and 8 measurements outside. The study focused on the concentrations of water vapor (H₂O), carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and ammonia (NH₃) to assess their distribution and potential environmental impact. The measured values of microclimatic parameters and gases were in accordance with the limits of optimal values, except for THI values that indicated the onset of mild heat stress. Based on the results, it can be concluded that while GHG concentrations vary depending on location and measurement conditions, proper barn design and management can help maintain air quality within acceptable limits. Several factors influenced the results, including herd size, ventilation efficiency, barn management practices, and air circulation at the time of measurement. The study highlights the importance of optimizing ventilation and manure management to reduce high gas concentrations inside dairy barns.

Key words: greenhouse gas, microclimate parameters, dairy farm

O4_03

Milk Coagulation Properties of Three Cattle Breeds

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Abstract

Milk coagulation is a critical process in cheese making, as it directly affects the texture and quality of the cheese. This study aimed to determine the influence of breed on milk coagulation properties. The present research included 138 individual milk samples from 3 breeds. The research showed that there are no statistically significant differences among the breeds. However, the results indicate that the coagulum firmness of the Brown Swiss breed is better than that of the Holstein Friesian and Simmental breeds. Still, to confirm these differences more samples must be analyzed.

Key words: milk, coagulation, breed

O4_04

**Prevalence, Persistence, and Costs of Acidosis in Holstein Cows
across Breeding Regions**

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Abstract

This research aimed to analyze the prevalence, persistence, and economic impact of acidosis in Holstein cows, with a focus on the influence of the breeding region. The study utilized 3,953,549 test-day records for Holstein cows collected from January 1, 2005, to December 31, 2022. Data were grouped based on the breeding regions in Croatia: Central, Eastern, and Mediterranean. The prevalence of acidosis risk and acidosis was determined by analyzing the fat-to-protein (F/P) ratio and daily milk yield. Additionally, the impact of acidosis on milk yield was assessed at different time points after the occurrence of acidosis. The economic implications were calculated by estimating the monthly and total differences in milk quantity and value following acidosis detection, considering the region of breeding. The findings provide valuable insights into the effects of acidosis on dairy cow productivity and highlight the importance of region-specific strategies to mitigate its economic consequences.

Key words: acidosis, Holstein cows, milk production, breeding region

O4_05

Variability of Milk Production Traits and the Mastitis Prevalence in Simmental Cows Considering Breeding Region

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Abstract

This research aimed to analyse the variability in daily milk production and quality, as well as the prevalence of subclinical and clinical mastitis in dairy Simmental cows, with a focus on the influence of breeding region. The data, collected over a 10-year period, included test-day records from cows in three regions of Croatia: Central, Eastern, and Mediterranean. Significant regional differences were observed in daily milk yield, fat content, and other milk quality parameters. Cows from the Central and Eastern regions had higher milk yield and fat content compared to those from the Mediterranean region. The study also examined the prevalence of mastitis, revealing higher rates of both subclinical and clinical mastitis in the Central and Eastern regions compared to the Mediterranean. Clinical mastitis was associated with a notable reduction in milk yield and quality, while subclinical mastitis, though less severe, still resulted in some decrease in milk production and quality compared to healthy cows. The results indicate the importance of monitoring mastitis prevalence and its impact on milk production, emphasizing the need for regional-specific management strategies to optimize dairy cattle health and productivity.

Key words: mastitis, milk yield, milk content, Simmental, breeding region

Improving Piglet's Production: Strategies for Antibiotic-Free Production

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Abstract

Reducing AMU and AMR is a key focus of modern pig production, and a main priority for the EU. The use and misuse of antibiotics in animal feed have led to problems with drug residues in animal products and increased bacterial resistance. Sano strategies for raising piglets without antibiotics include probiotics, prebiotics, phytobiotics, and organic acids. Introducing probiotics into piglet nutrition significantly improves gut health by promoting a balanced microbiome, which is crucial for nutrient absorption and overall well-being. This is particularly important in the early stages of growth when piglets are most vulnerable – e.g. *per os* application of *Piglobin*[®]. Different strains have different effects, so it is important to choose those that have been proven effective for gut health and growth – such as: *Enterococcus faecium*, *Bacillus subtilis* or *Bacillus licheniformis* (e.g. milk replacers such as *Sanolac Fercel*[®], *SanAmmat F*[®] or *SanAmmat Puddino*[®]). Prebiotics are non-digestible food ingredients that are fermented in the lower intestine to select beneficial bacteria; during fermentation, volatile fatty acids (VFAs) are produced, mainly acetic, propionic, and butyric acids, which reduce the pH of the intestine. Phytobiotics are a natural alternative to synthetic antimicrobials, helping to reduce the incidence of diseases in piglets (e.g. in the product *Antilaxan*[®]). Adding phytobiotics to piglet diets has been shown to improve feed efficiency, which is essential for maximizing growth potential while reducing feed costs for producers. These additives play a role in better health outcomes and reduced veterinary interventions. By lowering the pH value in the intestine, OA effectively inhibits the growth of harmful pathogens in piglets GIT. This is particularly important in the prevention of gastrointestinal diseases, e.g. formic (*Sanocid*[®]), propionic (*Acidosan*[®]), citric or butyric acid (*ButySan*[®]).

