



AGROSYM

BOOK OF PROCEEDINGS



*XVI International Scientific Agriculture Symposium
"Agrosym 2025"
Jahorina, October 2-5, 2025*



AGRO 2025
sym

BOOK OF PROCEEDINGS

**XVI International Scientific Agriculture Symposium
“AGROSYM 2025”**



Jahorina, October 2 - 5, 2025

Impressum

XVI International Scientific Agriculture Symposium „AGROSYM 2025“

Book of Proceedings Published by

Faculty of Agriculture, University of East Sarajevo, Republic of Srpska, Bosnia and Herzegovina
Faculty of Agriculture, University of Belgrade, Serbia
Mediterranean Agronomic Institute of Bari (CIHEAM - Bari) Italy
International Society of Environment and Rural Development, Japan
Balkan Environmental Association (B.EN.A), Greece
Centre for Development Research, University of Natural Resources and Life Sciences (BOKU),
Austria
Perm State Agro-Technological University, Russia
Voronezh State Agricultural University named after Peter The Great, Russia
Tokyo University of Agriculture, Japan
Jiangsu University, People's Republic of China
Shinshu University, Japan
Faculty of Agriculture, University of Western Macedonia, Greece
Arid Agricultural University, Rawalpindi, Pakistan
National School of Agriculture, Meknes, Morocco
Enterprise Europe Network (EEN)
Faculty of Agriculture, University of Akdeniz - Antalya, Turkey
Selçuk University, Turkey
Department of Agriculture, Food, and Environment, University of Catania, Italy
University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Slovak University of Agriculture in Nitra, Slovakia
Ukrainian Institute for Plant Variety Examination, Kyiv, Ukraine
National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine
Valahia University of Targoviste, Romania
National Scientific Center „Institute of Agriculture of NAAS“, Kyiv, Ukraine
Saint Petersburg State Forest Technical University, Russia
Northwest Normal University, People's Republic of China
University of Valencia, Spain
Faculty of Agriculture, Cairo University, Egypt
Tarbiat Modares University, Iran
Chapingo Autonomous University, Mexico
Cangzhou Normal University, People's Republic of China
Department of Agricultural, Food and Environmental Sciences, University of Perugia, Italy
Higher Institute of Agronomy, Chott Mariem-Sousse, Tunisia
Watershed Management Society of Iran
Institute of Animal Science - Kostinbrod, Bulgaria
University Joseph Ki-Zerbo, Burkina Faso
University Abdou Moumouni, Niger
SEASN- South Eastern Advisory Service Network, Croatia
Faculty of Economics Brcko, University of East Sarajevo, Bosnia and Herzegovina
Biotechnical Faculty, University of Montenegro, Montenegro
Faculty of Agriculture, University of Zagreb, Croatia
Institute of Field and Vegetable Crops, Serbia
Institute of Lowland Forestry and Environment, Serbia

Institute for Science Application in Agriculture, Serbia
Agricultural Institute of Republic of Srpska - Banja Luka, Bosnia and Herzegovina
Maize Research Institute "Zemun Polje", Serbia
Faculty of Agriculture, University of Novi Sad, Serbia
Institute for Animal Science, Ss. Cyril and Methodius University in Skopje, Northern Macedonia
Academy of Engineering Sciences of Serbia, Serbia
Balkan Scientific Association of Agricultural Economics, Serbia
Institute of Agricultural Economics, Serbia

Editor in Chief

Hamid El Bilali

Technical editors

Sinisa Berjan
Milan Jugovic
Rosanna Quagliariello

Website:

<http://agrosym.ues.rs.ba>

CIP - Каталогизација у публикацији
Народна и универзитетска библиотека
Републике Српске, Бања Лука

631(082)(0.034.2)

**INTERNATIONAL Scientific Agriculture Symposium
"AGROSYM" (16 ; 2025 ; Jahorina)**

Book of Proceedings [Електронски извор] / XVI International
Scientific Agriculture Symposium "AGROSYM 2025", Jahorina, October
2- 5, 2025 ; [editor in chief Hamid El Bilali]. - Onlajn izd. - El. zbornik. -
East Sarajevo : Faculty of Agriculture, 2025

Системски захтјеви: Нису наведени. - Наћин pristupa (URL): Наћин
pristupa
(URL): https://agrosym.ues.rs.ba/article/showpdf/BOOK_OF_PROCEEDINGS_2025_FINAL.pdf. - Ел. публикација у ПДФ формату опсега
1121 стр. - Насл. са насловног екрана. - Опис извора дана 20.11.2025.
- Библиографија уз сваки рад. - Регистар.

ISBN 978-99976-070-5-8

COBISS.RS-ID 14353894

**XVI International Scientific Agricultural Symposium “Agrosym 2025”
Jahorina, October 2-5, 2025, Bosnia and Herzegovina**

HONORARY COMMITTEE

President: **Prof. dr. Dusan Kovacevic**, Honorary president of AGROSYM Agriculture Symposium, Serbia
Mrs. Andjelka Kuzmic, Minister of Agriculture, Water Management and Forestry of Republic of Srpska, Bosnia and Herzegovina
Prof. dr. Sinisa Karan, Minister of Scientific-Technological Development, Higher Education and Information Society of Republic of Srpska, Bosnia and Herzegovina
Prof. dr Mario T. Tabucanon, President of the International Society of Environment and Rural Development, Japan
Prof. dr Milan Kulic, Rector of the University of East Sarajevo, Bosnia and Herzegovina
Prof. dr Vladan Bogdanovic, Dean of the Faculty of Agriculture, University of Belgrade, Serbia
Dr. Biagio Di Terlizzi, Director of the Mediterranean Agronomic Institute of Bari, Italy
Prof. Dr. Hüseyin Yilmaz, Rector of the Selcuk University, Turkey
Prof. dr Aleksey Andreev, Rector of the Perm State Agro-Technological University, Russia
Prof. dr Alexander Agibalov, Rector of the Voronezh State Agricultural University named after Peter The Great, Russia
Prof. dr Xing Weihong, President of Jiangsu University, People’s Republic of China
Prof. dr Barbara Hinterstoisser, Vice-Rector of the University of Natural Resources and Life Sciences (BOKU), Austria
Prof. dr Sorin Mihai Cimpeanu, Rector of the University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Prof. Shinichi Yonekura, Vice-President of the Shinshu University, Japan
Doc. Ing. Klaudia Halászová, Rector of the Slovak University of Agriculture in Nitra, Slovakia
Prof. dr Calin D. Oros, Rector of the Valahia University of Targoviste, Romania
Prof. Dr Katerina Melfou, Dean of the Faculty of Agriculture, University of Western Macedonia, Greece
Prof. dr Amr Ahmed Mostafa, Dean of the Faculty of Agriculture, Cairo University, Egypt
Prof. dr José Sergio Barrales Domínguez, Rector of the Chapingo Autonomous University, Mexico
Prof. dr Davut Karayel, Dean of Faculty of Agriculture, University of Akdeniz - Antalya, Turkey
Prof. Dr EGUCHI Fumio, Rector of the Tokyo University of Agriculture, Japan
Prof. dr Muhammad Naeem, Vice-Chancellor of Arid Agricultural University, Rawalpindi, Pakistan
Prof. dr Zhang Zhanping, President of Cangzhou Normal University, People's Republic of China
Prof. dr Wang Zhanren, President of Northwest Normal University, People's Republic of China
Dr Chokri Thabet, the General Director of the High Agronomic Institute of Chott Mariem, Sousse, Tunisia
Prof. dr Maya Ignatova, Director of the Institute of Animal Science- Kostinbrod, Bulgaria
Prof. dr Seyed Hamidreza Sadeghi, Professor at Tarbiat Modares University and the President of the Watershed Management Society of Iran, Iran
Prof. Jean-Francois Silas Kobiane, President of the University Joseph Ki-Zerbo, Burkina Faso
Prof. dr Francesco Tei, Director of the Department of Agricultural, Food and Environmental Sciences, University of Perugia, Italy
Prof. dr Viktor Kaminskyi, Director of National Scientific Center „Institute of Agriculture of NAAS“, Kyiv, Ukraine
Dr. Igor Hrovatič, President of South Eastern Advisory Service Network, Croatia
Prof. dr Mirza Dautbasic, Dean of the Faculty of Forestry, University of Sarajevo, Bosnia and Herzegovina
Prof. dr Bozidarka Markovic, Dean of the Biotechnical Faculty, University of Podgorica, Montenegro
Prof. dr Rade Jovanovic, Director of the Institute for Science Application in Agriculture, Serbia
Prof. dr Srdjan Lalic, Dean of the Faculty of Economics Brcko, University of East Sarajevo, Bosnia and Herzegovina
Prof. dr Vojislav Trkulja, Director of Agricultural Institute of Republic of Srpska - Banja Luka, Bosnia and Herzegovina
Dr. Miodrag Tolimir, Director of the Maize Research Institute “Zemun Polje”, Serbia
Prof. Dr. Dragana Latkovic, Director of the Institute of Field and Vegetable Crops, Serbia
Prof. dr Nenad Magazin, Dean of the Faculty of Agriculture, University of Novi Sad, Serbia
Prof. dr Rodne Nastova, Director of the Institute for Animal Science, Skoplje, Northern Macedonia
Prof. dr Sasa Orlovic, Director of the Institute of Lowland Forestry and Environment, Serbia
Prof. dr Jonel Subic, Director of the Institute of Agricultural Economics, Serbia
Prof. dr Branko Kovacevic, President of the Academy of Engineering Sciences of Serbia, Serbia
Prof. dr Radovan Pejanovic, President of Balkan Scientific Association of Agricultural Economics, Serbia

