



University of Belgrade, Technical Faculty in Bor



ECOENTER

**30th International Conference Ecological Truth
& Environmental Research
2023**

Proceedings

**Editor
Prof. Dr Snežana Šerbula**





University of Belgrade, Technical Faculty in Bor



ECO-TRUTH

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& Environmental Research
2023

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PREFACE

The 30th international conference Ecological Truth & Environmental Research – EcoTER'23 kept three areas in focus: ecology, environmental protection and sustainable development. The conference will be held on Mt Stara Planina in hotel Stara Planina, Serbia, 20–23 June 2023. The monograph is published on the occasion of the 30th anniversary of the conference. On behalf of the scientific and organizing committee, it is a great honor and pleasure to wish all the participants a warm welcome to the conference.

The monograph is published on the occasion of the 30th anniversary of the conference.

We hope to convey the message of the conference, which is that a transformation of attitudes and behavior would bring the necessary changes. This is also an opportunity for the participants who are experts in this field to exchange their experiences, expertise and ideas, and also to consider the possibilities for their collaborative research.

The 30th international conference Ecological Truth & Environmental Research – EcoTER'23 is organized by the University of Belgrade, Technical Faculty in Bor, and co-organized by the University of Banja Luka, Faculty of Technology, the University of Montenegro, Faculty of Metallurgy and Technology – Podgorica, the University of Zagreb, Faculty of Metallurgy – Sisak, the University of Pristina, Faculty of Technical Sciences – Kosovska Mitrovica and the Association of Young Researchers, Bor.

These Proceedings 103 papers from the authors coming from the universities, research institutes and industries in 11 countries: Australia, USA, Brazil, Spain, Portugal, Libya, Italy, Bulgaria, Bosnia and Herzegovina, North Macedonia, and Serbia.

As a part of this year's conference, the 5th Student Session – EcoTERS'23 is being held. We appreciate the contribution of the students and their mentors who have also participated in the conference.

The support of the Gold donor and their willingness and ability to cooperate has been of great importance for the success of the EcoTER'23. The organizing committee would like to extend their appreciation and gratitude to the Gold donor of the conference for their donation and support.

We appreciate the effort of all the authors who have contributed to these Proceedings. We would also like to express our gratitude to the members of the scientific and organizing committees, reviewers, speakers, chairpersons and all the conference participants for their support to the EcoTER'23. Sincere thanks go to all the people who have contributed to the successful organization of the EcoTER'23.

Prof. Snežana Šerbula,

President of the scientific and organizing committee

TABLE OF CONTENTS

Plenary Lecture

- Lidija Mančić, M. E. Rabanal, B. Marinković*
OPTICALLY ACTIVE NANOMATERIALS FOR ENVIRONMENTAL
REMEDICATION 2

Invited Lectures

- Aleksandra A. Jovanović*
THE EXTRACTION OF ACTIVE COMPOUNDS FROM PLANT WASTE:
THE POTENTIAL IN HUMAN AND INDUSTRIAL APPLICATIONS AS
THE CONCEPT OF ZERO WASTE IN THE CIRCULAR ECONOMY 7
- Tanja Brdarić*
ELECTROCHEMICAL ADVANCED OXIDATION PROCESSES FOR
WASTEWATER TREATMENT: RECENT ADVANCES AND
PERSPECTIVES 18
- Mirjana Marković, S. Radmanović, Đ. Čokeša, N. Potkonjak*
HUMIC ACIDS IN THE ENVIRONMENT 30
- Mira Stanković, M. Prokopijević, D. Bartolić, J. Stevanović, F. Andrić, K. Radotić*
ADVANCED OPTICAL TOOLS APPLIED ON HONEY SAMPLES FOR
BEE HEALTH STATUS MONITORING 40
- Dragana Bartolić, M. Nikolić, M. Stanković, M. Prokopijević, M. Algara,
S. Stanković, K. Radotić*
ESTIMATION OF THE ANTIFUNGAL ACTIVITY OF THE TWO
DIFFERENT CARBON DOTS AGAINST *Aspergillus flavus* 47

Conference Papers

Environmental monitoring and impact assessment

- Ana Čučulović, J. Stanojković, R. Čučulović, M. Stanković*
RADIOACTIVITY IN SOIL AND MOSSES FROM THE SPECIAL
NATURE RESERVE OF ZASAVICA IN 2021 56
- Djurdja Petrov, M. Ocokoljić, N. Galečić, D. Skočajić, I. Simović*
Chaenomeles × *superba* 'PINK LADY' IN DESIGNING PRIVATE
GARDENS IN CONDITIONS OF CLIMATE CHANGE 62