Key words: AMU (Antimicrobial usage), AMR (Antimicrobial resistance), piglets' production, probiotics, prebiotics, phytobiotics, OA (organic acids).

Morphometric Description of The Boric Arabian Horse Mare Families

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Abstract

The Boric Arabian horse has a long tradition of breeding in the territory of Bosnia and Herzegovina (BiH) dating back to 1884. The Borike Stud Farm, which ceased operations in 2018, played a significant role in breeding this population of horses. Today, the Boric Arabian horse is preserved in BiH thanks to private breeding. The aim of this research was to determine whether there is phenotypic uniformity between different mare families: Kadina, O'Bajan, Luna, El Hafi, and Hamdani. In this study, a total of 36 mares were measured, and 7 measurements were taken from each mare: withers height, back height, croup height, chest circumference, cannon bone circumference, body length, and back length. A simple analysis of variance with unequal repetitions was conducted to assess the significance of differences between mares of different families. The significance of the obtained differences was tested using Duncan's test. The average: withers height ranged from 142.6 cm (Luna and El Hafi) to 144.98 cm (Kadina), back height from 134.8 cm (El Hafi) to 137.12 cm (Kadina), croup height from 137.12 cm (Kadina) to 144.4 cm (El Hafi). The average chest circumference ranged from 166.91 cm (O'Bajan) to 176.62 cm (Kadina), and cannon bone circumference ranged from 17.23 cm (O'Bajan) to 17.75 cm (Luna). The average back length ranged from 73.45 cm (O'Bajan) to 77.4 cm (El Hafi), and body length ranged from 135 cm (O'Bajan) to 137 cm (El Hafi). The results showed no statistically significant differences in measurements between different mare families. These results support the recognition of the Boric Arabian horse breed.

Key words: uniformity, body measures, mares, Boric Arabian horse

Acknowledgment

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Mitochondrial DNA Analysis and Phylogenetic Tree Construction of Maternal Lines in Lipizzan Horses

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Abstract

The Lipizzan horse breed comprises 62 mare family lines. Mitochondrial DNA (mtDNA), especially the D-loop region, plays a vital role in tracing maternal lineage and preserving these historic family lines. This study included 13 horses and mares from Serbia that belongs to different mare family lines including Thais (Rebecca-Thais) (n=2), Drava-Dubovina (Djebrin) (n=2), Wera (Theodorosta) (n=4), Batosta (Africa) (n=3) and Zora (n=2). The D-loop region was sequenced, and the sequences were subjected to bioinformatics analyses. Multiple alignments of all obtained sequences and those downloaded from Genbank were performed with the reference mtDNA sequence downloaded from GenBank using the MEGA 11 software, and phylogenetic trees were constructed using PopART 1.7 and iTOL v6 online tools for visualization. Genetic distances were also analyzed using a heat map constructed in R software. Results of this study indicate that the Zora family line, though not officially recognized as a Lipizzan mare family line by LIF (Lipizzan International Federation), forms a cluster with classical Lipizzan mare lines, including Monteaura, Betalka, Wera, and Allegra. The primary aim of this study is to construct phylogenetic trees using Neighbor-Joining and Median-Joining methods, thereby analyzing the genetic diversity and evolutionary relationships among these mare family lines. The Neighbor-Joining tree provided a hierarchical representation of genetic distances, while the Median-Joining network revealed multiple evolutionary pathways, illustrating intraspecific genetic variability.