SCIENTIFIC COMMITTEE

- President:** **Dr. Hamid El Bilali**, Mediterranean Agronomic Institute of Bari, Italy
Vice-president: **Prof. dr Sinisa Berjan**, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
Vice-president: **Prof. dr Zeljko Dolijanovic**, Faculty of Agriculture, University of Belgrade, Serbia
Prof. dr Machito Mihara, Tokyo University of Agriculture, Japan
Prof. dr John Brayden, Norwegian Agricultural Economics Research Institute (NILF), Norway
Prof. dr Steve Quarie, Visiting Professor, School of Biology, Newcastle University, United Kingdom
Prof. dr Andreas Melcher, CDR, University of Natural Resources and Life Sciences (BOKU), Vienna, Austria
Prof. dr Dieter Trautz, University of Applied Science, Germany
Prof. dr Mustafa Harmankaya, Dean of Faculty of Agriculture, University of Selçuk- Konya, Turkey
Prof. dr Sergei Eliseev, Perm State Agro-Technological University, Russia
Prof. dr Dani Shtienberg, full professor, Department of Plant pathology and Weed Research, ARO, the Volcani Center, Bet Dagan, Israel
Prof. dr William Meyers, Howard Cowden Professor of Agricultural and Applied Economics, University of Missouri, USA
Prof. dr Markus Schermer, Department of Sociology, University of Innsbruck, Austria
Prof. dr Carmelo Rapisalda, Department of Agriculture, Food and Environment; University of Catania, Italy
Prof. dr Thomas G. Johnson, University of Missouri – Columbia, USA
Prof. dr Fokion Papathanasiou, School of Agricultural Sciences, University of Western Macedonia, Greece
Prof. dr Sabahudin Bajramovic, Faculty of Agriculture and Food Sciences, University of Sarajevo, Bosnia and Herzegovina
Prof. dr Hiromu Okazawa, Faculty of Regional Environment Science, Tokyo University of Agriculture, Japan
Prof. dr Tatiana Sivkova, Faculty for Veterinarian Medicine and Zootechny, Perm State Agro-Technological University, Russia
Prof. dr Aleksej Lukin, Voronezh State Agricultural University named after Peter The Great, Russia
Prof. dr Matteo Vittuari, Faculty of Agriculture, University of Bologna, Italy
Prof. Katsuharu Saito, Faculty of Agriculture, Shinshu University, Japan
Prof. dr. Ebrahim Sepehr, Faculty of Agriculture, Urmia University, Iran
Prof. dr. Andrea Criscione, Department of Agriculture, Food and Environment, University of Catania, Italy
Prof. Giorgio Testa, Department of Agriculture, Food and Environment, University of Catania, Italy
Prof. Gabriella Vindigni, Department of Agriculture, Food and Environment, University of Catania, Italy
Prof. dr Seyed Mohsen Hosseini, Faculty of Natural Resources, Tarbiat Modares University, Iran
Prof. dr Ardian Maci, Faculty of Agriculture and Environment, Agricultural University of Tirana, Albania
Prof. dr Regucivilla A. Pobar, Bohol Island State University, Philippines
Prof. dr Azeem Khalid, Arid Agriculture University, Rawalpindi, Pakistan
Prof. dr Aayesha Riaz, Arid Agriculture University, Rawalpindi, Pakistan
Prof. dr Munir Ahmad, Arid Agriculture University, Rawalpindi, Pakistan
Prof. dr Sudheer Kundukulangara Pulissery, Kerala Agricultural University, India
Prof. dr EPN Udayakumara, Faculty of Applied Sciences, Sabaragamuwa University, Sri Lanka
Prof. dr Vladimir Smutný, full professor, Mendel University, Faculty of agronomy, Czech Republic
Prof. dr Franc Bavec, full professor, Faculty of Agriculture and Life Sciences, Maribor, Slovenia
Prof. dr Natalija Bogdanov, Faculty of Agriculture, University of Belgrade, Serbia
Prof. dr Richard Barichello, Faculty of Land and Food Systems, University of British Columbia, Canada
Prof. dr Francesco Porcelli, University of Bari Aldo Moro, Italy
Prof. dr Vasilije Isajev, Faculty of Forestry, University of Belgrade, Serbia
Prof. dr Elazar Fallik, Agricultural Research Organization (ARO), Volcani, Israel
Prof. dr Junaid Alam Memon, Pakistan Institute of Development Economics, Pakistan
Prof. Aziz Abouabdillah, National School of Agriculture, Meknes, Morocco
Prof. dr. Jorge Batlle-Sales, Department of Biology, University of Valencia, Spain
Prof. dr Pandi Zdruli, Land and Water Resources Department; IAMB, Italy
Prof. dr Mladen Todorovic, Land and Water Resources Department; IAMB, Italy
Prof. dr Maksym Melnychuk, National Academy of Agricultural Science of Ukraine, Ukraine
Prof. dr Borys Sorochynskiy, Ukrainian Institute for Plant Variety Examination, Kyiv, Ukraine
Dr. Lorenz Probst, CDR, University of Natural Resources and Life Sciences (BOKU), Vienna, Austria
Prof. Dragana Sunjka, Faculty of Agriculture, University of Novi Sad, Serbia
Prof. dr Miodrag Dimitrijevic, Faculty of Agriculture, University of Novi Sad, Serbia
Prof. dr Mohsen Boubaker, High Institute of Agronomy of Chott Meriem, Sousse, Tunisia
Prof. dr Ion Viorel, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Prof. dr. Chuleemas Boonthai Iwai, Faculty of Agriculture, Khon Kaen University, Thailand

Prof. dr Wathuge T.P.S.K. Senarath, Department of Botany, University of Sri Jayewardenepura, Colombo, Sri Lanka

Dr. Hamada Abdelrahman, Soil Science Dept., Faculty of Agriculture, Cairo University, Egypt

Prof. dr Maya Ignatova, Director of the Institute of Animal Science- Kostinbrod, Bulgaria

Prof. dr Ioannis N. Xynias, School of Agricultural Technology & Food Technology and Nutrition, Western Macedonia University of Applied Sciences, Greece

PhD ing. Artur Rutkiewicz, Department of Forest Protection, Institute of Forest Sciences, Warsaw University of Life Sciences - SGGW, Poland

Prof. dr Mohammad Sadegh Allahyari, Islamic Azad University, Rasht Branch, Iran

Dr. Lalita Siriwattananon, Faculty of Agricultural Technology, Rajamangala University of Technology Thanyaburi (RMUTT), Thailand

Prof. dr Konstantin Korlyakov, Perm Agricultural Research Institute, Russia

Dr. Larysa Prysiashniuk, Ukrainian Institute for Plant Variety Examination, Kyiv, Ukraine

Prof. dr Oksana Kliachenko, National University of Life and Environmental Science of Ukraine, Ukraine

Dr. Abid Hussain, International Centre for Integrated Mountain Development (ICIMOD), Nepal

Dr. Amrita Ghatak, Gujarat Institute of Development Research (GIDR), India

Prof. dr Naser Sabaghnia, University of Maragheh, Iran

Dr. Karol Wajszczuk, Poznan University of Life Sciences, Poland

Prof. dr Penka Moneva, Institute of Animal Science - Kostinbrod, Bulgaria

Prof. dr Mostafa K. Nassar, Animal husbandry Dept., Faculty of Agriculture, Cairo University, Egypt

Prof. dr Andrzej Kowalski, Director of the Institute for Agricultural and Food Economy, Warszawa-Poland

Prof. dr Yalcin Kaya, The Director of the Plant Breeding Research Center, University of Trakya, Turkey

Prof. dr Sanja Radonjic, Biotechnical Faculty, University of Montenegro, Montenegro

Prof. dr Ionela Dobrin, Department for Plant Protection, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania

Prof. dr Inocencio Buot Jr., Institute of Biological Sciences, College of Arts and Sciences, University of the Philippines Los Banos, Philippines

Prof. dr Monica Paula Marin, Department for Animal Husbandry, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania

Prof. dr Nedeljka Nikolova, Institute for Animal Science, Ss. Cyril and Methodius University in Skopje, Republic of Macedonia

Prof. dr Mohammad Al-Mamun, Department of Animal Nutrition, Bangladesh Agricultural University, Bangladesh

Prof. dr Anucha Wittayakorn-Puripunpinyoo, School of Agriculture and Co-operatives, Sukhothai Thammathirat Open University, Nonthaburi, Thailand

Dr. Redouane Choukr-Allah, International Center for Biosaline Agriculture (ICBA), United Arab Emirates

Prof. dr Ignacio J. Díaz-Maroto, High School Polytechnic, University of Santiago de Compostela, Spain

Prof. dr Nidal Shaban, University of Forestry Sofia, Bulgaria

Prof. dr Mehdi Shafaghati, Faculty of Geography, Tarbiat Moalem (kharazmi) University, Iran

Prof. dr Youssif Sassine, Lebanese University Beirut, Lebanon

Prof. dr Cafer Topaloglu, Faculty of Tourism, Mugla Sitki Kocman University, Turkey

Prof. dr Seyed Hamidreza Sadeghi, Faculty of Natural Resources, Tarbiat Modares University, Iran

Prof. Zain Ul Abdin, Department of Entomology, University of Agriculture, Faisalabad, Pakistan

Prof. dr Mohsen Mohseni Saravi, University of Teheran and Member of WMSI Management Board, Iran

Prof. dr Branislav Draskovic, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina

Prof. dr Mahmood Arabkhedri, Soil Conservation and Watershed Management Research Institute and Member of WMSI Management Board, Iran

Prof. dr Ataollah Kavian, Sari Agricultural Science and Natural Resources University and Member of WMSI Management Board, Iran

Prof. dr Tugay Ayasan, Department of Organic Farming Business Management, Osmaniye, Applied Science School of Kadirli, Osmaniye Korkut Ata University, Turkey

Prof. dr Sakine Özpınar, Department of Farm Machinery and Technologies Engineering, Faculty of Agriculture, Çanakkale Onsekiz Mart University, Çanakkale, Turkey

Prof. dr Sherein Saeide Abdelgayed, Faculty of Veterinary Medicine, Cairo University, Cairo, Egypt

Prof. dr Zohreh Mashak, Islamic Azad University, Karaj Branch, Iran

Dr. Khalid Azim, National Institute of Agriculture Research, Morocco

Dr. Mario Licata, Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy

Prof. Fatiha Addyoubah, Moulay Ismail University, Morocco

Prof. dr Muhammad Ovais Omer, Faculty of Bio-Sciences, University of Veterinary & Animal Sciences, Lahore, Pakistan

Dr. Edouard Musabanganji, School of Economics/CBE, University of Rwanda, Rwanda

Prof. dr Kubilay Baştaş, Department of Plant Protection, Faculty of Agriculture, Selçuk University, Turkey
Dr. Branka Kresovic, Maize Research Institute “Zemun Polje”, Serbia
Dr. Milan Stevanovic, Maize Research Institute “Zemun Polje”, Serbia
Prof. Violeta Babic, Faculty of Forestry, University of Belgrade, Serbia
Dr. Svetlana Balesevic-Tubic, Institute of Field and Vegetable Crops Novi Sad, Serbia
Dr. Ana Marjanovic Jeromela, Institute of Field and Vegetable Crops Novi Sad, Serbia
Prof. dr Tatjana Krajisnik, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
Prof. dr Aleksandra Govedarica-Lucic, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
Prof. dr Desimir Knezevic, University of Pristina, Faculty of Agriculture, Kosovska Mitrovica - Lesak, Kosovo i Metohija, Serbia
Dr. Snezana Mladenovic-Drinic, Maize Research Institute “Zemun Polje”, Serbia
Prof. dr Nebojsa Momirovic, Faculty of Agriculture, University of Belgrade, Serbia
Prof. dr Osman Mujezinovic, Faculty of Forestry, University of Sarajevo, Bosnia and Herzegovina
Prof. dr Dalibor Ballian, Faculty of Forestry, University of Sarajevo, Bosnia and Herzegovina
Prof. dr Zoran Jovovic, Biotechnical Faculty, University of Montenegro, Montenegro
Prof. dr Danijel Jug, Faculty of Agriculture, University of Osijek, Croatia
Prof. dr Milan Markovic, Biotechnical Faculty, University of Montenegro, Montenegro
Prof. Mirjana Jovovic, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
Prof. dr Dejana Stanic, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
Prof. Goran Marinkovic, Faculty of Technical Sciences, University of Novi Sad, Serbia
Dr Dejan Stojanovic, Institute of Lowland Forestry and Environment, Serbia
Dr Dobrivoj Postic, Institute for plant protection and environment, Belgrade, Serbia
Dr Srdjan Stojnic, Institute of Lowland Forestry and Environment, Serbia
Dunja Demirović Bajrami, Research Associate, Geographical Institute “Jovan Cvijić,” Serbian Academy of Sciences and Arts, Belgrade, Serbia

ORGANIZATION COMMITTEE

President: Prof. dr Vesna Milic, Dean of the Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
Prof. Dr Marko Gutalj, Vice rector of the University of East Sarajevo, Bosnia and Herzegovina
Prof. Dr Jelena Kronic, Vice rector of the University of East Sarajevo, Bosnia and Herzegovina
Dr. Maroun El Moujabber, Mediterranean Agronomic Institute of Bari, Italy
Dr Milic Curovic, The journal “Agriculture and Forestry”, Biotechnical Faculty Podgorica, University of Montenegro, Montenegro
Dr. Tatiana Lysak, International Relations Office, Voronezh State Agricultural University named after Peter The Great, Russia
Dr. Oksana Fotina, International Relations Center, Perm State Agro-Technological University, Russia
Prof. dr Fokion Papathanasiou, School of Agricultural Sciences, University of Western Macedonia, Greece
Dr Ana Marjanović Jeromela, Institute of Field and Vegetable Crops, Serbia
Prof. dr Engr. Teodora Popova, Institute of Animal Science - Kostinbrod, Bulgaria
Dr Daniela Spina, Department of Agriculture, Food and Environment, University of Catania, Italy
Prof. dr Mehmet Musa Ozcan, Faculty of Agriculture, Selçuk University, Turkey
Prof. dr Arfan Yousaf, Arid Agricultural University, Rawalpindi, Pakistan
Dr. Abdulvahed Khaledi Darvishan, Faculty of Natural Resources, Tarbiat Modares University, Iran
Prof. dr Nikola Pacinovski, Institute for Animal Science, Ss. Cyril and Methodius University in Skopje, Northern Macedonia
MSc. Erasmo Velázquez Cigarroa, Department of Rural Sociology, Chapingo Autonomous University, Mexico
Dr. Ecaterina Stefan, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Dr. Jeeranuch Sakkhamduang, The International Society of Environmental and Rural Development, Japan
Prof. Irfan Ozturk, Trakya Agriculture Research Institute in Edirne, Turkey
Dr. Raoudha Khanfir Ben Jenana, High Institute of Agronomy of Chott Meriem, Sousse, Tunisia
Dr. Romaric Kiswendsida Nanema, University Joseph Ki-Zerbo, Burkina Faso
Dr. Hamada Abdelrahman, Soil Science Dept., Faculty of Agriculture, Cairo University, Egypt
Prof. Dragana Sunjka, Faculty of Agriculture, University of Novi Sad, Serbia
MSc. Aleksandra Susnjar, Faculty of Agriculture, University of Novi Sad, Serbia
MSc. Dragana Boskovic, Faculty of Agriculture, University of Novi Sad, Serbia
Dr. Antonije Zunic, Faculty of Agriculture, University of Novi Sad, Serbia
Dr. Vedran Tomic, Institute for Science Application in Agriculture, Serbia