Mirjana Đurašević, I. Čeliković, I. Kandić, T. Milanović, A. Samolov, N. Mladenović Nikolić, A. Kandić	
ACTIVITY CONCENTRATIONS OF ^{210}Pb , ^{137}Cs , AND ^{40}K IN WILD MUSHROOMS FROM SERBIA AND THEIR EFFECTIVE DOSE TO INGESTION	69
Jelena Čović, M. Z. Momčilović, M. Randelović	
LANTHANUM IMMOBILIZED ONTO GRAPHENE AS A CATALYST DESIGNED FOR ELECTROCHEMICAL APPLICATIONS	75
Jelena Čović, M. Z. Momčilović, M. Randelović	
NITROGEN DOPED CARBON MICROSPHERES SUPPORTED ONTO MWCNT AS NOVEL ELECTRODE MATERIAL	82
Aleksandra Nesic, S. Meseldzija, M. Momcilovic	
SUSTAINABLE PECTIN MONOLITH CRYOGELS	88
Daniela Djikanović, O. Prodanović, J. Dragišić Maksimović, J. Jovanović, A. Kalauzi, D. Spasojević, K. Radotić	
INVESTIGATION OF SILICA-LIGNIN INTERACTION. APPLICATION OF AFM AND FLUORESCENCE TECHNIQUES	94
Vesna Djikanović, J. Čanak Atlagić, K. Zorić, S. Andjus, M. Ilić, V. Nikolić, K. Jovičić	
COMPOSITION OF THE FISH COMMUNITY OF THE RIBNICA RIVER WITH RESPECT TO THE CONSERVATION STATUS	99
Nikola Marinković, B. Tubić, A. Atanacković, N. Popović, J. Tomović, M. Raković, M. Paunović	
INDICATIVE ECOLOGICAL STATUS ASSESSMENT OF RIBNICA RIVER (KOLUBARA BASIN) BASED ON AQUATIC MACROINVERTEBRATES	104
Tamara Petronijević, I. Kostić Kokić, T. Anđelković, B. Zlatković, K. Kitanović, D. Bogdanović, N. Stanković	
INFLUENCE OF FREEZING ON NITRATE AND NITRITE CONTENT IN RADISH, PARSLEY LEAF AND CELERY ROOT	109
Marija Matić, D. Pavlović, V. Perović, D. Sekulić, N. Radulović, M. Mitrović, P. Pavlović	
DETERMINATION OF PTEs CONTENT IN LIVESTOCK FODDER AND SOIL IN THE VICINITY OF THERMAL POWER PLANTS AND ASH DISPOSAL SITES	115
Sonja Veljović Jovanović, S. Milić Komić, B. Živanović, A. Sedlarević Zorić, N. Šušić	
LEAF NITROGEN BALANCE INDEX USED TO MONITOR STRESS RESPONSE TO AIR POLLUTION OF DECIDUOUS TREE SPECIES GROWN IN URBAN ZONE OF BELGRADE	122

Bojana Živanović, S. Milić Komić, A. Sedlarević Zorić, A. Jelušić, N. Šušić, S. Marković, S. Veljović Jovanović	
USE OF BIOCHEMICAL METHODS FOR ASSESING OXIDATIVE STRESS IN TREES IN URBAN AREA DURING GROWING SEASON	129
Nikola Šušić, S. Milić Komić, B. Živanović, A. Jelušić, S. Marković, A. Sedlarević Zorić, S. Veljović Jovanović	
ACCLIMATION OF PEDUNCULATE OAK SEEDLINGS TO DIFFERENT LIGHT CONDITIONS IN THE FIRST MONTHS AFTER GERMINATION	135
Božica Vasiljević, J. Đuknić, N. Marinković	
BENTHIC DIATOMS AS PROXY FOR THE ECOLOGICAL CONDITIONS OF THE RIBNICA RIVER, SERBIA	141
Milanka Negovanović, L. Kričak, S. Milanović, J. Marković, N. Simić, S. Ignjatović	
BLASTING MATS FOR THE PROTECTION OF PEOPLE, STRUCTURES AND THE ENVIRONMENT IN PROXIMITY TO THE BLAST SITE	147
Aleksandra Kolarski, V. Srečković, Z. Mijić	
INFLUENCES OF EXTREME SOLAR ACTIVITY ON EARTH ENVIRONMENT – CASE STUDY	154
Maja Poznanović Spahić, A. Gulan, D. Spahić, P. Tančić, S. Sakan, S. Petrović	
AVAILABILITY OF TOXIC ELEMENTS IN ROADSIDE SOILS (HIGHWAY 75, VOJVODINA, SERBIA): IS THERE ANY SIGNIFICANT CONTAMINATION RISK?	160
Tanja Kalinović, A. Radojević, J. Kalinović, J. Milosavljević, S. Šerbula	
MULTICRITERIA EFFICIENCY ASSESSMENT OF THE PINE TREE POTENTIAL FOR THE PHYTOREMEDIATION OF COPPER	167
Žaklina Tasić, M. Petrović Mihajlović, A. Simonović, M. Radovanović, M. Antonijević	
ELECTROCHEMICAL SENSING OF FOLIC ACID	173
Vanja Trifunović, S. Milić, Lj. Avramović, M. Antonijević, M. Radovanović	
POTENTIAL ENVIRONMENT POLLUTANT – INTERMEDIATE PRODUCT OF THE STEEL PRODUCTION PROCESS	179
Natalija Ognjanović, V. Nedelkovski, S. Stanković, S. Milić	
BIOPESTICIDES IN THE ENVIRONMENT	185
Urban and industrial ecology	
Goran Milentijević, M. Agatonović, M. Rančić, M. Milosavljević	
ENVIRONMENTALLY ACCEPTABLE PROCEDURE FOR THE SYNTHESIS OF TETRAETHYLTHIURAMMONOSULFIDE TETS	191