Key words: mtDNA, mare family lines, horses, neighbor-joining method, median-joining method

Detection of Genetically Modified Organisms in Bio Products on the Croatian Market

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Abstract

The production of bio or eco food implies production without the use of mineral fertilizers, hormones, pesticides, and GMOs. In Croatia, organic production has been growing year by year, regulated by legal provisions that set high standards for ecological production, which relies on renewable energy sources, waste recycling, limited pesticide use, and the prohibition of GMO use at any stage of production (food, animal feed, soil enhancers, plant protection). The purpose of organic production is to protect human health, nature, and the environment, as well as consumers. To maintain production consistency, legal regulations aligned with EU regulations on organic agricultural production and food production have been introduced, while the possible presence of GMOs in organic crops and food is regulated by GMO legislation. EU Regulation 1829/2003 regulates monitoring and labeling rules for food containing > 0.9% GMOs, including organic products. The aim of this paper was to determine the presence of GM soybean, corn, wheat, and rice lines in organic products commercially available on the Croatian market, and to determine their share in products containing GMOs. The study detected a low presence (0.1%) of GM soybean line MON 89788 in two organic soy beverages, while no GM corn, wheat, flax, or rice was found. The GMO content in all tested organic products remained below the regulatory labeling threshold (0.9%). These findings indicate that GM contamination in organic products on the Croatian market is minimal and primarily results from unavoidable cross-contamination during production, transport, or storage.

Key words: bioproducts, organic products, eco food, GMO detection, Real-Time PCR, CTAB method

The Role of Physical Structure in Ruminant Nutrition

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Abstract

The advancement of modern technology in livestock farming has introduced new feeding practices for ruminants, optimizing milk production. However, the increased use of concentrated feeds has also led to health challenges in dairy cows. This study examines the impact of silage particle size and the balance between fibrous and concentrated feeds on milk fat content and quality in lactating cows. Research was conducted on eight dairy farms in northern Vojvodina, Subotica district. Silage particle size was analyzed using the Penn State Particle Separator and compared to optimal standards. Information on farm feeding practices was collected from producers. The results showed significant variability in compliance with recommended silage particle sizes. Only one farm (12.5%) fully met Penn State standards, indicating frequent deviations. The study also found that a higher proportion of concentrates in the diet was linked to lower milk fat content, while farms incorporating more fibrous feeds, such as hay, achieved better results. Although silage particle size alone did not directly affect milk fat, the concentrate-to-fiber ratio significantly influenced milk fat levels. Based on these findings, it is recommended that producers increase fibrous feed, particularly hay, and reduce concentrates to improve milk fat content. Additionally, ensuring proper silage processing can contribute to better diet formulation and overall cow health. This study highlights the importance of balanced nutrition in dairy farming to support milk production and quality.

Key words: physical structure, milk fat, dairy cows, Penn state separator

**The Use of Lignin as a Marker in a Digestibility Trial
on *Tenebrio molitor* Insect Larvae**

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Abstract

The *Tenebrio molitor* or yellow mealworm is a widely studied alternative source of protein in animal nutrition. This study aimed to explore the use of lignin as a marker in the digestibility research of *Tenebrio molitor*. The digestibility results obtained from the total collection method were compared with those determined using a marker, and the data was statistically processed. It used two types of feed: wheat bran and oat flakes. The concentration of lignin varied greatly between the two, with wheat bran containing 2.17% and oat flakes 0.51%. The results show that the digestibility determined by both the direct method and the method using lignin as a marker is very similar for wheat bran; however, there is a notable difference for oat flakes feed. High values of determination coefficients (r^2) show a high correlation between digestibility values obtained by the two methods. Yet, regression analysis shows that only in the case of wheat bran two methods are resulting in similar values. In the case of oat flakes, systematic regression bias is obvious, as confirmed by intercept and slope significant p values. Lignin can serve as a useful marker in digestibility trials involving insects. The concentration of lignin in the feed appears to be crucial for obtaining accurate results. However, this is only a preliminary trial, and further research is needed to draw definitive conclusions.

Key words: marker, total collection, digestibility, *Tenebrio molitor*

Acknowledgment

This research was supported by the Science Fund of the Republic of Serbia under grant number 7284, titled "Advancing Sustainable Solutions by Developing Insect-based Protein as New Feed Options - PRO-SUSTAIN." Additionally, it is in accordance with the agreement for the realization and funding of scientific research work at NIO for the year 2025, reference number 451-03-136/2025-03/200117, dated February 4, 2025.