MSc. Vojin Cvijanovic, Institute for Science Application in Agriculture, Serbia
MSc. Mladen Petrovic, Institute of Agricultural Economics, Serbia
Dr. Milan Stevanovic, Maize Research Institute "Zemun Polje", Serbia
Dr. Andrej Pilipovic, Institute of Lowland Forestry and Environment, Serbia
Dr. Sc. Morteza Behzadfar, Tarbiat Modares University, Tehran, Iran
Dr. Larysa Prysiashniuk, Ukrainian Institute for Plant Variety Examination, Kyiv, Ukraine
Doc. dr Sead Ivojevic, Faculty of Forestry, University of Sarajevo, Bosnia and Herzegovina
Dr. Nenad Markovic, Enterprise E. N. (EEN) Coordinator, University of East Sarajevo, Bosnia and Herzegovina
Domagoj Group, SEASN - South Eastern Advisory Service Network, Croatia
Dr. Milan Ninkovic, Scientific Institute of Veterinary Medicine of Serbia
Prof. dr Zeljko Lakic, Agricultural Institute of Republic of Srpska - Banja Luka, Bosnia and Herzegovina
Dr. Milan Jugovic, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
Prof. dr Dejana Stanic, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
Dr. Milena Stankovic, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
Prof. dr. Stefan Stjepanovic, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
MSc. Stefan Bojic, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
Dr. Tanja Jakisic, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
Dr. Boban Miletic, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
Dr. Nedeljka Elez, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
MSc. Selena Kovacevic, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
Dr. Branka Govedarica, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
Dr. Igor Djurdjic, Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina, **General Secretary**

FOREWORD

The world is facing a range of crises that require policymakers to base their decisions on scientific data and evidence to effectively address them. Issues such as climate change, loss of biodiversity, degradation of natural resources (e.g. land and water), ongoing conflicts, persistent inequalities, and economic disruptions are progressively weakening the ability of agri-food systems to ensure food security and nutrition for all. Research plays a vital role in providing evidence and technical expertise, acting as a facilitator and policy broker in the development of agri-food strategies, investment planning, innovation policies, and other important policy processes. Additionally, research is essential for generating the knowledge, evidence, and resources required to promote responsible and inclusive innovation. It also offers support to a range of stakeholders, including farmers' organizations, businesses, and civil society groups. Integrating research with long-term policy strategies can enhance the acceptance and adoption of innovations in the agri-food sector, particularly when these innovations are promoted through inclusive platforms. To achieve a sustainable impact at scale, it is essential to improve collaboration in agri-food research and innovation. Scientific events and gatherings can be crucial in reaching this objective.

The International Agriculture Symposium AGROSYM has served as an annual forum for sixteen years, facilitating global scientific discussions on agriculture, food, rural development, the environment, and forestry. This symposium offers an excellent opportunity to share ideas, strengthen existing networks, establish new academic connections, and stimulate dialogue among academia, public institutions, the private sector, and civil society organizations. Participants engage in discussions about recent global and regional trends in the agri-food sector. The multidisciplinary findings presented at AGROSYM contribute to the dissemination of knowledge and best practices among all stakeholders in the agri-food chain, including farmers, extension agents, researchers, and policymakers. Additionally, the symposium emphasizes the importance of agriculture and food science as vital components of many national research strategies, impacting the broader community as well.

This Book of Proceedings from the 16th International Scientific Agricultural Symposium “AGROSYM 2025” encompasses articles which illustrate a wide range of research and insights across the comprehensive spectrum of agricultural disciplines. These articles address the following themes: 1) Plant production, 2) Plant protection and food safety, 3) Organic agriculture and agroecology, 4) Environmental protection and natural resources management, 5) Animal husbandry, 6) Rural development and agro-economy, and 7) Forestry and agroforestry.

We wish to express our heartfelt appreciation to all authors, reviewers, and colleagues who assisted in preparing this Book of Proceedings. Our special thanks go to co-organizers, partners, and sponsors for their unwavering support and collaboration.

We hope this multidisciplinary and international collection of research findings serves as a valuable resource for all stakeholders and encourages continuous dialogue and exchange to facilitate the transition towards sustainable, resilient, and inclusive agri-food systems.

East Sarajevo, 1 November 2025

Dr. Hamid El Bilali, CIHEAM Bari, Italy – Editor in Chief, President of the Scientific Committee
Prof. Dr. Sinisa Berjan, University of East Sarajevo, Bosnia and Herzegovina & **Prof. Dr. Zeljko Dolijanovic**, University of Belgrade, Serbia – Vice-presidents of the Scientific Committee

CONTENT

PLANT PRODUCTION	27
SEED GERMINATION OF LENTIL GENOTYPES UNDER SALINITY STRESS AND NANO-SILICON APPLICATION Naser SABAGHNIA, Mohsen JANMOHAMMADI, Fariborz SHEKARI.....	28
USING GPS AND GIS IN PRECISION AGRICULTURE OPTIMIZATION IN A HUNGAIAN FARM Ahmed EL SHAL , Péter RICZU, János TAMÁS	31
ANALYSYS AND REVIEW OF RESPONSES AGRICULTURAL PLANTS TO HUMIC SUBSTANCES Mirjana JOVOVIĆ, Zoranka MALEŠEVIĆ, Aleksandra GOVEDARICA – LUČIĆ.....	37
RESISTANCE OF TOMATO GENOTYPES TO LATE BLIGHT (<i>Phytophthora infestans</i>) UNDER CONDITIONS OF NATURAL INFECTION Milomirka MADIĆ, Nenad PAVLOVIĆ, Milan ŠEVIĆ, Vladeta STEVOVIĆ, Dalibor TOMIĆ, Branka GOVEDARICA, Dragan ĐUROVIĆ	46
ADAPTABILITY AND STABILITY OF PROMOSING BREAD WHEAT LINES USING GGE BILOT ANALYSIS Damla BALABAN GÖÇMEN, Oğuz BİLGİN, Alpay BALKAN, İsmet BAŞER.....	52
RELATIONSHIPS BETWEEN YIELD AND YIELD TRAITS IN WHEAT UNDER DIFFERENT DROUGHT APPLICATIONS İsmet BAŞER, Alpay BALKAN, Oğuz BİLGİN, Damla BALABAN GÖÇMEN, Kamil ÖZCAN.....	60
THE INFLUENCE OF SOIL TYPE ON THE QUALITY TRAITS OF POTATO Tanja JAKIŠIĆ, Milan JUGOVIĆ, Branka GOVEDARICA, Igor ĐURĐIĆ, Nevena RISTIČEVIĆ, Selena KOVAČEVIĆ	66
COMPARATIVE ANALYSIS OF ESSENTIAL OIL OF <i>HELICHRYSUM ITALICUM</i> L. FROM PLANTATION AND RECLAIMED SOILS Zoranka MALEŠEVIĆ, Jelena LAZAREVIĆ, Mirjana JOVOVIĆ, Selena KOVAČEVIĆ, Ivana BOŠKOVIĆ	72
THE EFFECT OF ZEOLITE TYPE AND DOSAGE ON PEA SEED GERMINATION AND EARLY GROWTH TRAITS Nevena RISTIČEVIĆ, Branka GOVEDARICA, Igor ĐURĐIĆ, Vesna MILIĆ, Tanja JAKIŠIĆ, Selena KOVAČEVIĆ, Aleksandar GAVRILOVIĆ	78
NDVI-BASED ASSESSMENT OF PHYSIOLOGICAL STATUS IN PROKUPAC VINEYARDS UNDER DIFFERENT CROP PROTECTION STRATEGIES Marija GAVRILOVIĆ, Vedran TOMIĆ, Biljana VELJKOVIĆ, Danijela ŽIVOJINOVIĆ, Anđelija OBRADOVIĆ	84
EFFECTS OF ABIOTIC STRESS CONDITIONS ON GENE EXPRESSION IN <i>SOLANACEAE</i> SPECIES Akife DALDA-SEKERCI, Hande Seda ÖZDAL	92

RESPONSE OF WINTER WHEAT TO REDUCED TILLAGE AND FERTILIZATION

Željko DOLIJANOVIĆ, Dušan KOVAČEVIĆ, Milena SIMIĆ, Snežana OLJAČA, Zoran JOVOVIĆ, Milena BILJIĆ 101

ANALYSIS OF THE FERTILITY POTENTIAL OF RED WINE VARIETIES GROWN IN THE TREBINJE AREA (BOSNIA AND HERZEGOVINA)

Tijana BANJANIN, Milica GLIŠIĆ, Kristina MILIŠIĆ, Zorica RANKOVIĆ VASIĆ 108

RESEARCH OF AGRICULTURE LAND FOR IRON (Fe) CONTENT IN THE AREA OF THE CITY OF SOMBOR IN SERBIA

Vladimir SABADOŠ, Danijela ŽUNIĆ 115

IN VITRO PROPAGATION OF EUROPEAN VARIETIES OF *ARONIA MELANOCARPA* (MICHX.) ELLIOTT 'NERO' AND 'ALEXANDRINA'

Ioana-Cătălina NICOLAE, Tatiana CALALB, Nina CHIORCHINĂ, Maria TABĂRA, Natalia ONICA, Iulia BOZBEI 122

BOTANICAL COMPOSITION OF PERMANENT GRASSLAND AND FORAGE QUALITY IN THE MUNICIPALITY OF LUČANI IN REPUBLIC OF SERBIA

Vladimir ZORNIĆ, Nedeljko RACIĆ, Đorđe LAZAREVIĆ, Zoran LUGIĆ, Dalibor TOMIĆ, Nenad PAVLOVIĆ, Mirjana PETROVIĆ..... 129

EFFECT OF NITROGEN FERTILIZERS WITH UREASE INHIBITORS ON THE QUALITY CHARACTERISTICS OF WINTER CEREALS

Dimitrios BARTZIALIS, Stefania PASCHALI-PAPANASTASIOU, Dimitrios-Marios LEKKAS, Ippolitos GINTSIODIS, Kyriakos D. GIANNOULIS, Nikolaos G. DANALATOS 135

EFFECT OF BENZYLADENINE (BA) ON GROWTH AND FLOWER QUALITY OF PURPLE - PINK PICO (*Chrysanthemum* sp.)