<i>Andela Stojić, D. Tanikić, E. Požega</i>		
TECHNOLOGICAL PROCESSES AS SOURCES OF POLLUTION IN THE ENVIRONMENT		198
<i>Aleksandar Lisica, N. Stojanović, M. Veselinović, J. Petrović, N. Stavretović, M. Tešić</i>		
LONDON PLANE (<i>Platanus × acerifolia</i> (Aiton) Willd.) IN THE STREET TREE LINES OF THE OLD TOWN IN BELGRADE		203
<i>Djordja Petrov, M. Ocokoljić, N. Galečić, D. Skočajić</i>		
APPLICATION OF SPECIES OF THE GENUS <i>Parthenocissus</i> L. IN URBAN GREEN INFRASTRUCTURE – STATE AND PERSPECTIVES		210
<i>Djordja Petrov, M. Ocokoljić, N. Galečić, D. Skočajić, I. Simović</i>		
SECOND FLOWERING OF <i>Philadelphus coronarius</i> L. IN GREEN-BLUE INFRASTRUCTURE OF BELGRADE		216
<i>Dragana Pavlović, M. Matić, V. Perović, O. Kostić, D. Sekulić, M. Mitrović, P. Pavlović</i>		
EFFECTS OF SO ₂ AND NO ₂ ON THE PHOTOSYNTHETIC EFFICIENCY AND CATALASE ANTIOXIDATIVE ENZYME ACTIVITY IN <i>Betula pendula</i> Roth		222
<i>Ermenegilda Vitale, P. Napoletano, C. Arena, A. De Marco</i>		
PLANT-SOIL RELATIONSHIPS IN MEDITERRANEAN SPECIES GROWN ON TECHNOSOLS ENRICHED WITH COMPOST		228
Air, water and soil pollution, prevention and control		
<i>Milica Blažić, M. Milovanović, T. Sekulić, V. Stupar, Z. Živković</i>		
IMPACTS OF PESTICIDE APPLICATION ON THE ENVIRONMENT		235
<i>George Vuković, D. Kovačević, N. Đorđević, M. Perić, S. Knežević, M. Nikolić, B. Vlahović, V. P. Pavlović, G. Rašić, S. Nenadović, M. Ivanović, M. Mirković, V. B. Pavlović</i>		
GREEN SYNTHESIS OF GEOPOLYMER-POLYURETHANE COMPOSITES FOR EM SHIELDING		241
<i>Ana Vukmirović, B. Obrovski, S. Vukmirović, I. Mihajlović</i>		
APPLICATION OF STATISTICAL METHODS FOR THE ANALYSIS OF WASTEWATER TREATMENT PLANT EFFICIENCY		247
<i>Ivana Mihajlović, A. Hgeig, N. Živančev, M. Petrović, M. Novaković</i>		
COMPARISON OF DIFFERENT SORBENTS IN THE HERBICIDE REMOVAL FROM WATER		251
<i>Aleksandar Krstić, I. Bracanović, D. Vasić Anićijević, A. Kalijadis</i>		
VALLME PREPARATION METHOD FOR THE DETERMINATION PHARMACEUTICALS IN WATER		256

Marija Koprivica, J. Petrović, J. Dimitrijević, M. Ercegović, M. Simić, M. Grubišić REMOVAL EFFICIENCY OF HEAVY METAL IONS FROM AQUEOUS SOLUTION WITH WASTE TREE BIOMASS HYDROCHARS	261
Nevena Surudžić, D. Spasojević, M. Stanković, M. Spasojević, R. G. A. Elgahwash, R. Prodanović, O. Prodanović HORSE RADISH PEROXIDASE IMMOBILIZATION WITHIN MICRO-BEADS OF OXIDIZED TYRAMINE-ALGINATE FOR PHENOL REMOVAL FROM WASTEWATER	267
Dragica Spasojević, O. Prodanović, N. Surudžić, D. Djikanović, J. Simonović Radosavljević, K. Radotić, R. Prodanović WASTEWATER TREATMENT BY AMINATED PEROXIDASE IN ALGINATE HYDROGEL	272
Branislava Matić, M. Milić CONTRIBUTION OF INSTITUTE OF PUBLIC HEALTH OF SERBIA IN MONITORING TRAFFIC-INDUCED AIR POLLUTION IN BELGRADE	276
Nenad Malić, U. Matko, M. Trbić, R. Pijunović, M. Marković ALTERNATIVE METHODS OF REHABILITATION (SOIL RECOVERY), RECLAMATION AND REMEDIATION OF MINE TECHNOSOLS	283
Snežana B. Simić, K. A. Markeljić PRELIMINARY ECOLOGICAL STATUS ASSESSMENT OF THE GROŠNICA RIVER BASED ON PHYTOBENTHOS	289
Snežana B. Simić, N. B. Đorđević AN ASSESSMENT OF THE ECOLOGICAL POTENTIAL OF ŠUMARICE RESERVOIRS (CENTRAL SERBIA) BASED ON PHYTOPLANKTON	295
Miloš Prokopijević, M. Stanković, D. Bartolić, A. Lj. Mitrović, K. Radotić FLUORESCENCE CHARACTERISATION OF BISPENOL A IN VARIOUS SOLVENTS AND DRINKING WATER	302
Slobodan Ničković, L. Ilić, S. Petković, G. Pejanović, A. Huete, Z. Mijić NOVEL APPROACH IN AIRBORNE POLLEN DISPERSION MODELLING	306
Nena Velinov, S. Najdanović, M. Petrović, M. Radović Vučić, M. Kostić, J. Mitrović, A. Bojić THE APPLICATION OF SORBENT SYNTHESIZED USING ULTRASOUND FOR REMOVAL OF TEXTILE DYE	312
Milica Petrović, S. Najdanović, N. Velinov, S. Rančev, D. Radivojević, M. Radović Vučić, A. Bojić ATMOSPHERIC PRESSURE CORONA PLASMA DEGRADATION OF REACTIVE ORANGE 4 IN DEIONIZED AND RIVER WATER	318