Traditional Portuguese Custard Tarts and Alternative Innovative Protein Sources - Insects

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Abstract

A growing global population, climate change and a degradation of natural resources are set to conjugate present problems in human forthcoming life on Earth. Edible insects offer important resource for many people as a source of animal protein. Pastel de Nata (Portuguese custard tart) is a traditional Portuguese pastry good, worldwide appreciated. In this work, innovative custards tarts were made with insects' inclusion, and studied the nutritional composing, texture and sensory attributes. Traditional Pastel de Nata (CT), and an innovative custard tart with incorporation of 6 % of Black Soldier Fly flour (BSF) were produced. All custards were analysed by conventional official methods (Dry method, Kjeldahl, Soxhlet), sensory analysis (hedonic test with structure score scale 1 to 5), texture evaluation with a texturometer (penetration test with 20 mm probe) and by an innovative method of hyperspectral image (Spectral Camera VNIR 400-1000nm). The results pinpoint a promising Portuguese custard tart since the traditional revealed similar moisture content (54-56%) and plus a significant ($p < 0,05$) increase in crude protein was achieved with the incorporation of BSF flour (15%). Concerning to texture analysis, performed by penetration test, the inclusion of insect's flour led to a decrease in both hardness and adhesiveness. In sensory assessment, overall appreciation was similar to the traditional ones. In conclusion the innovative Portuguese custard tart with BSF have a good potential, once the insect alternative protein source is recognized by man as a natural food for human consumption.

Key words: sensory, texture, *Hermetia illucens*

Acknowledgment

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Influence of Solid Feed, Lactose, and Protein Quality on Calf Growth and Rumen Development

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Abstract

The consumption of solid food in pre-weaning calves focuses on starter mixes and roughage (hay, straw, and silage). It is essential to provide a starter mix that stimulates rumen development and microbial fermentation without negatively affecting growth. The first rumen colonizers are anaerobes such as *Streptococcus* and *Enterococcus*, which create anaerobic conditions for microorganism growth. Different types of food, like concentrates and roughage, influence papilla growth and rumen development. The quality of the starter mix and particle size are also important for preventing diseases such as rumen parakeratosis and acidosis. Different fiber levels in the starter mix affect food intake and growth of the calves. Studies show that adding fiber to the diet improves digestive system development, while different processing methods of grains affect the intensity of fermentation in the rumen. Additionally, different carbohydrate types, such as lactose, can impact rumen development and fermentation, while proteins like L-lysine and DL-methionine can be crucial for calf growth and development.

Key words: pre-weaning calves, solid food, starter mix, roughage (hay, straw, silage), rumen development

**Livestock Production as a Potential for International Trade Exchange,
the Case of the Republic of Croatia**

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Abstract

The key feature of the current international trade exchange of livestock, meat, and meat products in the Republic of Croatia is the relatively high and growing foreign trade deficit. In order to overcome the negative economic trends and improve the situation, it is essential to find new or revitalize existing markets, which is crucial for overcoming various weaknesses in international trade. Through an integrated approach that includes sustainable resource management, the introduction of new technologies, and production inputs, it is possible to create the conditions necessary to improve the situation in international trade flows. Therefore, this paper will analyze trade components, imports, and exports of livestock as economic categories during the period from 2019 to 2023. The methodology used in this paper will include calculations for import coverage by exports, relative import coverage, expressed comparative advantage, calculation of the relative foreign trade balance, and statistical trend analysis. The aim of this paper is to present the trade of livestock, specifically pigs, cattle, sheep, and goats, through international trade flows, i.e., imports and exports, to show the trade balance, and, through trend calculations, project the trade exchange for the next five-year period.

Key words: livestock production, international trade, imports, exports, trade balance

Session 4: Animal Science

Poster Presentations



Manual Locomotion Scoring Systems for Lameness Detection in Dairy Cows

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Abstract

In the intensive milk production on dairy farms, there are a number of production problems. One of them is the high prevalence of lame cows. The economic losses owing to lameness range from 27.0 to 62.0\$ in average per cow. There are a lot of difference reasons for economic losses due to lameness and hoofs problems, and they can be divided into two main groups: direct (reproductive problems, less milk production) and indirect (veterinary treatments, early culling) costs. Numerous advanced disorders that affect cows' hooves can cause lameness. Timely detection of cows with a lower degree of lameness can prevent more severe stages and improve the welfare of the cows. There are several ways of detecting lameness, which can be direct and indirect methods. The objective of this paper was to describe and compare some of the manual locomotion scoring systems. All systems use ordinal or continuous types of scale and observed different gait (abduction or adduction, asymmetric gait, short step) and posture traits (arched back, hip hick, head bob). The most used manual locomotion scoring system is based on asymmetric gait, of the unbalanced weight distribution and arched back. Incorporating lameness assessment into daily farm routines requires additional commitment from farmers. This includes training, additional time and persistence, which often makes them less acceptable to farmers. Early detection of the onset of lameness can shorten treatment time, reduce treatment costs and increase animal welfare.