Pham THI PHUONG THAO, Le THANH TOAN, Le THI HOANG YEN, Le THI MONG CAM 141

INFLUENCE OF INTERCROPPING MAIZE WITH CLIMBING BEAN ON FORAGE YIELD AND QUALITY

Darko UHER, Dubravko MACESIĆ, Goran KIŠ, Dario JAREŠ, Ivan HORVATIĆ.... 148

CLASSIFICATION OF COMBINED STRESSES IN AUBERGINE (*SOLANUM MELONGENA* L.) USING MACHINE LEARNING AND HYPERSPECTRAL IMAGING

Maria BEMPI, Aris KYPARISSIS 154

USE OF META-TOPOLIN AS AN ALTERNATIVE CYTOKININ FOR *IN VITRO* MULTIPLICATION OF *ACTINIDIA KOLOMIKTA*

Ioana-Cătălina NICOLAE, Maria TABĂRA, Melania GHEREG, Natalia ONICA, Oana VENAT, Liliana BĂDULESCU, Nina CHIORCHINĂ..... 161

THE INFLUENCE OF DIFFERENT METHODS OF CALCIUM FERTILIZATION IN THE SOIL ON THE YIELD AND THE BLOSSOM-END ROT (BER) IN PEPPER FRUIT

Aleksandra GOVEDARICA-LUČIĆ, Mirjana JOVOVIĆ, Alma MEMIĆ, Dragica GAGOVIĆ 167

SELECTED BREEDING LINES OF SUNFLOWER SEEDS IN REDUCING DROUGHT STRESS ON MORPHOLOGICAL CHARACTERISTICS DURING THE GERMINATION PHASE

Tanja MIJATOVIĆ, Branka GOVEDARICA, Igor ĐURĐIĆ, Nevena RISTIČEVIĆ, Vesna MILIĆ 172

ORCHIDACEAE IN THE FLORA OF THE TREBEVIĆ NATURE PARK (BOSNIA AND HERZEGOVINA)

Natasa MARIC, Sladjana PETRONIC 180

CONSERVATION STATUS OF THE MACROPHYTES OF THE TIŠINA PROTECTED HABITAT (BOSNIA AND HERZEGOVINA)

Natasa MARIC, Sladjana PETRONIC, Zoran MATIC..... 187

THE EFFECTS OF FERTILIZATION METHODS ON THE MECHANICAL COMPOSITION OF GRAPES OF THE VINE VARIETY VRANAC

Nedim MARIĆ, Semira SEFO 193

ASSESSMENT OF DROUGHT IMPACT ON TRITICALE (X TRITICOSECALE WITTMAK) YIELD ACROSS VARIOUS ENVIRONMENTS

Zakaria AL AJLOUNI..... 199

BIOSTIMULANTS EFFECT ON LAVENDER (*LAVANDULA ANGUSTIFOLIA*) CULTIVATION IN THE SECOND GROWING YEAR

Maria DALAKOURA, Kyriakos D. GIANNOULIS, Dimitrios BARTZIALIS, Ippolitos GINTSIODIS, Nikolaos G. DANALATOS 204

EFFECT ON THE YIELD OF THREE VARIETIES OF CHAMOMILE (*MATRICARIA CHAMOMILLA* L.) USING DIFFERENT BIOSTIMULANTS

Anastasia-Charikleia KYRIAZAKI, Kyriakos D. GIANNOULIS, Dimitrios BARTZIALIS, Ippolitos GINTSIODIS, Nikolaos G. DANALATOS..... 210

PROPAGATION OF *CORNUS ALBA* 'SIBIRICA' BY SOFTWOOD HEEL CUTTINGS

Marija MARKOVIĆ, Mihailo GRBIĆ, Dragana SKOČAJIĆ, Danijela ĐUNISIJEVIĆ-BOJOVIĆ, Marijana MILUTINOVIĆ 216

MULTIVARIATE ANALYSIS OF BREAD WHEAT ROOT AND SHOOT TRAITS AT THE SEEDLING STAGE AND AT THE BOOTING STAGE FOR DROUGHT-TOLERANCE

Milica BLAŽIĆ, Gordana BRANKOVIĆ, Dejan DODIG, Vesna KANDIĆ, Tomislav ŽIVANOVIĆ 220

COMPUTATIONAL INTELLIGENCE FOR INVESTIGATION ON GENETIC DIVERSITY AMONG GENOTYPES OF SAFFLOWER FOR YIELD PERFORMANCE

Naser SABAGHNIA, Fariborz SHEKARI, Mohsen JANMOHAMMADI..... 228

RESPONSE OF DRAGONHEAD TO SOWING DENSITY REGARDING ESSENTIAL OIL YIELD AND SOME BIOCHEMICAL TRAITS

Naser SABAGHNIA, Mohsen JANMOHAMMADI, Fariborz SHEKARI..... 233

FUNGAL COMMUNITY ASSOCIATED WITH SWEET POTATO ROOTS DURING STORAGE	
Beatrice Michaela IACOMI, Elena DOBRIN, Lenuța CHIRA, Adrian CHIRA, Elena Maria DRAGHICI	237
THE EFFECT OF ABIOTIC STRESS ON THE FLOWERING AND PRODUCTIVITY OF ZUCCHINI	
Zdenka GIREK, Suzana PAVLOVIĆ, Milan UGRINOVIĆ, Jelena DAMNJANOVIĆ, Dejan CVIKIĆ, Nenad PAVLOVIĆ	243
VARIATIONS OF MAIZE YIELD IN LONG-TERM CROP ROTATION	
Milena SIMIĆ, Miodrag TOLIMIR, Vesna DRAGIČEVIĆ, Željko DOLIJANOVIĆ, Natalija PAVLOVIĆ, Milan BRANKOV	249
EFFECTS OF THE DIFFERENT TERM GRAPE THINNING ON THE YIELD AND GRAPE QUALITY OF CABERNET SAUVIGNON CV. GRAPES	
Milica GLIŠIĆ, Aleksandra MARKOVIĆ, Danijela ŽIVOJINOVIĆ, Andreja PREKOVIĆ, Zoran PRŽIĆ, Saša MATIJAŠEVIĆ	255
PHYSICAL AND CHEMICAL CHARACTERIZATION OF PLUM CULTIVARS (<i>PRUNUS DOMESTICA</i> L.)	
Mirjana RADOVIC, Mihajlo LIZDEK, Mirko KULINA, Slavisa MILOVANOVIC, Dejan ZEJAK	261
QUALITY PROPERTIES OF WHEAT BREAD	
Desimir KNEŽEVIĆ, Vesna DJUROVIĆ, Mirela MATKOVIĆ STOJŠIN, Dragan GRČAK, Milosav GRČAK, Dušan UROŠEVIĆ, Sarina REZAEI SHOJAEI, Simin HAGH-NAZARI	270
VARIABILITY OF MASS OF SPIKE AMONG WHEAT VARIETIES	
Dušan UROŠEVIĆ, Desimir KNEŽEVIĆ, Mirela MATKOVIĆ STOJŠIN, Artiona LAZE, Gordana BRANKOVIĆ, Jelena STOJILJKOVIĆ, Veselinka ZEČEVIĆ	277
PHENOTYPIC VARIABILITY AND SIMILARITY OF NUMBER OF SPIKELETS IN PRIMARY SPIKE IN WHEAT VARIETIES (<i>Triticum aestivum</i> L.)	
Dušan UROŠEVIĆ, Desimir KNEŽEVIĆ, Mirela MATKOVIĆ STOJŠIN, Jelica ŽIVIĆ, Danica MIĆANOVIĆ, Adriana RADOSAVAC, Vesna KANDIĆ	285
EFFECT OF OAT INTERCROPPING ON <i>ERYSIPHE PISI</i> DISEASE INDEX IN WINTER PEA	
Milosav GRČAK, Dragan GRČAK, Desimir KNEŽEVIĆ, Radivoje JEVTIĆ, Vesna ŽUPANSKI, Branka ORBOVIĆ, Vera RAJIČIĆ	293
DETERMINATION OF YIELD AND YIELD COMPONENTS OF SOME SALSOLA AND SUAEDA SPECIES ACCORDING TO PHENOLOGICAL PERIODS	
Bilal KESKİN, Süleyman TEMEL, Ali İhsan ATALAY, Faruk TOHUMCU, Seda AKBAY TOHUMCU	301
MECHANICALLY-AIDED HARVESTING OF TABLE GRAPES WITH AN ELECTRICALLY PROPELLED PROTOTYPE	
Roberto TOMASONE, Mauro PAGANO, Carla CEDROLA	308
PLANT PROTECTION AND FOOD SAFETY	314

STUDY OF THE INFLUENCE OF STORAGE PERIOD ON THE ACCUMULATION OF HYDROXYMETHYLFURFURAL IN CANNED PRODUCTS BASED ON CARROT

Zinaida YEGOROVA, Anastasia NAVROTSKAYA, Angelina BUTKO, Tatiana SHACHEK 315

THE HARMFULNESS OF LEAFMINER *NAPOMYZA GYMNOSTOMA* Loew (Diptera, Agromyzidae) IN BIJELJINA AREA (BOSNIA AND HERZEGOVINA)

Dejana STANIĆ, Jovana OBRADOVIĆ 324

INFLUENCE OF GROWING LOCATION ON BIOACTIVE COMPOUNDS AND ANTIOXIDATIVE ACTIVITY OF 'CLERY' STRAWBERRY FRUITS IN HERZEGOVINA

Maja KAZAZIC, Emina MEHIC, Amna OMANOVIC 331

ASSESSMENT OF NATURAL RADIOACTIVITY LEVELS IN AGRICULTURAL SOIL AND TRANSFER IN RICE IN THE KOCHANI REGION, NORTH MACEDONIA

Aleksandra ANGELESKA, Radmila CRCEVA NIKOLOVSKA, Elizabeta DIMITRIESKA STOJKOVIKJ, Ljupco ANGELOVSKI, Igor ESMEROV, Risto UZUNOV 337

ASSESSMENT OF RADIOACTIVITY AND RADIOLOGICAL HAZARD FROM NATURAL RADIONUCLIDES CONTAINED IN RICE FROM NORTH MACEDONIA

Aleksandra ANGELESKA, Radmila CRCEVA NIKOLOVSKA, Elizabeta DIMITRIESKA STOJKOVIKJ, Igor ESMEROV, Stefan JOVANOV, Ljupco ANGELOVSKI, Risto UZUNOV 344

SCIENTIFIC AND REGULATORY PERSPECTIVES ON IRRADIATED FOOD: DETECTION STANDARDS AND SAFETY EVALUATION

Ljupco ANGELOVSKI, Elizabeta DIMITRIESKA STOJKOVIKJ, Radmila CRCEVA NIKOLOVSKA, Igor ESMEROV, Risto UZUNOV, Sandra MOJSOVA, Aleksandra ANGELESKA 351

THE ROLE OF RURAL TOURISM IN ADVANCING SUSTAINABLE DEVELOPMENT IN NORTH MACEDONIA

Ljupco ANGELOVSKI, Aleksandra ANGELESKA, Radmila CRCEVA NIKOLOVSKA, Snezana DIMITROVSKA, Sandra MOJSOVA, Igor ESMEROV, Elizabeta DIMITRIESKA STOJKOVIKJ 359

LIST OF SOME INVASIVE INSECTS ESTABLISHED IN NORTH MACEDONIA

Stanislava LAZAREVSKA, Sterja NACHESKI, Miroljub GOLUBOVSKI, Blagoj SURBEVSKI 368