Slobodan Najdanović, M. Petrović, N. Velinov, M. Kostić, J. Mitrović, D. Bojić, A. Bojić	
THE INFLUENCE OF TYPE OF SOLVENT ON THE ELECTROCHEMICALLY SYNTHESIZED SORBENTS BASED ON BASIC BISMUTH NITRATES	324
Milena Dimitrijević, S. Kovačević, U. Jovanović, M. Stanić, M. Opačić, I. Santrač, M. Tanović, V. Čurić, I. Spasojević	
APPLICATION OF MICROALGA <i>Chlorella sorokiniana</i> IN WASTEWATER BIOREMEDIATION – CASE OF LAKE ROBULE	330
Milan Gorgievski, M. Marković, N. Štrbac, V. Grekulović, M. Zdravković	
ADSORPTION ISOTHERMS FOR COPPER IONS BIOSORPTION ONTO ONION PEELS	335
Sonja Stanković, V. Nedelkovski, M. Radovanović, S. Milić	
MECHANISM AND KINETICS OF ELECTROCATALYTIC OXIDATION OF PHENOL	341
Jelena Milosavljević, S. Šerbula, A. Radojević, T. Kalinović, J. Kalinović	
ECOENZYMATIC STOICHIOMETRY AS AN EMERGING METHOD IN THE ASSESSMENT OF SOIL HEAVY METAL POLLUTION	348
Protection and preservation of natural resources	
Mihajlo Stanković	
ORCHIDS OF THE ZASAVICA SPECIAL NATURE RESERVE	354
Gordana Šekularac, M. Aksić, T. Dimitrijević (ex. Ratknić), M. Vranešević, N. Gudžić, M. Ratknić	
CLIMATIC BALANCE OF THE WATER FOR THE SOIL OF THE KRUŠEVAC REGION IN CENTRAL SERBIA	361
Gordana Šekularac, M. Aksić, T. Dimitrijević (ex. Ratknić), M. Vranešević, S. Gudžić, N. Gudžić, M. Ratknić	
INFLUENCE OF IRRIGATION METHOD ON THE OCCURRENCE AND INTENSITY OF THE GRAY MOLD OF LETTUCE	367
Aleksandar Stevanović, T. Sekulić, M. Blažić, N. Radić, A. Popović, V. Stupar	
THE IMPACT OF IRRIGATION ON THE QUALITY OF THE ENVIRONMENT AND WATER RESOURCES	373
Aleksandar Stevanović, M. Saulić, M. Blažić, V. Stupar, D. Stojićević, Z. Živković	
BIOPREPARATIONS IN THE FUNCTION OF ORGANIC AGRICULTURE IN FRUIT GROWING AND VITICULTURE	379
Vladanka Stupar, T. Sekulić, M. Blažić, N. Radić, A. Popović, A. Stevanović	
IRRIGATION – IMPACT ON SOIL AS AN ENVIRONMENTAL FACTOR	385

Milan Nedeljković, S. Mladenović, J. Petrović	
A RENEWABLE ENERGY SOURCES AND SUSTAINABLE DEVELOPMENT EQUATION	391
Ecological ethics and environmental education	
Tatjana Miljojčić	
FORGING A SUSTAINABLE FUTURE: THE CIRCULAR ECONOMY IN THE FASHION INDUSTRY	396
Ecotoxicology and environmental safety	
Darko Anđelković, M. Branković	
CITRATE BUFFERED QuEChERS vs SIMPLIFIED SAMPLE PREPARATION METHOD: COMPARATIVE LC/MS ANALYSIS OF PESTICIDES IN APPLES	402
Darko Anđelković, M. Branković	
APPLICABILITY OF THE QuEChERS IN NON-CHROMATOGRAPHY-BASED PESTICIDE ANALYSIS IN APPLES	407
Darko Anđelković, M. Branković	
ESI vs APCI IN SELECTED PESTICIDES MS DETECTION IN APPLES	413
Tamara Petronijević, I. Kostić Kokić, Dj. Milošević, M. Stojković Piperac, N. Stanković, T. Anđelković	
DIFFERENT GROWTH RESPONSES OF SELECTED REPRESENTATIVES OF PHYTOPLANKTON TO THE PRESENCE OF THE ANTIBIOTIC VANCOMYCIN	420
Tamara Petronijević, I. Kostić Kokić, T. Anđelković, B. Zlatković, D. Stajić, D. Bogdanović, N. Stanković	
DETERMINATION OF SEVEN ANIONS IN WATER LETTUCE GROWN IN A NATURAL UNPOLLUTED HABITAT BY ION CHROMATOGRAPHY	426
Milica Zdravković, V. Grekulović, N. Štrbac, J. Suljagić, I. Marković, M. Gorgievski, M. Marković	
THE COPPER CORROSION IN CHLORIDE MEDIUM WITH ADDITION OF BLACKBERRY LEAF EXTRACT	432
Hazardous materials and green technologies	
Aleksandra A. Jovanović, M. R. Elferjane, M. Gnjatović, B. Bugarski, A. Marinković	
PHOSPHOLIPID LIPOSOMES AS A CARRIER FOR ALOE VERA WASTE EXTRACT	438