Key words: lameness, detection, methods, locomotion scoring systems, dairy cows

Acknowledgment

Supported by the Faculty of Agrobiotechnology Sciences Osijek, Croatia, Project for Fitness Potential of Animals in Economically Sustainable Agricultural Production; Project for Ecologically and Economically Sustainable Animal Production.

Ricotta, By-products or Cheese of The New Generations

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Abstract

The aim of this work is to present the results of the research, obtained for the nutritional values of the ricotta cheese by-products in the productions of Trappist cheese. The production of albumen cheeses is possible thanks to the specific properties of whey proteins, which are not sensitive to the action of acid or rennet enzymes, so they remain unchanged during the coagulation of milk, and after separating the curds, they almost completely turn into whey. This paper presents the nutritive benefits of a ricotta made from twhey remaining after the production of Trappist cheese. The content of total dry matter in ricotta is 27.9%, content of fat is 15.00%. Milk fat content in dry matter we get 55.17, the protein content obtained by the tests was 8%, ash content of 0.62% was obtained. The energy value of whey is 181 kcal or 752 kJ.

Key words: ricotta, nutritional value, whey

**Microbiological Safety of Raw Milk Cheese in Montenegro,
focusing on *Listeria monocytogenes***

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Abstract

Raw milk cheese represents an essential part of Montenegro's dairy heritage, offering unique sensory and nutritional properties. However, the use of unpasteurized milk in cheese production raises microbiological safety concerns, particularly regarding the presence of foodborne pathogens. Among these, *Listeria monocytogenes* poses a significant risk due to its ability to survive and proliferate under refrigeration conditions, potentially leading to severe health implications, especially for vulnerable populations. This study aimed to assess the microbiological safety of raw milk cheese from Montenegro, with a specific focus on *Listeria monocytogenes* contamination. A total of 1,864 raw milk cheese samples were collected from different regions of Montenegro in 2023 as part of a national food safety monitoring program and analyzed in Diagnostic Veterinary Laboratory in Podgorica. Standardized horizontal detection method was applied to identify the pathogen. The results revealed that *Listeria monocytogenes* was detected in only 2 samples, indicating a very low occurrence rate. The findings suggest that, despite the inherent risks associated with raw milk cheese production, Montenegrin cheese producers maintain high hygiene standards that effectively minimize *Listeria monocytogenes* contamination. However, considering the potential public health risks, continuous monitoring and risk assessment remain necessary. Further efforts should be focused on enhancing awareness among cheese producers, improving hygiene practices, and ensuring compliance with microbiological safety regulations. By maintaining rigorous safety standards while preserving traditional cheese-making techniques, Montenegro could continue to offer high-quality raw milk cheese with minimal health risks.

Key words: raw milk cheese, *Listeria monocytogenes*, food safety, Montenegrin traditional dairy products

The Effective Population Size of The Boric Arabian Horse Population from the Republic of Srpska

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Abstract

The tradition of breeding the Boric Arabian horse in our region is more than a hundred years long. The state stud farm Borike, where these horses were systematically bred for decades, is closed in 2018. Few years ago, the Association of Boric Arabian Horse Breeders was formed. The Association submitted a request to the Ministry of Agriculture for recognition of the new breed. According to the legal legislation, the conditions for the recognition are: unique characteristics which are differ from other breeds, effective population size greater than 50, uniformity of morphological and production characteristics in the last three generations, adaptation to the geographical area, as well as genetic distancing from other related breeds. In this sense, extensive research was conducted with the aim of collecting: morphometric measures of horses, samples for genotyping, as well as information on the number of male and female horses that will be used in reproduction. The aim of this work was to analyze the effective population size of this horse population. Based on the number of mares and stallions, the effective population size (N_e) was calculated according to the formula $N_e = 4mf/N$, where m is the number of stallions, f is the number of mares and N is the total number. The obtained value of the effective population size was 52.71. In further work, it is necessary to calculate the effective population size by pedigree analysis, as well as genetic and genomic analyses, in order to obtain more precise data and a clearer insight into the variability of this population. It is also necessary to continue with the collection of data in finding and recording all horses that are descended from Boric Arabian horses.