***MORINGA OLEIFERA* OVERDOSE: ALLELOPATHIC EFFECTS OF HIGH-CONCENTRATION EXTRACT ON BAMBARA GROUNDNUT**

Abdel Kader NAINO JIKA 374

VIALE BIOTECHNOLOGICAL WAYS FOR LEGUMICULTURE: INTEGRATION OF COMPOST AND BIOACTIVE SYSTEMS BASED ON BYOPOLIMERS

Valentina-Elena GORGAN, Petronela NECHITA, Gabriela Elena BAHIRIM 380

BEE DIVERSITY IN SEMI-NATURAL HABITATS IN AGRICULTURAL LANDSCAPES IN VOJVODINA PROVINCE, SERBIA	
Ivana KAVGIĆ, Zlata MARKOV RISTIĆ, Sonja MUDRI-STOJNIC	386
EXPLORING THE POTENTIAL OF AUTOCHTHONOUS PROBIOTIC STARTER CULTURES STRAINS IN FRESH CHEESE PRODUCTION	
Dušan BASTA, Ksenija ČOBANOVIĆ, Nataša GOLIĆ, Katarina VELJOVIĆ, Nikola POPOVIĆ, Snežana GLAMOČIĆ.....	392
THE INFLUENCE OF SUBSTRATE ACIDITY ON PRODUCTION OF MUSHROOM <i>LENTINULA EDODES</i> (BERK.) PEGLER	
Miroslava MARKOVIĆ, Renata GAGIĆ-SERDAR, Goran ČEŠLJAR.....	398
EDIBLE MUSHROOMS AS NEW FOOD AND NEW ADDITIVES	
Višnja SIKIMIĆ, Slavica ČABRILO, Nada JELIĆ.....	404
EXTRACTION METHODS USED IN OBTAINING PHYTOMELATONIN-RICH EXTRACTS FROM CITRUS SPECIES	
Özgül GERÇEKER, Sevcan ÜNLÜTÜRK, Tolga AKCAN, Şelale Öncü GALUE	413
USE OF HALOCHROMIC SYSTEMS IN INTELLIGENT FOOD PACKAGING	
Ozlem Kizilirmak ESMER, Sevgi CAY	422
EFFECT OF RHIZOSPHERIC BACTERIA IN CONTROLLING <i>FUSARIUM OXYSPORUM</i>	
Redouan QESSAOUI, Safouane BENJAAA, Salahddine CHAFIKI, Abdelmalk MAHROUG, Soumaya EL ASSRI, Abdelhadi AJERRAR, Hasna ELHJOUJI, Mohamed ALOUANI, Rachid BOUHARROUD.....	427
ORGANIC AGRICULTURE AND AGROECOLOGY	435
CHEMICAL COMPOSITION OF LEAVES FROM FIVE <i>Vitis vinifera</i> L. CULTIVARS	
Ladislav VASILIŠIN, Goran VUČIĆ, Srđan LJUBOJEVIĆ, Nataša LAKIĆ-KARALIĆ, Staniša LATINOVIĆ	436
INCREASING THE PRODUCTIVITY POTENTIAL OF THE CHERNOZEM IN THE REPUBLIC OF MOLDOVA IN CONDITIONS OF CLIMATE RESILIENCE	
Tatiana DAVID, Leonid POPOV, Valerian CERBARI.....	444
MULTIVARIATE VISUALIZATION UNLOCKS OPTIMAL SEED PRIMING STRATEGIES FOR SAHELIAN FARMERS: A MORINGA-BAMBARA GROUNDNUT CASE STUDY	
Abdel Kader NAINO JIKA	450
CHALLENGES, CONCEPTS AND INTERNATIONAL VIEWS ON ORGANIC WINE CERTIFICATION AND CONSUMPTION	
Cosmina - Ionela VASILACHE, Adrian Gheorghe ZUGRAVU.....	456
SUSTAINABLE MANAGEMENT OF THE PROTECTION OF VEGETABLE CROPS IN THE ORGANIC FARMING SYSTEM	
Divna SIMIĆ, Snežana JANKOVIĆ, Željko DOLIJANOVIĆ, Vera POPOVIĆ, Vojin CVIJANOVIĆ, Jelena MARKOVIĆ, Vladan PEŠIĆ	463

CITIZEN SCIENCE INSIGHTS INTO DECOMPOSITION ACROSS FARMS USING TEA BAGS AND COTTON FABRIC

Dušanka VUJANOVIĆ, Andrijana ANDRIĆ, Jelena JOVIĆ, Kristina KALKAN, Nataša LJUBIČIĆ, Ljiljana ŠAŠIĆ ZORIĆ, Aleksandar IVEZIĆ, Tijana BAROŠEVIĆ 469

MORINGA PODS: AN ORGANIC WASTE SOLUTION FOR *TETRANYCHUS URTICAE* CONTROL

Redouan QESSAOUI, Darbali Fatima ZAHRA, Salahddine CHAFIKI, Abdelmalk MAHROUG, Soumaya EL ASSRI, Bahoch SAID, Abdelhadi AJERRAR, Hasna ELHJOUJI, Ait Aabd NAIMA, Tahiri ABDEGHANI, Rachid BOUHARROUD 477

IMPACT OF SUCCESSIONAL AGROFORESTRY SYSTEMS ON SOIL BIOLOGY IN THE MEDITERRANEAN

Pedro R. SOARES, Carla S. S. FERREIRA, Lyudmyla SYMOCHKO, Patrícia SANTOS, Coen RITSEMA, Luuk FLESKENS 484

ENVIRONMENT PROTECTION AND NATURAL RESOURCES

MANAGEMENT 491

VALORIZATION OF ORGANIC WASTE, THE CASE OF DATE STONES, IN WATER TREATMENT

Mimouna YAKOUBI, Nasser BELBOUKHARI, Khaled SEKKOUM 492

IMPERVIOUSNESS DENSITY OF LAND IN BOSNIA AND HERZEGOVINA

Branislav DRAŠKOVIĆ, Ljiljana TANASIĆ, Milan GLIŠIĆ 499

A DAMAGE ASSESSMENT OF THE BEECH-FIR ECOSYSTEM AFTER EXPLOITATION

Fatima MUHAMEDAGIĆ, Zemira DELALIĆ, Nihad GERZIĆ, Merjem HUSKIĆ 505

INVASIVE ALIEN PLANT SPECIES OF THE MUNICIPALITY OF GRUDE (BOSNIA AND HERZEGOVINA)

Mate BOBAN, Helena BREKALO, Safija BOŠKAILO, Toni GALIĆ, Aldin BOŠKAILO, Danijela PETROVIĆ 511

DIVERSITY OF ENDEMIC PLANTS AT SPRING OF BUNICA AND BUNA CHANNELS, BOSNIA AND HERZEGOVINA

Lejla RIĐANOVIĆ, Robert KEPIĆ, Emina ADEMOVIĆ, Sanel RIĐANOVIĆ 518

ETHNOBOTANICAL ANALYSIS OF THE TRADITIONAL USE OF WILD PLANTS AND MUSHROOMS IN THE AREA OF BUSOVAČA (BOSNIA AND HERZEGOVINA)

Iva RELOTA, Sandra MEDIĆ, Antonela MUSA, Safija BOŠKAILO, Aldin BOŠKAILO, Danijela PETROVIĆ 524

GERMPLASM COLLECTIONS OF NEGLECTED AND UNDERUTILIZED SPECIES AS RESEARCH AND CONSERVATION PLATFORMS FOR THEIR VALORIZATION

Zakaria KIEBRE, Mariam KIEBRE, Romaric Kiswendsida NANEMA, Fanta Sheirita Reine TIETIAMBOU, Veli-Matti ROKKA, Hamid EL BILALI, Filippo ACASTO, Jacques NANEMA 531

WATER RETENTION CHARACTERISTICS OF TERRA ROSSA IN RELATION TO HUMUS CONTENT

Aleksandra BENZA, Mirjam NIKOLIĆ, Danijela JUNGIC, Nikolina JURKOVIĆ BALOG..... 539

SPATIAL AND TEMPORAL HISTORICAL LANDSCAPE CHANGE IN A MICRO BIODIVERSITY HOTSPOT OF GREECE

Asimina SKOUTERI, Vassilios P. PAPANASTASIS..... 545

INTEGRATED STATISTICAL APPROACHES TO SUSTAINABLE AQUACULTURE DEVELOPMENT: INSIGHTS FROM THE BALTIC SEA REGION FOR ENVIRONMENT PROTECTION AND NATURAL RESOURCE MANAGEMENT

Inese SKAPSTE..... 551

FLOWERING AND FRUITING BIOLOGY OF *PYRUS ELAEAGNIFOLIA* PALL. IN THE CONDITIONS OF THE REPUBLIC OF MOLDOVA

Irina SFECLĂ, Elena TOFAN-DOROFEEV..... 557

***EPIPACTIS MUELLERI* GODFERY (ORCHIDACEAE) – A NEW SPECIES FOR THE FLORA OF THE REPUBLIC OF MOLDOVA**

Olga IONITA..... 568

NITRATE NITROGEN AND NITRATE REDUCTASE ACTIVITY REGIME IN SOILS OF AGROCENOSSES OF THE DONETSK PEOPLE'S REPUBLIC

Andrey BEREZOVSKIY, Dmitry SYSHCHYKOV, Irina AGUROVA..... 574

ASSESSMENT OF ERODIBILITY INDICES AND THE DEGREE OF SOIL AGGREGATION DEPENDING ON THE TYPE OF LAND USE (EASTERN SERBIA)

Boško GAJIĆ, Milan ĐORĐEVIĆ, Miloš MANIĆ, Mrđan ĐOKIĆ, Ranko DRAGOVIĆ, Aleksandar ČUPIĆ, Mihajlo JOVIĆ, Ivana SMIČIKLAS, Snežana DRAGOVIĆ..... 579

LIGNOCELLULOSIC ARCHITECTURE AND BIOCONVERSION POTENTIAL OF *ARUNDO DONAX* AND *ZEA MAYS*: A FLUORESCENCE APPROACH

Daniela ĐIKANOVIĆ, Dragana BARTOLIĆ, Mira STANKOVIĆ, Gabor STENBACH, Miloš PROKOPIJEVIĆ, Aleksandar KALAUZI, Ksenija RADOTIĆ..... 585

INFLUENCE OF DRYING TREATMENT ON ANTIOXIDANT ACTIVITY IN FOUR DIFFERENTLY PIGMENTED MAIZE (*ZEA MAYS* L.) SEED CULTIVARS

Daniela ĐIKANOVIĆ, Miloš PROKOPIJEVIĆ, Mira STANKOVIĆ, Olivera PRODANOVIĆ, Branka ŽIVANOVIĆ, Ksenija RADOTIĆ, Dragana BARTOLIĆ.... 591

THE IMPACT OF HARVEST TIME ON THE CONTENT OF POLYPHENOLIC COMPOUNDS AND ANTIOXIDANT CAPACITY OF FRUITS OF *Chaenomeles japonica* (Thunb.) Lindl. ex Spach

Mirjana OCOKOLJIĆ, Jelena ČUKANOVIĆ, Radenka KOLAROV, Djurdja PETROV, Nevenka GALEČIĆ, Dejan SKOČAJIĆ, Isidora SIMOVIĆ..... 595

THE IMPACT OF LOCAL ADAPTATION ON THE PHENOLOGICAL PATTERNS OF FLOWERING IN *Buddleja davidii* 'PINK DELIGHT' IN KARADORDEV PARK, BELGRADE (SERBIA)

Mirjana OCOKOLJIĆ, Nevenka GALEČIĆ, Dejan SKOČAJIĆ, Jelena ČUKANOVIĆ, Radenka KOLAROV, Dragan VUJIČIĆ, Djurdja PETROV	602
A STUDY ON THE FLOWERING CHARACTERISTICS OF CHAENOMELES × SUPERBA 'PINK LADY'	
Mirjana OCOKOLJIĆ, Djurdja PETROV, Nevenka GALEČIĆ, Dejan SKOČAJIĆ, Sara ĐORĐEVIĆ, Radenka KOLAROV, Jelena ČUKANOVIĆ	609
SPATIAL USE AND THE NEEDS OF VISITORS OF THE BOJČIN FOREST NATURE MONUMENT (BELGRADE, SERBIA)	
Jovana PETROVIĆ, Nenad STAVRETOVIĆ, Dušan JOKANOVIĆ, Vesna NIKOLIĆ JOKANOVIĆ	615
INVASIVE AND ALLERGENIC PLANT SPECIES ON RUNNING TRAILS OF ADA CIGANLIJA (BELGRADE, SERBIA)	
Jovana PETROVIĆ, Nenad STAVRETOVIĆ, Dušan JOKANOVIĆ, Vesna NIKOLIĆ JOKANOVIĆ	621
STRENGTHENING ORGANIZATIONAL QUALITY THROUGH ISO 9001 AND ISO 10005 INTEGRATION	
Marija PEROVIĆ, Marija TODORVIĆ, Tatjana MITROVIĆ	628
ENVIRONMENTAL BEHAVIOR AND TRACER POTENTIAL OF FLUORIDE IN GROUNDWATER	
Marija PEROVIĆ, Tatjana MITROVIĆ	634
BEE-ING IN THE NEWS: ANALYZING SERBIAN NEWSPAPER COVERAGE OF BEES	
Snežana POPOV, Zlata MARKOV RISTIĆ, Dušanka VUJANOVIĆ	639
TOXICOLOGICAL RISKS PEDICTION OF THE METOLACHLOR HERBICIDE AS ENVIRONMENTAL CONTAMINANT	
Tatjana MITROVIĆ, Darija OBRADOVIĆ, Saša LAZOVIĆ, Marija PEROVIĆ	644
ECOLOGICAL STATUS EVALUATION OF SERBIAN SURFACE WATERS BASED ON PHOSPHORUS CONCENTRATIONS	
Tatjana MITROVIĆ, Marija PEROVIĆ, Tijana MILICEVIĆ	649
APPLYING SWOT ANALYSIS TO THE VALUATION OF POLLINATION ECOSYSTEM SERVICES	
Zlata MARKOV RISTIĆ, Sonja MUDRI-STOJNIĆ	655
CULTIVATION OF HOVERFLIES ON FARMS: BIOLOGICAL, PRACTICAL AND ECONOMIC PERSPECTIVES	
Zlata MARKOV RISTIĆ, Snežana POPOV	661
IMPACTS OF AGRICULTURAL WATER USE AND SEASONAL DROUGHT ON WATER RESOURCES: A CASE STUDY OF KESKIN DAM, TURKIYE	
Eray HARMAN	667
HISTORICAL SHARK EXPLOITATION AND CONTEMPORARY CONSERVATION EFFORTS IN THE TURKISH SEAS	
Ertan TASKAVAK, Halit FILIZ	674