Aleksandra A. Jovanović, M. R. Elferjane, M. Milošević, M. Gnjatović, A. Marinković	
Vaccinium myrtillus LEAF WASTE EXTRACTS WITH NATURAL DEEP EUTECTIC SOLVENT	444
Danijela Kovačević, N. Đorđević, S. Glišić, B. Vlahović, V. B. Pavlović	
MORPHOLOGICAL INVESTIGATION OF PVDF/MAGNETITE@NC/BaTiO ₃ SEMI-SPHERICAL COMPOSITE MATERIALS FOR OIL REMOVAL	450
Branislava Savić, D. Aćimović, M. Ječmenica Dučić, M. Simić, D. Vasić Anićijević, T. Brdarić	
DEGRADATION OF PHENOL AND SUBSTITUTED PHENOLS: INFLUENCE OF APPLIED POTENTIAL	456
Marija Ječmenica Dučić, D. Aćimović, B. Savić, M. Simić, A. Krstić, D. Vasić Anićijević, T. Brdarić	
DEGRADATION OF DYES MIXTURE BY ELECTROCHEMICAL OXIDATION USING STAINLESS STEEL ELECTRODE	460
Marija Simić, D. Aćimović, B. Savić, M. Ječmenica Dučić, I. Perović, D. Vasić Anićijević, T. Brdarić	
THE OXYGEN EVOLUTION REACTION AT TIN DIOXIDE-CARBON-BASED ELECTRODES	465
Drita Abazi Bajrami, M. Marinkovski, K. Lisichkov, S. Kuvendziev	
OPTIMIZATION OF THE <i>Helichrysum arenarium</i> EXTRACT OBTAINED WITH ULTRASOUND-ASSISTED EXTRACTION	469
Berina Sejdinović	
VIBRATION ISOLATION	475
Uroš Stamenković, I. Marković	
THE INFLUENCE OF AGEING ON THE THERMAL PROPERTIES AND MICROSTRUCTURE OF THE EN AW-6082 GREEN ALUMINIUM ALLOY	482
Ljubiša Balanović, D. Manasijević, I. Marković, U. Stamenković, M. Petrić	
MICROSTRUCTURAL AND THERMAL CHARACTERIZATION OF Bi-Sb-Sn ALLOYS FOR ECOLOGICAL APPLICATION	488
Vladan Nedelkovski, S. Stanković, M. Radovanović, Ž. Tasić, S. Milić	
OPTIMIZATION OF PHENOL ELECTROCHEMICAL OXIDATION USING MODIFIED Ti/SnO ₂ -TYPE ANODES	494
Aleksandar Cvetković, Ž. Tasić, M. Petrović Mihajlović, A. Simonović, M. Radovanović, M. Nujkić, M. Antonijević	
INFLUENCE OF SUBSTITUTES ON THE EFFICIENCY OF ORGANIC CORROSION INHIBITORS	500

Sonja Stanković, M. Nujkić, Ž. Tasić, D. Medić, A. Papludis, S. Milić	
MODIFIED MEMBRANES WITH GRAPHENE OXIDE – REMOVAL OF DYES FROM WASTEWATER	506
Human and ecological risk assessment	
Olga Kostić, D. Pavlović, M. Marković, Z. Miletić, N. Radulović, M. Mitrović, P. Pavlović	
HUMAN HEALTH RISK ASSESSMENT OF PTE _s IN ELECTROFILTER ASH AND CHRONOSEQUENCE FLY ASH FROM “TENT A” DISPOSAL SITES	512
Agriculture: nutrition, organic food and health impacts	
Markola Saulić, V. Trajić, D. Stojićević, A. Stevanović, Z. Živković	
EFFECT OF EXTRACT <i>Ecklonia maxima</i> ON CONDITION OF AGRICULTURAL CROPS	519
Metodi Mladenov	
SUITABILITY OF THE SOILS IN THE MUNICIPALITY OF KOVACHEVTSI, BULGARIA FOR GROWING ON EINKORN WHEAT (<i>Triticum monococcum</i>)	524
Gorica Cvijanović, V. Stepić, M. Bajagić, V. Cvijanović, J. Marinković, N. Đurić	
INFLUENCE OF EFFECTIVE MICROORGANISMS ON THE BASIC PARAMETERS OF SOIL BIOGENICITY IN THE PRODUCTION OF WHEAT AND CORN	529
Vojkan Miljković, R. Ljupković, M. Miljković	
APPLICATION OF CLASSIC THIN LAYER CHROMATOGRAPHY METHOD FOR QUALITATIVE DETERMINATION OF SYNTHETIC FOOD COLORS	535
Alternative energy: efficiency and environmental policy	
Snežana Brković, N. Zdolšek, I. Perović, G. Tasić, M. Seović, S. Mitrović, J. Georgijević	
NOVEL CARBON MATERIAL FOR OER IN VARIOUS ELECTROLYTE SOLUTIONS	540
Nikola Zdolšek, I. Perović, S. Brković, M. Seović, J. Georgijević, S. Mitrović, P. Laušević	
THE EFFECT OF DIFFERENT TYPE OF ELECTROLYTES ON THE DISCHARGE CAPACITY OF Zn-AIR BATTERIES	545
Jelena Georgijević, J. Milikić, N. Zdolšek, I. Perović, S. Brković, S. Mitrović, B. Šljukić	
IRON, COBALT DUAL DOPED CARBON ELECTROCATALYST FOR EFFICIENT WATER SPLITTING	550