Key words: Boric Arabian horses, recognition of the new breed, condition

Acknowledgment

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**Analysis of Horse Interactions Depending on Group Size
through a New Object Test**

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Abstract

The study analysed equine responses to novelty, focusing on how the size of a horse group affects interactions with unfamiliar objects and the degree of curiosity exhibited by the horses. Being herd animals by nature, horses derive a sense of security from their social structure, but the development of cognitive abilities in each individual can vary depending on the herd size and environmental factors that foster curiosity. In smaller groups, horses tend to integrate more equally, which allows them to confront new challenges more swiftly and cohesively. Conversely, larger groups may lead to increased individualism. Smaller groups facilitate a more collaborative environment, particularly in scenarios involving intensive human-horse interactions through training, which provides both stimulation and a secure foundation for work. In larger groups, curiosity stimulation is enhanced through positive reinforcement during interactions. These findings are anticipated to enhance equine welfare within horse breeding practices. Notably, considerable individual variation was observed in the horses' responses, indicating a need for further research to deepen our understanding of both equine interactions and their interactions with humans.

Key words: equine, curiosity, novel object test (NOT), welfare

Changes in External Egg Quality Traits during the Laying Season in Native Goose

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Abstract

Raising geese holds a marginal position within poultry production in Bosnia and Herzegovina, where chicken meat and eggs dominate both in terms of production and consumption. The native goose, as a breed representing the majority of the goose population in country, is traditionally raised in extensive or semi-intensive systems for the production of meat, fat, and feathers. Despite the importance of hatching egg quality in determining incubation success, recent data on the egg quality of native goose remain scarce. This study aimed to assess changes in selected external egg quality traits during the second laying season of native goose reared in a semi-intensive production system. A total of 90 eggs were collected and analyzed across early, middle, and late laying period. The results showed that egg weight, shell weight, and shell thickness were significantly affected by the laying period, with all three traits showing lower values in the late laying period compared to the early and middle period ($p < 0.05$). In contrast, shell percentage was not significantly influenced by laying period ($p > 0.05$). The overall means (\pm standard deviation) for the evaluated traits during the second laying season were: egg weight 156.93 ± 22.39 g, egg shape index $65.48 \pm 2.96\%$, shell weight 17.89 ± 2.70 g, shell percentage $11.43 \pm 1.14\%$, and shell thickness 0.59 ± 0.06 mm. These findings enhance the understanding of egg quality in the native goose and may contribute to the conservation and improvement of this breed.

Key words: native goose, egg quality, shell quality, laying period

Ensiling and Presence of Aflatoxin M1 in Cow's Milk

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Abstract

The main goal of ensiling plants is preservation their nutritional value, as close as possible to the nutritional value they have in the form of fresh green plants. The technology of ensiling is a primary microbial process in which lactic acid bacteria are crucially important to protect energy content and prevent silo mass from the development of harmful microorganisms. The main points of risk are the selection of the correct stage of maturity of the plant for ensiling, the rapid squeezing of air inside the plant mass in the silo, and the correct covering. Changes in the silo mass occur practically as soon as the mass of plants is transferred from the field to the prepared silo object. The direction and intensity of the change depend on several factors, but mostly on those that condition the successful development of lactic acid fermentation, such as moisture in the nutrient, anaerobic environment, carbohydrate content, and temperature. These factors enable the conditions in which the desired microorganisms will dominate during the fermentation of the plant mass and obtain quality silage with high nutritional value. Contamination with undesirable microbes and chemical agents is one of the major problems in silage production. To minimize the aflatoxin contamination in crop plants, various physical, chemical, and biological methods, and breeding and genetic engineering approaches, have been used to reduce its level below the recommended one.