GEOGRAPHICALLY WEIGHTED REGRESSION BASED APPROACHES FOR ENHANCING PRECIPITATION ESTIMATION IN AGROECOSYSTEMS	
Filiz DADASER-CELİK, Mete CELİK, Ali Ümran KÖMÜŞCÜ.....	680
MODELLING HYDROLOGICAL PROCESSES AT BURDUR LAKE BASIN (TURKEY) WITH SWAT	
Mehmet SOYLU, Meltem KACIKOC, Filiz DADASER-CELİK.....	685
PRELIMINARY ASSESSMENT OF WATER QUALITY IN EĞİRDİR LAKE BASED ON FIELD MONITORING	
Meltem KACIKOC, Eda BOYACIOGLU, Filiz DADASER-CELİK.....	691
A SOLUTION TO CLIMATE CHANGE AND WATER SCARCITY: STUDIES ON RAINWATER HARVESTING IN TURKEY	
Yoldaş EKTİREN.....	700
IMPROVING WATER EFFICIENCY IN AGRICULTURE: A DEFICIT IRRIGATION APPROACH FOR TURKEY	
Yoldaş EKTİREN.....	705
CULTURAL LANDSCAPES OF THE BIOSPHERE RESERVE “OS ANCARES LUCENSES E MONTES DE CERVANTES, NAVIA E BECERREÁ”	
Ignacio J. DIAZ-MAROTO.....	710
HOW DO CULTURAL ECOSYSTEM SERVICES IN MOUNTAIN AREAS CONTRIBUTE TO THE WELL-BEING OF LOCAL COMMUNITIES?	
Ignacio J. DIAZ-MAROTO.....	717
THE ROLE OF SUSTAINABLE FOREST RESOURCE MANAGEMENT IN THE SOCIOECONOMIC GROWTH OF THE EASTERN MOUNTAINS OF GALICIA IN SPAIN	
Ignacio J. DIAZ-MAROTO.....	723
POTENTIAL ROLES OF MELATONIN AND ITS METABOLITES IN REDUCING HEAVY METAL TOXICITY IN VEGETABLES	
Aygül KARACA	729
AN ANALYSIS OF THE SOCIO-ECONOMIC CHARACTERISTICS OF PADDY FARMS IN TURKEY	
Sema Ezgi YÜCEER, Sibel TAN.....	736
THE USE OF SEAWEED EXTRACTS TO MITIGATE ABIOTIC STRESSES IN VEGETABLES	
Aygül KARACA, Nusret ÖZBAY	743
ANIMAL HUSBANDRY	749
RAW MILK QUALITY AS A BASIS FOR CHEESE PRODUCTION	
Drazenko BUDIMIR, Milijana ŠKRBIĆ	750
BACTERIA AND LOWER RESPIRATORY TRACT DISEASES IN HORSES	
Mariyana NIKOLOVA, Sasho SABEV	755

CLINICAL STUDIES OVER EQUINE GASTROULCERATIVE SYNDROME IN HORSES (EGUS)

Sasho SABEV, Mariyana NIKOLOVA 763

PRODUCTIVITY AND EGG QUALITY OF LAYING HENS FED WITH BLACK SOLDIER FLY (*HERMETIA ILLUCENS*) LARVAE MEAL

Aiga NOLBERGA-TRŪPA, Niklāvs KLEINS, Kārlis SAMS 770

THE INFLUENCE OF THE LEPTIN GENE ON MILK PRODUCTION IN THREE CONSECUTIVE LACTATIONS IN HOLSTEIN FRIESIAN CATTLE

Igor ESMEROV, Radmila CRCEVA NIKOLOVSKA, Nikolay MARKOV, Risto UZUNOV, Ljupco ANGELOVSKI, Aleksandra ANGELESKA, Ljupco MICKOV ... 778

PORTUGUESE CONSUMERS' PREFERENCE REGARDING THE PRESENTATION OF PROTECTED DESIGNATION OF ORIGIN TRANSMONTANO GOAT CHEESE

António José FERNANDES, Fernando SOUSA, Dina AVEIRO, Maria Isabel RIBEIRO 784

PORK MEAT CONSUMPTION: A COMPARATIVE ANALYSIS BETWEEN BRAZILIAN AND PORTUGUESE CONSUMERS

António José FERNANDES, Juan de Oliveira MORAIS, Maria Isabel RIBEIRO 791

PORTUGUESE CONSUMERS' PREFERENCE REGARDING THREE PROTECTED DESIGNATION OF ORIGIN TRANSMONTANO GOATLING BUTCHER PIECES

António José FERNANDES, Fernando SOUSA, Dina AVEIRO, Maria Isabel RIBEIRO 798

PHARMACEUTICAL CONTAMINANTS IN AQUATIC ENVIRONMENTS: IMPACT ON EDIBLE FISH AND SUSTAINABLE MANAGEMENT PERSPECTIVES

Daniela-Nicoleta ROPOTAN, Lorena DEDIU 804

EFFECT OF GLYCEROL SUPPLEMENTATION ON BLOOD CONCENTRATIONS OF INSULIN AND BIOCHEMICAL PARAMETERS IN PERIPARTUM DAIRY COWS

Julijana TRIFKOVIĆ, Dušan BOŠNJAKOVIĆ, Slavica DRAŽIĆ, Ljubomir JOVANOVIĆ, Milica STOJKOVIĆ, Danijela KIROVSKI, Željko SLADOJEVIĆ 810

THE POSSIBILITY OF USING ESSENTIAL OILS OF *ORIGANUM VULGARE* L., *MENTHA X PIPERITA* L. AND *SATUREJA MONTANA* L. AGAINST GASTROINTESTINAL NEMATODES IN SHEEP

Filip ŠTRBAC, Radomir RATAJAC, Nataša TOLIMIR, Divna SIMIĆ, Slađan STANKOVIĆ, Antonio BOSCO, Laura RINALDI, Nataša SIMIN, Dejan ORČIĆ, Slobodan KRNJAJIĆ, Dragica STOJANOVIĆ 817

THE INFLUENCE OF WEATHER ON THE QUALITY OF HONEY IN RASINA REGION FOR THE PERIOD OF 2019-2024

Goran JEVIĆ, Snežana BABIĆ, Snežana ANDELKOVIĆ, Đorđe LAZAREVIĆ, Mirjana PETROVIĆ, Vladimir ZORNIĆ, Kazimir MATOVIĆ 826

PORCINE REPRODUCTIVE RESPIRATORY SYNDROME AS A HEALTH PROBLEM IN SWINE PRODUCTION

Jovan BOJKOVSKI, Sreten NEDIĆ, Sveta ARSIĆ, Radiša PRODANOVIĆ, Aleksandra MITROVIĆ, Branko ANGELOVSKI, Milan NINKOVIĆ 832

CONSTRUCTIVE ALIGNMENT OF LEARNING OUTCOMES, TEACHING METHODS AND ASSESSMENT STRATEGIES IN THE FARM ANIMAL BIOSECURITY COURSE

Slavca HRISTOV, Branislav STANKOVIC, Dimitar NAKOV, Milica RADJENOVIC 837

CHARACTERISTICS OF KAJMAK PRODUCED IN THE VALJEVO AREA IN SERBIA

Tanja VUČIĆ, Snežana JOVANOVIĆ, Kristina SOFRONIĆ 845

EFFECT OF PROTEASE AND SEX ON CARCASS QUALITY AND ABDOMINAL FAT OF SLOW-GROWING HYBRID OF CHICKEN

Vladimir DOSKOVIĆ, Snežana BOGOSAVLJEVIĆ-BOŠKOVIĆ, Zdenka ŠKRBIĆ, Miloš LUKIĆ, Bojan STOJANOVIĆ, Simeon RAKONJAC, Veselin PETRIČEVIĆ.. 851

RISK ASSESSMENT OF ANIMAL WASTE FOR OCCUPATIONAL HEALTH AND SAFETY IN LIVESTOCK SECTOR

Turgut AYGÜN 857

SOME ENVIRONMENTAL EFFECTS ON BODY WEIGHT AT WEANING AND SHEARING AND GREASY WOOL YIELD IN MORKARAMAN EWES

Turgut AYGÜN 863

RAISING SYSTEMS IN SMALL RUMINANT HUSBANDRY IN EASTERN ANATOLIA OF TÜRKİYE

Turgut AYGÜN 869

SUPPLEMENTATION WITH GARLIC POLYSULFIDES EFFECTIVELY REDUCES ENTERIC METHANE EMISSIONS IN DAIRY COWS

Julijana TRIFKOVIĆ, Dušan BOŠNJAKOVIĆ, Sreten NEDIĆ, Ljubomir JOVANOVIĆ, Ivan VUJANAC, Željko SLADOJEVIĆ, Danijela KIROVSKI 875

FISH FEED: AN ANALYSIS OF OLD AND NEW TECHNOLOGIES

Albana UKA 883

DEVELOPMENT OF COMPETENCES OF VETERINARIANS AND ANIMAL HUSBANDRY ENGINEERS FOR BIOSECURITY MEASURES IMPLEMENTATION ON ANIMAL FARMS

Branislav STANKOVIC, Slavča HRISTOV, Dimitar NAKOV, Sonja OBRENOVIC, Milica RADJENOVIC, Ivana MILOSEVIC-STANKOVIC 888

EVALUATION OF EGGSHELL HYGIENE AND QUALITY OF TABLE EGGS FOLLOWING SURFACE DISINFECTION WITH LIQUID CHLORINE DIOXIDE

Ajla ALIŠAH, Nedim BEGIĆ, Julijana TRIFKOVIĆ, Miroslav LALOVIĆ, Abdulah GAGIĆ 895