Greenhouse effect and global climate change

- Tatjana Dimitrijević, G. Šekularac, M. Ratknić, M. Aksić**
EFFECTS OF CLIMATE CHARACTERISTICS ON THE DIAMETER INCREMENT OF RED OAK IN THE CITY OF BELGRADE (SERBIA) 555
- Milica Blažić, T. Sekulić, V. Stupar, Z. Živković**
GREENHOUSE EFFECT AND GLOBAL CLIMATE CHANGE – IMPACT ON AGRICULTURE 561
- Vojkan Miljković, I. Gajić, Lj. Nikolić**
GLOBAL CLIMATE CHANGES: GREENHOUSE GASSES, CITIES AND PLASTICS 567

Sustainable development and green economy

- Zlata Živković, M. Saulić, D. Stojićević, M. Jevtić, V. Stupar**
ROLE OF NUTRIENTS IN CONTROLLING PLANT DISEASES AND PATHOPHYSIOLOGICAL ALTERATIONS IN PLANTS IN SUSTAINABLE AGRICULTURE. A REVIEW 572
- Zlata Živković, M. Saulić, D. Stojićević, M. Jevtić**
THE WAY OF MANAGING PLANT DISEASES IN SUSTAINABLE AGRICULTURE 578
- Dragan Ugrinov, M. Nikolić**
THE ROLE OF PLANTS IN BIOECONOMY AND CIRCULAR ECONOMY 584
- Vojkan Miljković, I. Gajić, Lj. Nikolić**
AGRICULTURAL WASTE IN SUSTAINABLE AGRICULTURE 589
- Ana Radojević, J. Milosavljević, S. Šerbula, T. Kalinović, J. Kalinović**
RECYCLING OF Li-ION BATTERIES FROM THE END-OF-LIFE VEHICLES: OPPORTUNITY OR LIABILITY IN THE FUTURE? 593

Environmental biology

- Vladimir Topalović, S. Matijašević, V. Savić, J. Nikolić, J. Stojanović, S. Zildžović, S. Grujić**
CRYSTALLIZATION CHARACTERISTICS OF BIOACTIVE POLYPHOSPHATE GLASSES 599

Environmental and material flow management

- Isidora Berežni, T. Marinković, B. Batinić**
ASSESSING THE COMPOSITION OF MUNICIPAL SOLID WASTE IN ŠID 605

Ivan Bracanović, A. Krstić, A. Kalijadis

SYNTHESIS AND CHARACTERISATION OF CARBON NANOMATERIAL USING HYDROTHERMAL CARBONISATION METHOD

612

Hamid Husić, S. Čerčić, V. Aganović

RETROSPECTIVE OF THE PLANNED ACTIVITIES FOR THE REHABILITATION OF THE DAMAGED AREA OF THE FORMER SURFACE MINE ČUBRIĆ

617

Student Section

Students: Ana Smiljković, Isidora Sujić (Serbia)

Mentor: Maja Nujkić (Serbia)

ENVIRONMENTAL AND HEALTH RISK OF CO₂ IN INDOOR ENVIRONMENTS

624

Student: Avram Kovačević (Serbia)

Mentor: Uroš Stamenković (Serbia)

ANTHROPOGENIC MERCURY IN THE ENVIRONMENT: GLOBAL EMISSIONS AND RECYCLING POSSIBILITIES

626

Student: Petar Milanović (Serbia)

Mentors: Uroš Stamenković, Avram Kovačević (Serbia)

THE INFLUENCE OF COOLING RATE ON MECHANICAL PROPERTIES AND MICROSTRUCTURE OF C45 CARBON STEEL

628

Student: Milica Denić (Serbia)

Mentor: Jelena Kalinović (Serbia)

AIR POLLUTION WITH CARCINOGENIC SUBSTANCES

630

Student: Gordan Mišić (Serbia)

Mentor: Jelena Kalinović (Serbia)

ACID RAIN AND SMOG – CHEMICAL REACTIONS

632

Student: Milica Denić (Serbia)

Mentor: Ana Radojević (Serbia)

MEDICAL WASTE MANAGEMENT

634

Student: Gordan Mišić (Serbia)

Mentor: Ana Radojević (Serbia)

ENVIRONMENTAL POLLUTION BY PET PACKAGING

636

Student: Marija Stanković (Serbia)

Mentor: Ana Simonović (Serbia)

COPPER CORROSION IN ARTIFICIAL ACID RAIN SOLUTION IN PRESENCE OF 5-PHENYL-1-TETRAZOLE

638

BIOPESTICIDES IN THE ENVIRONMENT

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Abstract

Pesticides are substances intended for the prevention, destruction, suppression or reduction of pests. The continuous application of pesticides has led to the development of resistance in plant and animal species and the transfer of microelements through treated plants to the bodies of humans and animals. This can lead to chronic and acute diseases, and even toxic poisoning. In order to avoid the negative impact of pesticides on plant and animal life and to prevent environmental pollution, researchers suggest the use of biopesticides. Biopesticides are an environmentally friendly alternative to synthetic pesticides. They are obtained from natural materials such as microorganisms (fungi, bacteria, viruses, etc.), plants (extracts from plants) and the animal world (nematodes) and some minerals. This paper provides an overview of scientific research on the use of biopesticides instead of pesticides in order to reduce environmental pollution.

Keywords: pesticides, pollutants, biopesticides, environment.