Key words: silage, legal regulations, aflatoxin, lactic acid bacteria, nutritional chain of humans and animals

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Microbiology of Water in Production of Food of Animal Origin

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Abstract

One of the most important prerequisites for safe food of animal origin is healthy animals used to produce food of animal origin. Water used in the production of food of animal origin must, in terms of its quality, including microbiological safety, meet the requirements relating to drinking water intended for human consumption. The experiment used drinking water originating from primary food production, including water from animal farms and meat, milk and fish production, sampled in 2023-2024 from area of the Republic of Srpska (Bosnia and Herzegovina). A total of 1,044 samples were examined (744 in 2023, and 300 in 2024). The aim of the study is to determine the microbiological status of drinking water from production of food of animal origin, using standard methods BAS EN ISO 6222, BAS EN ISO 7899-2 and BAS EN ISO 9308-1. The research determined 66.80% satisfactory samples and 33.20% unsatisfactory samples in 2023, and 71% satisfactory samples and 29% unsatisfactory samples in 2024. A significantly higher number of unsatisfactory samples of well and spring water was observed compared to the water supply system. In relation to the tested parameters, 16.33% of samples were unsatisfactory due to an increased number of microorganisms cultivated at 22°C, and 22.49% of samples due to an increased number of microorganisms cultivated at 37°C. When it comes to pathogens, 11.16% of unsatisfactory samples were due to the presence of intestinal enterococci and 16.28% due to the presence of *Escherichia coli* and coliform. Considering that almost one third of water samples are unsatisfactory, and the significant presence of pathogenic bacteria, it is necessary to take more frequent and detailed measures for disinfection and water control, to ensure optimal prerequisites to produce food of animal origin.

Key words: water, food, animals, production, microbiology

**The Influence of Selective Breeding on the Body Weight of
Rainbow Trout (*Oncorhynchus mykiss*)**

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Abstract

The aim of this study was to determine the impact of the eight-year implementation of the breeding program in the selection of rainbow trout (*Oncorhynchus mykiss*) in the Republic of Serbia. For this study, body mass data of trout collected during the aquaculture implementation of the Main Breeding Program were used. In breeding and selection, the most important characteristic is the rainbow trout's body weight at 12 months of age, or when it approaches consumption size. Under closely monitored conditions, fish up to five months of age were spawned and raised at the Center for Fisheries and Applied Hydrobiology "Mali Dunav" at the University of Belgrade's Faculty of Agriculture's Experimental Farm "Radmilovac.". A commercial pond was used for additional rearing and production characteristic monitoring following the fish's fifth month of life and individual marking (chipping - PIT tags, Norway). The average body mass of the fish was estimated by analyzing data from three generations (F1, F2, and F3). The PROC MEANS procedure was used to obtain basic statistical indicators of body mass using standard parameters, and the SAS software package's GLM method was used to determine statistical significance between generations. According to the findings, the F3 generation had the largest average body mass of fish at 12 months of age, while the F1 generation had the smallest average body mass. Statistical analysis of the collected data revealed the existence of significant differences in terms of average body mass between the observed generations ($p < 0.05$). Ultimately, it can be concluded that rainbow trout's long-term breeding contributes to their increased body weight.

Key words: aquaculture, selection, body mass, trout

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**Parameters of Feed Utilization in Common Carp (*Cyprinus carpio*)
fed with Earthworms, Mealworms and Zooplankton**

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Abstract

The high protein content and good digestibility make fishmeal a good protein source for fish feed production. The importance of fishmeal is undisputed, but it is also the biggest reason why the price of concentrated fish feed is constantly increasing. Reducing reliance on this protein source in fish feed production is an important issue to ensure more economical production. The experiment was carried out in a cage system at the Center for Fishery and Applied Hydrobiology „Mali Dunav“ at the experimental estate „Radmilovac“ of the Faculty of Agriculture University of Belgrade. This study aimed to investigate the possibility of completely replacing fishmeal (FM) with non-conventional protein sources such as earthworm (EW), mealworm (MW), and zooplankton (ZO), and their influence on feed utilization parameters in carp. Based on the results of the control measurements, the daily feed rate (DFR), feed intake (FI), protein intake (PI), and feed efficiency ratio (FER) were calculated. The highest DFR value was found in the fish fed with FM, followed by the experimental groups fed with MW and EW, while the lowest value of this parameter was found in the fish fed with ZO. A significant difference was found between the experimental groups fed with FM and ZO ($p < 0.05$) for this parameter. The lowest FI and PI values were obtained in the fish fed with ZO, and the values obtained were significantly different from those of the fish fed with FM and MW ($p < 0.05$), while the obtained values for FER did not differ between the experimental groups ($p > 0.05$). According to our research, there were no negative effects on the diet when fishmeal was completely replaced with unconventional protein sources. We can conclude that earthworms, mealworms, and zooplankton could be suitable alternatives to this traditional protein source.

Key words: fishmeal, earthworm, mealworm, zooplankton, *Cyprinus carpio*

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This paper was created as a result of research supported by the contract on the realization and financing of scientific research between the Faculty of Agriculture and the Ministry of Science, Technological Development, and Innovation of the Republic of Serbia, Contract Registration Number 451-03-137/2025-03/200116.