ANALYSIS OF THE USE AND PRESENCE RESIDUES OF ANTIBIOTICS IN TABLE EGGS IN MODERN LAYING HEN FARMS IN THE DAKAR REGION AND SURROUNDING AREA (SENEGAL)	
Khalifa Serigne Babacar SYLLA, Arame THIOUNE, Sadibou BA, Rianatou BADA-ALAMBEDJI.....	900
RURAL DEVELOPMENT AND AGROECONOMY	909
PUBLIC POLICIES, PRIVATE INITIATIVES AND RURAL DEVELOPMENT FOR CLIMATE-RESILIENT AGRICULTURE IN BOSNIA AND HERZEGOVINA	
Branka TOPIĆ-PAVKOVIĆ	910
BUYING BEHAVIOUR IN CONSUMERS OF FRESH VEGETABLES	
Elma SEFO, Zrinka KNEZOVIĆ, Anamarija ŠEVO.....	920
FISH CONSUMPTION PREFERENCES AND CONSUMER CHARACTERISTICS IN HERZEGOVINA-NERETVA CANTON, BOSNIA AND HERZEGOVINA	
Predrag IVANKOVIĆ, Marija LASIĆ, Luka DRAGIĆEVIĆ	927
ANALYSIS OF THE ECONOMIC PROFITABILITY OF DIFFERENT BELL PEPPER PRODUCTION METHODS	
Radomir BODIROGA, Milica STOJANOVIĆ, Uroš GALINAC, Ljubiša ŠEVKUŠIĆ, Koštana VINČIĆ	933
SUPPLY CHAIN FINANCE AS A FUNDING OPPORTUNITY FOR FARMERS	
Zorica GOLIĆ, Saša LALIĆ.....	939
INCLUSIVE GREEN FINANCE: IMPORTANCE FOR STRENGTHENING THE AGRICULTURAL RESILIENCE TO CLIMATE CHANGE	
Zorica GOLIĆ.....	948
AGRICULTURAL BIOGAS PLANTS IN EUROPEAN RURAL DEVELOPMENT AND THE ENERGY TRANSITION	
Krzysztof PILARSKI, Agnieszka A. PILARSKA	957
HEALTH AND SAFETY OF FARMERS IN POLAND	
Władysław MIGDAŁ, Joanna MAKULSKA, Barbara TOMBARKIEWICZ, Michał CUPIAŁ.....	966
DEMOGRAPHIC TRENDS AND THEIR IMPLICATIONS FOR SUSTAINABLE RURAL DEVELOPMENT: A CASE STUDY OF THE BUFTEA AREA, ILFOV COUNTY, ROMANIA	
Andreea Roxana FIRĂȚOIU, Elena SOARE, Aurelia-Ioana CHEREJI, Irina-Adriana CHIURCIU, Liviu MĂRCUȚĂ	973
RURAL LABOR: AN ANALYSIS OF THE PROSPECTS FOR EMPLOYMENT OF YOUTH IN THE AGRICULTURAL SECTOR	
Irina CHEKHOVSKIKH	982
THE ROLE OF KNOWLEDGE TRANSFER TRAININGS IN FIELD CROP AND VEGETABLE PRODUCTION: AN ANALYSIS OF A TEN-YEAR PERIOD	
Divna SIMIĆ, Snežana JANKOVIĆ, Vojin CVIJANOVIĆ, Vedran TOMIĆ, Marijana MASLOVARIĆ, Ivana STANIMIROVIĆ, Nataša TOLMIR	989

SMART AGRICULTURE AND CRYPTOECONOMICS: CHALLENGES AND OPPORTUNITIES FOR THE WESTERN BALKANS	
Vedran TOMIĆ, Robert RADIŠIĆ, Marija GAVRILOVIĆ, Stevan ČANAK, Nikola LJILJANIĆ	998
IMPORTANCE OF THE TEMPERATURE-HUMIDITY INDEX IN ENSURING OPTIMAL SHELTER CONDITIONS FOR ANIMAL PRODUCTION IN TURKEY	
Merve Nur EKTIREN, Yoldaş EKTIREN	1004
ASSESSING GENDER SENSITIVITY OF THE SMALL-SCALE MECHANIZED RAISED BED TECHNOLOGY (MRB) IN EGYPT	
Gehan A.G. ELMENOFI, Aman ELGARHY, Bezaiet DESSALEGN, Biju GEORGE	1009
AGRICULTURAL TRENDS AND CHALLENGES IN SLOVAKIA IN COMPARISON WITH BOSNIA AND HERZEGOVINA	
Branislav DUDIC, Velibor SPALEVIC	1019
EVALUATION OF THE ECONOMIC EFFICIENCY OF FRUIT ORCHARD PRODUCTION WITH RISK CONSIDERATION	
Jozef REPISKÝ, Nándor NAGY	1025
FORECASTING APRICOT PRODUCTION IN TÜRKİYE USING THE ARIMA (BOX-JENKINS) MODEL	
Ashl DALGIC.....	1032
FORESTRY AND AGRO-FORESTRY	1040
ANALYSIS OF CHAINSAW OPERATORS’ EXPERIENCE IN FORESTRY	
Dane MARČETA, Miodrag ŠTRBAC, Vladimir PETKOVIĆ, Danijela PETROVIĆ, Milan SUKUR	1041
BRANDING CHALLENGES AND PERSPECTIVES OF NON-TIMBER FOREST PRODUCTS IN SARAJEVO-ROMANIJA REGION IN BOSNIA AND HERZEGOVINA	
Nedeljka ELEZ	1049
CHEMICAL COMPOSITION OF <i>Morchella costata</i> (Vent.) Pers AND FOUR OTHER EDIBLE MUSHROOMS FROM BOSNIA AND HERZEGOVINA	
Srđan LJUBOJEVIĆ, Ladislav VASILIŠIN, Goran VUČIĆ, Nataša LAKIĆ-KARALIĆ, Staniša LATINOVIĆ	1054
GERMINATION OF <i>Fagus sylvatica</i> L. SEEDS DEPENDING ON X-RAY DOSE	
Dina ELISOVETCAIA, Raisa IVANOVA, Jan BRINDZA	1064
MORPHOLOGICAL DIVERGENCE AMONG SIX SAHELIAN TREE SPECIES: IMPLICATIONS FOR FUNCTIONAL AGROFORESTRY DESIGN	
Abdel Kader NAINO JIKA	1072
RESEARCH ON THE POSSIBILITY OF IMPLEMENTING FOREST CLIMATE PROJECTS IN THE FOREST FUND OF THE RUSSIAN FEDERATION	
Svetlana MORKOVINA, Denis KUZNETSOV, Andrey TOPCHEEV	1078

MONITORING LAND USE CHANGE IN VOJVODINA USING THE COLLECT EARTH TOOL	
Dragan BOROTA, Damjan PANTIĆ, Brano VAMOVIĆ, Aleksandar GOLUBOVIĆ	1085
HYDROLOGICAL REGIME OF HIGROPHILOUS FORESTS ON THE ISLANDS ALONG THE DANUBE RIVER	
Dušan JOKANOVIĆ, Vesna NIKOLIĆ JOKANOVIĆ	1094
MORPHOLOGICAL LEAF TRAITS VARIATION WITHIN AND AMONG FIVE PEDUNCULATE OAK (<i>Quercus robur</i> L.) POPULATIONS IN REPUBLIC OF SRPSKA (BOSNIA AND HERZEGOVINA)	
Milena STANKOVIĆ NEĐIĆ, Srđan STOJNIĆ, Marko GUTALJ, Boban MILETIĆ, Branislav FILIPIĆ, Branislav KOVAČEVIĆ, Lazar KESIĆ, Miloš BAČIĆ Saša ORLOVIĆ.....	1101
REHABILITATION OF DAMAGED FORESTS AS A RESULT OF CLIMATE CHANGE IN THE FUNCTION OF ENVIRONMENTAL PROTECTION	
Zvonimir BAKOVIĆ, Vladimir VASIĆ, Bratislav KISIN	1108
AUTHOR INDEX.....	1117

TOXICOLOGICAL RISKS PEDICTION OF THE METOLACHLOR HERBICIDE AS ENVIRONMENTAL CONTAMINANT

Tatjana MITROVIĆ^{1,*}, Darija OBRADOVIĆ¹, Saša LAZOVIĆ¹, Marija PEROVIĆ²

¹Institute of Physics Belgrade, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia

²Jaroslav Černi Water Institute, Jaroslava Černog 80, 11226 Belgrade, Serbia

*Corresponding author: tmitrovic@ipb.ac.rs

Abstract

Herbicide application has undeniably enhanced agricultural productivity, but it also carries significant environmental and human health hazards because of its inherent toxicity and long-term persistence. This study set out to characterize metolachlor's toxicokinetic profile, including sensitive groups such as pregnant women after ingestion of contaminated water, and to predict its toxicity in aquatic species. We used OPERA-derived physiologically based toxicokinetic (PBTK) models to simulate metolachlor distribution in human tissues based on surface water concentration (45.5 µg/L) measured in 2018 at the Markovicevo monitoring site on Brzava River, which was the highest reported metolachlor content found during 2016-2022 among all surface water profiles in Serbia. Chemical toxicity was forecasted with ProTox-3.0, while acute aquatic toxicity endpoints were estimated via multiple linear regression in the SILIS-PTOXRA platform. Standard PBTK modeling indicated peak accumulation in the gastrointestinal tract (0.4062 mg/L) and liver (0.3392 mg/L), suggesting potential hepatotoxicity. Fetal PBTK simulations for pregnant and breastfeeding women predicted slightly lower tissue concentrations 0.297 mg/L in the gut and 0.2721 mg/L in the liver, yet still within a concerning range. Predicted toxicity profiles showed that *Zebrafish embryos* and larvae experience high mortality at 48 and 96 hours of exposure, shifting to moderate toxicity by 120–132 hours. In contrast, the freshwater crustacean *Thamnocephalus platyurus* exhibited only moderate acute sensitivity. These results underscore the pressing need for more comprehensive monitoring of pesticide contamination and for further research into the human health implications of long-term exposure to metolachlor-tainted water.

Keywords: *pesticide pollutants; metolachlor; toxicity.*

Introduction

Pesticides encompass a significant range of chemical substances used to manage insects, fungi, and weeds in agricultural settings. The use of herbicides, has notably boosted crop yields, but it has also been linked to serious negative effects on the environment and human health due to their toxicity and long persistence in the ecosystem (Zhang et al., 2025). A heightened awareness of the repercussions of careless herbicide application has prompted advancements in both the quality and dosage of these chemicals, as well as progress in producing more environmentally friendly crop protection products.

Metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxymethylethyl) acetamide] (Figure 1) is a selective chloroacetamide herbicide primarily employed to manage annual grasses and certain broadleaf weeds in various crops. As a systemic herbicide, it is absorbed by plants and distributed throughout their systems and it is typically used pre-emergence, prior to weed germination. Metolachlor inhibits the synthesis of long-chain fatty acids, which are vital for plant growth and development. This important herbicide has been utilized for many decades across more than 70 different crops worldwide. It is extensively applied in crops such as corn, soybeans, and potatoes, and has been found in both surface and groundwater (Rapacz et al.,

2025). According to World Health Organization regulations, the maximum permissible concentration of metolachlor in drinking water is set at 0.01 mg/L. Therefore, this herbicide is a significant concern for environmental health. The ingestion of metolachlor leads to acute toxicity through the formation of methemoglobin. Increased concentrations of methemoglobin impair oxygen transport to tissues, resulting in hypoxia and lactic acidosis (Suekane et al., 2022).

The aim of this manuscript was to estimate the toxicokinetic profile of metolachlor including vulnerable populations such as pregnant women after consuming contaminated water as well as to estimate its aquatic toxicity potential. Acute toxicity towards zebrafish embryos and freshwater crustaceans, as well as long-term toxicity expressed as NOAEC values, are important endpoints, since they provide insight into both short-term organism sensitivity and potential chronic effects, which literature highlights as essential for a comprehensive ecological risk assessment. This study analyses metolachlor concentration data derived from the Environmental Protection Agency's reports spanning 2016 to 2022, encompassing 79 monitoring sites along 47 watercourses, in addition to six locations within the canal network and two reservoirs. In addition to pesticide concentrations, these reports aggregate data on biological quality elements and indicators of ecological status (potential), alongside physicochemical, chemical, and microbiological parameters assessed in rivers and reservoirs throughout the Republic of Serbia.

Materials and Methods

To obtain a more detailed toxicokinetic characterization of metolachlor we used the OPERA modules from the CompTox Chemistry Dashboard project (Żandarek et al., 2024). The CompTox Dashboard is a web-based data hub developed by EPA's National Centre for Computational Toxicology. In our OPERA simulations for the detected compounds, we used both the `solve_pbt` and `solve_fetal_pbt` modeling routines.

We also applied OPERA models to characterize the physiologically based toxicokinetic (PBTK) behavior of herbicide detected in surface water. First, we used the `solve_pbt` function from EPA's R package (v 2.2.2) to simulate plasma steady-state concentrations (C_{ss}) and peak tissue concentrations (C_{max}). `Solve_pbt` is a multi-compartment model that includes gut, arterial and venous blood, lung, liver, kidney, and a “rest-of-body” compartment. For each compound, we assumed a 70 kg human receiving an oral dose equivalent to the measured water concentration, administered continuously over 24 hours per day, for three days.

Next, we ran a fetal PBTK simulation via `solve_fetal_pbt` (also in `httk` v 2.2.2), which extends the maternal model with fetal compartments and a shared placental unit. This human-only model can simulate oral or intravenous exposures beginning at gestational day 91 and continuing through day 280.