INTRODUCTION

The pollution of ecosystems by pesticides has occurred due to their increased use in agriculture. Western Europe, North America, and Australia are considered highly polluted areas, where contamination is caused by excessive pesticide use. These regions have high-intensity agriculture. In addition to pesticide pollution, a characteristic of these areas is the loss of habitats for many plant and animal species, resulting from substrate homogenization caused by the widespread use of artificial fertilizers [1]. The use of conventional pesticides and fertilizers over several decades has led to their bioaccumulation, with detrimental effects on soil biodiversity and the development of resistance in pests. With the increasing number of plant and animal species that are resistant to typical pesticides, it becomes imperative for researchers to develop new and more effective biopesticides. The demand for more efficient biological pesticides has been growing worldwide in recent years. Due to the various undesirable effects of pesticide application, researchers aim to develop more effective biopesticides that would have targeted efficacy while minimizing harm to non-targeted species and the overall environment. Some authors believe that the use of nanotechnology in the production of biopesticides could enable adequate treatments for targeted species [2].

PESTICIDES AS ENVIRONMENTAL POLLUTANTS

Pesticides represent a group of chemical substances whose application in agriculture is based on the eradication of harmful organisms. The main mechanisms of pesticide action are biomagnification and bioaccumulation [3]. Pesticides are used in agriculture for their protective role against certain plant crops. Their protective function consists of destroying, preventing, or controlling the growth of pests, including insects, rodents, and specific animal species. They also prevent unwanted plant growth, which, together with insects, negatively affects crop yields or damages specific plant species [4]. Pesticides often have a negative impact on the quality and quantity of food produced from plants treated with these chemicals, despite being applied to protect certain plant species. The increased presence of pesticides and other harmful chemicals adversely affects the functioning of organs in all living organisms [3].

Environmental pollutants are toxic substances that contaminate and negatively affect the living world, resulting from industrialization and intensive agriculture [5]. Figure 1 illustrates the movement of pesticide residues in nature. Residual pesticide particles, carried by air and water, can pollute plant and animal life that is not in proximity to the treated crops. Additionally, the retention of pesticide residues in the soil can be toxic to other organisms. The circulation of pesticide residues in nature, through air, groundwater, and surface water, leads to contamination of the entire environment and all living beings within it [6].

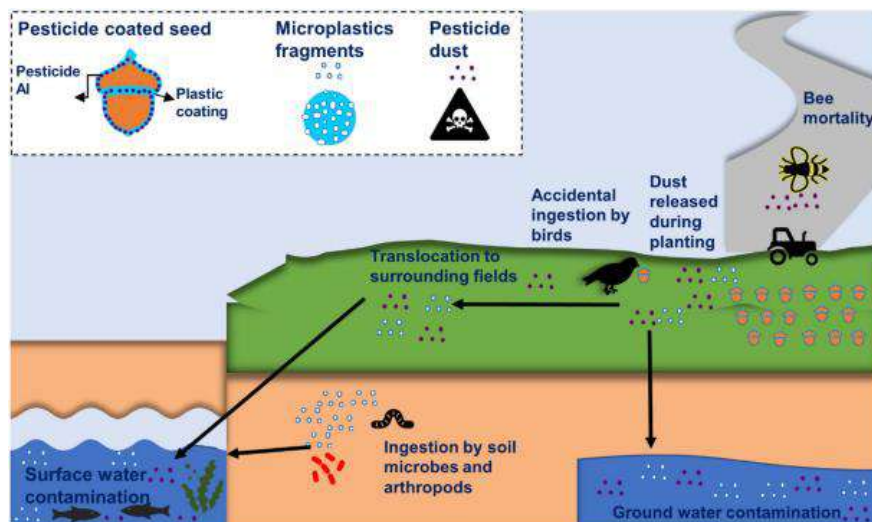


Figure 1 Schematic representation of pollutant movement in the environment [6]

It is crucial to accurately assess the current and future ecological state of an environment, as well as the ecotoxicological effects that impact it. This is commonly done by determining the concentrations of specific pollutants in a given environment. Numerous studies have been conducted, using various types of plants, insects, and animals as bioindicators of environmental pollution. When bioindicators are exposed to pesticides, they are simultaneously subjected to significant stress, resulting in morphological and physiological changes, as well as alterations in their behaviour [5]. Figure 2 depicts the environmental circulation of pesticides applied to a specific plant species through the air, water, and soil.

According to the authors Khursheed *et al.* [7], pesticide application leads to contamination of the entire ecosystem.