Aquaponics - Innovative Method of Integral Cultivation of Fish and Plants

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Abstract

Food production to feed the world's population is conditioned by various challenges (climate change, lack of water for growing fish, irrigation of cultivated plants, etc.), and agricultural production is constantly being modernized to provide food for the population. This work aims to present the aquaponic system's potential (fish and plant cultivation). The aquaponics system is particularly interesting for areas that do not have significant amounts of water available, areas where the soil is not suitable for agricultural production, and urban areas. Aquaponics is a system of integral cultivation of fish and plants based on water recirculation. The fish tanks are connected to beds for growing plants whose root systems are in water (without soil). The water is mechanically purified after leaving the fish tanks, then directed to beds for growing plants that utilize nutrients from the water and returned to the fish tanks. According to size, aquaponic systems can be large ($>1,000 \text{ m}^2$), medium ($200 - 1,000 \text{ m}^2$), small ($50 - 200 \text{ m}^2$), very small ($5 - 50 \text{ m}^2$), and micro ($<5 \text{ m}^2$). Depending on the goal, aquaponic production can be commercial or for household needs, education and research, landscaping, and decoration. The advantages of this method of integral cultivation of fish and plants are: low water consumption, the cultivation of fish and plants is controlled, the cultivation of plants is without soil, no large areas are needed for production, and the yields can be significant. The disadvantages of this system are high initial investment, and the competitiveness of the obtained product (fish and plant species that have a higher price on the market are chosen for cultivation).

Key words: aquaponics, integral cultivation, fish, plants

Morphological Analysis of Honeybee in Republic of Srpska

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Abstract

Beekeeping plays a significant role in animal husbandry, providing valuable products such as honey, beeswax, royal jelly, and pollination services, essential for the survival of terrestrial ecosystems. The European honeybee (*Apis mellifera*) is classified into various subspecies, with the Carniolan bee (*Apis mellifera carnica*) being native to the Republic of Srpska. This research aimed to investigate the potential interbreeding between native Carniolan bees and other races, particularly the Greek (*Apis mellifera cecropia*) and Anatolian (*Apis mellifera anatoliaca*) bees, using geometric morphometry. Bee samples were collected from 17 registered breeding centers across the Republic of Srpska and analyzed using the IdentiFly software, which relies on geometric morphometry for classification. The results indicated some interbreeding with the Greek and Anatolian bees, particularly in breeding centers located in warmer regions, such as Trebinje. However, no significant influence from the Italian bee (*Apis mellifera ligustica*) was observed. Climate change and the rise in temperatures have contributed to the northward spread of the Greek and Anatolian bees, influencing the Carniolan bee population. The findings highlight the need for continued monitoring and selective breeding to preserve the native Carniolan bee and adapt to the challenges posed by climate change. Future research should focus on detailed analyses of bee populations and the impact of climate change on the distribution of honeybee races.

Key words: native bee, climate impact, geometric morphometrics, crossbreeding, breeding centers

**Assessment of Honeybee (*Apis mellifera*) Diversity in an Apiary
using Morphometric Analysis of Forewings**

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Abstract

Apiary management, whether in terms of production, colony dynamics or health, relies on understanding diversity within individuals. This study deals with variability within an apiary of four colonies, in Maine-et-Loire, France during autumn 2023. 401 individuals from *Apis mellifera mellifera* and Buckfast bee hybrids were evaluated, and a qualitative analysis of seven observation points on the venation of the forewings between the marginal, submarginal and medial cells was carried out. Quantitative data on thorax, head and forewing length, and forewing width were also collected. Multiple Correspondence Analysis and Ascending Hierarchical Classification were used to build a typology of individuals based on their morphology. Four of the types identified correspond to a specific colony, while two other types are more contrasted and group together individuals from four different colonies. Observation points based on the distal vein of the distal submarginal cell and on the marginal cell provide the best contrast between individuals. Nevertheless, the overall analysis did not reveal any very precise specific morphotypes. Quantitative analysis did not reveal any significant differences, apart from average forewing length and average thorax length for one colony compared with the others. These differences raise questions about the diversity of individuals within colonies, where the extensive hybridization from which they originate does not generally induce a wide range of morphotypes, but may contribute to the formation of certain more contrasting individuals.

Key words: Apis mellifera, apiary, forewing, morphometric evaluation

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