The ProTox-3.0 (Prediction of TOXicity of chemicals) was used to predict the toxicity of metolachlor which relies on comparing the structural characteristics of the compounds under study with known toxic effects to forecast toxic fragments. It applies all of the toxicity parameters to the most promising component that is likely to be the source of biological activity (Alomar et al., 2025).

In our analysis, we used the SILIS-PTOXRA software (In silico Screening and Prediction of Toxic Hazard and Risk Assessment), freely available and developed for the prediction of toxicological endpoints (Żandarek et al., 2025). For forecasting acute based toxicity on multiple linear regression models the following ecotoxicological endpoints were observed:

- Acute Toxicity towards *Zebrafish Embryo*, the acute toxicity is expressed as the median lethal concentration (LC₅₀, mg/L) which is the concentration in water that kills 50 % of a test batch of fish within a continuous period of exposure, usually: 48h,

96 h, 120 h and 132 h,

- Acute Toxicity towards Freshwater Crustacean *Thamnocephalus platyurus* and
- Long term toxicity (28 days, NOAEC in mg/L), expressed as No Observed Effect Concentration (NOAEC), concentration below which an unacceptable effect is unlikely to be observed.

The chemical aquatic toxicity (pLC50, mg/L) can be classified into five categories i.e., very highly toxic (<0.1), highly toxic (0.1–1), moderately toxic (>1–10), slightly toxic (>10–100), and non-toxic (>100) (US-EPA, 2021). Taken together, these parameters are directly connected to the aquatic toxicity profile of metolachlor, since they capture both acute mortality in sensitive test organisms and potential sublethal or chronic effects at environmentally relevant concentrations. By integrating short-term endpoints such as LC50 with long-term thresholds like NOAEC, a more precise picture of metolachlor’s ecological hazard can be obtained, which is consistent with previous findings that emphasize the importance of combining acute and chronic bioassays in environmental risk assessment.

Results and Discussion

Among all measured metolachlor concentrations, the highest value (45.5 µg/L) was measured in 2018. at the Markovicevo profile on the Brzava River (Danube–Tisa–Danube catchment) and used for all subsequent calculations. It is important to emphasize that the other water-quality parameters were also elevated in the same sample: turbidity reached 160 NTU, suspended solids 335 mg/L, total phosphorus 0.336 mg/L, orthophosphates 0.123 mg P/L, total iron 5580.9 mg/L, and aluminium 4179.6 mg/L. While these values point to significant pollution, they represent a single peak, most likely caused by local weather events and agricultural runoff that temporarily raised turbidity, rather than continuous ongoing contamination.

A graphical representation of the obtained results is given in Figures 1 and 2, showing the box plots of the Cmax values. The points in the box plot correspond to the compartment Cmax for selected compounds, and the boxes show the median Cmax and interquartile range for each compartment. Box-plot of metolachlor representing the predicted concentrations in human compartments are presented in the Figure 2.

The solve_fetal_pbtck model predictions show that the maximal accumulation for metolachlor is expected in gastrointestinal system (0.4062 mg/l) and liver (0.3392 mg/L) (Figure 1). This includes potential hepatotoxicity. Graphical illustration of detected herbicide representing the predicted concentrations in human compartments for pregnant woman are presented in the Figure 3. In this case (pregnant woman and woman in lactation) (solve_fetal_pbtck model), higher concentrations can also be expected in the gastrointestinal system (0.297 mg/l) and liver (0.2721 mg/L) (Figure 2).

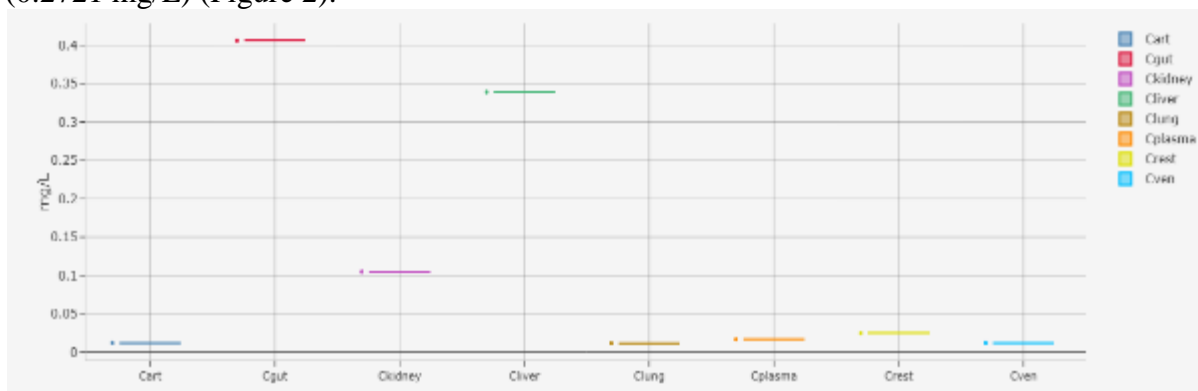


Figure 1. The graphical representation of multiple-compartment PBTCK modelling for metolachlor and related compounds in human body compartments

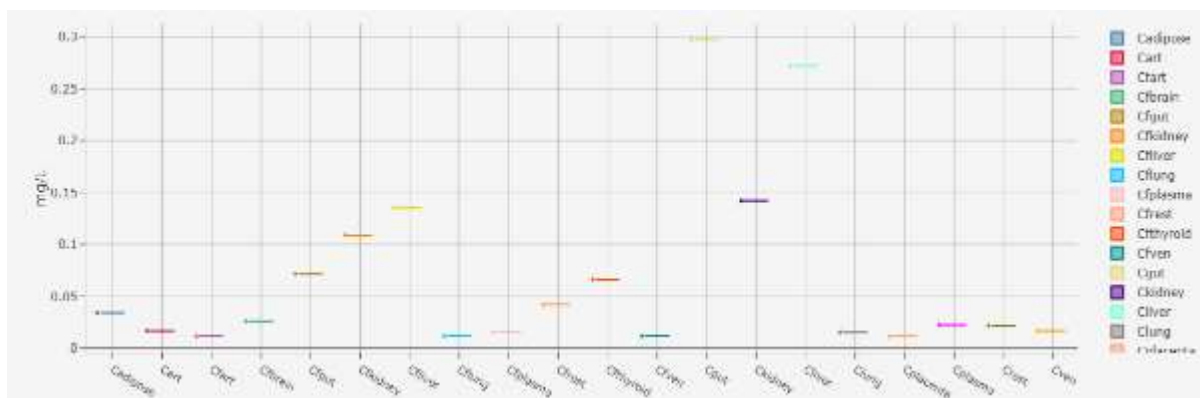


Figure 2. The graphical representation of multiple-compartment PBTK modelling for metolachlor and related compounds in pregnant woman body compartments

As for the aquatic organism’s toxicities (*Zebrafish Embryo*, *Thamnocephalus platyurus*) the following table presents endpoints for screening-level risk assessments.

Table 1. The predicted toxicities (pLC50, NOAEC) for aquatic organisms (*Zebrafish Embryo* and *T. platyurus*)

pLC50-T. platyurus	1.011
pLC50-T. platyurus_whole	0.99
pLC50-48h-zebrafish	0.577
pLC50-48h-zebrafish_whole	0.468
pLC50-96h-zebrafish	0.69
pLC50-96h-zebrafish_whole	0.524
pLC50-120h-zebrafish	1.684
pLC50-120h-zebrafish_whole	1.705
pLC50-132h-zebrafish	1.416
pLC50-132h-zebrafish_whole	1.479
pNOAEC	10.896
pNOAEC_whole	8.551

According to the predicted results, after 48 and 96 h of exposure, it was determined that metolachlor is highly toxic in the zebrafish model, while after 120 and 132 h is moderately toxic. On the other hand, it can be seen that metolachlor is less toxic to *T. platyurus* (moderately toxic) with values compared to the zebrafish model. The predicted results indicate that metolachlor has a higher acute toxicity toward zebrafish embryos compared to *T. platyurus*, with LC50 values falling within the “highly toxic” range at 48 and 96 h of exposure, while shifting to “moderately toxic” levels after 120 and 132 h. This time-dependent variation suggests that zebrafish embryos are particularly sensitive during early developmental stages, which is consistent with literature reports showing that fish embryos are among the most vulnerable indicators of pesticide exposure due to their rapid cell division (Khoshnood, 2024). In contrast, the moderate toxicity observed in *T. platyurus* is consistent with findings that crustaceans often show less sensitivity to certain herbicides compared to fish models (Wang et al., 2024). Furthermore, the predicted NOAEC values (>8) indicate that chronic effects may occur only at concentrations substantially higher than those typically detected in environmental monitoring programs. However, given the persistence and widespread use of metolachlor, even moderate acute toxicity raises concerns for aquatic ecosystems, particularly under conditions

of repeated or cumulative exposure. These results emphasize the importance of integrating both acute and chronic endpoints into ecological risk assessment.

Conclusions

Contemporary society confronts extensive pesticide application, insufficient monitoring, and the resulting elevated environmental contamination driven by agricultural activities. When present as pollutants, these chemicals pose serious health concerns and toxicological risks. The specific compound examined, metolachlor, can accumulate at higher levels in the gastrointestinal system and liver in pregnant woman and woman in lactation following ingestion of contaminated water. Moreover, pronounced adverse effects on aquatic organisms are anticipated. This investigation therefore establishes a foundation for further studies into the health profile associated with consumption of pesticide-tainted water.

References

- Alomar, H. A., El Kady, W. M., Mandour, A. A., Naim, A. A., Ghali, N. I., Ibrahim, T. A., & Fathallah, N. (2025). Computational antidiabetic assessment of *Salvia splendens* L. polyphenols: SMOTE, ADME, ProTox, docking, and molecular dynamic studies. *Results in Chemistry*, 14. <https://doi.org/10.1016/j.rechem.2025.102081>
- Khoshnood, Z. (2024). A review on toxic effects of pesticides in Zebrafish, *Danio rerio* and common carp, *Cyprinus carpio*, emphasising Atrazine herbicide. *Toxicology Reports*, 13, 101694. <https://doi.org/10.1016/j.toxrep.2024.101694>
- Rapacz, D., Smolińska-Kempisty, K., & Wolska, J. (2025). Detection of S-metolachlor herbicide in water samples using new molecularly imprinted polymer for solid-phase extraction. *Journal of Water Process Engineering*, 75. <https://doi.org/10.1016/j.jwpe.2025.107980>
- Suekane, A., Edamoto, M., Kubo, K., Abe, T., Nakatsutsumi, K., & Ameda, T. (2022). Metolachlor Poisoning with Lactic Acidosis Improved by Thiamine Administration: A Case Report. *American Journal of Case Reports*, 23. <https://doi.org/10.12659/AJCR.937873>
- Wang, J., Wang, Z., Dou, Y., Cong, J., Sun, H., Wang, L., & Duan, Z. (2024). Ecological risk assessment for typical organophosphorus pesticides in surface water of China based on a species sensitivity distribution model. *Science of The Total Environment*, 913, 169805. <https://doi.org/10.1016/j.scitotenv.2023.169805>
- Žandarek, J., Žmudzki, P., Obradović, D., Lazović, S., Bogojević, A., Koszła, O., Sołek, P., Maciąg, M., Płazińska, A., Starek, M., & Dąbrowska, M. (2024). Analysis of pharmacokinetic profile and ecotoxicological character of cefepime and its photodegradation products. *Chemosphere*, 353. <https://doi.org/10.1016/j.chemosphere.2024.141529>
- Žandarek, J., Žmudzki, P., Obradović, D., Lazović, S., Bogojević, A., Płazińska, A., Plazinski, W., Plech, T., Starek, M., & Dąbrowska, M. (2025). Cefazolin and its photodegradation products – Prediction of pharmacokinetic profile and ecotoxicological potential. *Journal of Environmental Chemical Engineering*, 13(1). <https://doi.org/10.1016/j.jece.2024.115084>
- Zhang, C., Zhang, W., Cao, W., Guo, X., Zeng, D., Chen, Z., & Li, X. (2025). Unraveling the hidden pathways: Bioaccumulation and metabolism of atrazine, acetochlor, and metolachlor in aquatic organisms. *Environmental Research*, 279. <https://doi.org/10.1016/j.envres.2025.121852>