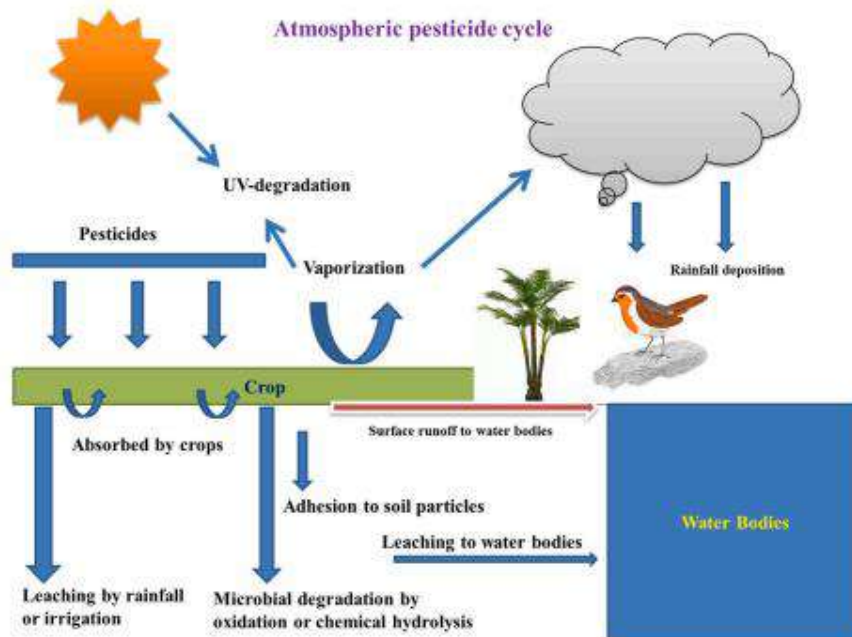


Figure 2 Ecologic cycle of conventional pesticides [7]

BIOPESTICIDES IN THE ENVIRONMENT

The mode of action of a biopesticide is crucial for its effectiveness and commercial success. Synthetic pesticides typically consist of a single chemical with specific effects, while biopesticides have more complex mechanisms of action. Biopesticides contain both chemical and biochemical components that modify and control the biochemical, genetic, or structural functions of targeted pests (Figure 3). A large number of biopesticides are composed of bacteria, such as *Bacillus thuringiensis* (Bt), entomopathogenic fungi like *Beauveria bassiana* and *Metarhizium anisopliae*, viruses, single-celled eukaryotes, or entomopathogenic nematodes (EPN). Some biopesticides are derived from microorganisms, such as the neurotoxic insecticide Spinosad, which consists of spinosyns A and D obtained through fermentation of the actinomycete Spinosad, or they can be derived from plants. EF and EPN act by attacking insects through the cuticle, penetrating the host's body, where they reproduce and ultimately kill the host insect, considered a pest. Bacterial control agents, microbial and plant-based products like Spinosad and azadirachtin, are activated after ingestion or through contact, causing rapid death in a wide range of insect pests [8].

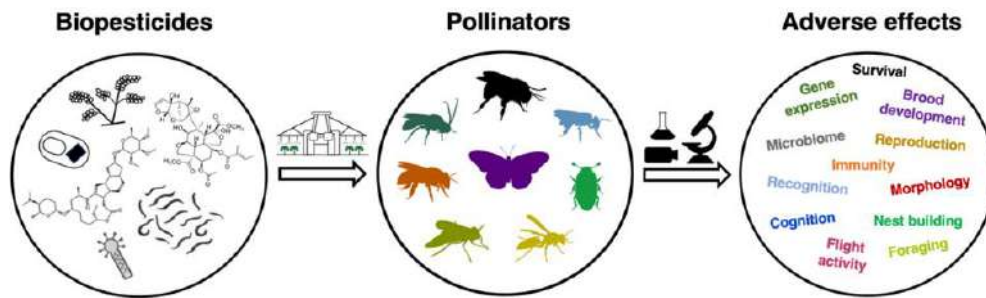


Figure 3 The impact of biopesticides on target species and the harmful effects resulting from their application [8]

Implementation of various sorts of biopesticides aiming to reduce environmental pollution

Numerous studies show that synthetic pesticides, which are predominantly used in agriculture, are toxic to non-target plant and insect species, as well as other surrounding organisms, animals, and even humans. Simply put, the entire ecosystem is poisoned by the application of chemical pesticides. Moreover, certain species have developed and continue to develop increasing resistance to synthetic pesticides. By accumulating these chemicals in their bodies, they survive and thrive despite pesticide contamination. Biopesticides are defined as a type of pesticide derived from natural raw materials, such as plants, bacteria, fungi, animals, minerals, etc. They represent an alternative to synthetic pesticides, providing a more natural and healthier solution for the surrounding living world. Biopesticides are more environmentally friendly and serve the same purpose as synthetic pesticides: controlling unwanted plant species, insects, animals, as well as protecting crops from diseases such as viruses, bacteria, fungal infections, and more. In a study conducted by Adhikari and colleagues [9], the efficacy of biopesticides and their impact were evaluated by applying them to potato tubers in order to manage and control the population of moth insects. The biopesticides used in the experiment were *Bacillus thuringiensis*, *Acorus calamus*, *Azadirachta indica*, and *Artemisia vulgaris*. *Bacillus thuringiensis* is a gram-positive bacterium found in the soil and commonly used as a biological insecticide. *Acorus calamus*, also known as sweet flag or calamus, yields essential oil through distillation and is used in the production of plant protection products against insects and parasites. *Azadirachta indica*, commonly known as neem, has strong antiviral, antifungal, and antibacterial properties. *Artemisia vulgaris*, also known as mugwort or black sage, is used in the production of bioherbicides.

During the experiments, the potato tubers were first coated with solutions of biopesticides, *Bacillus thuringiensis*, *Acorus calamus*, *Azadirachta indica*, and *Artemisia vulgaris*, and then bioinsecticides in powder form were applied over the potato tubers. Testing on samples of different potato varieties using the bioinsecticide *Acorus calamus* demonstrated significant effectiveness [9]. Control research indicates that larval mining was reduced by 88%, while decay loss of the tubers was reduced by 93%. Figure 4 shows a visible difference in the degree of damage to the tubers after treatment with different bioinsecticides: (a) *Azadirachta indica*, (b) *Acorus calamus*, (c) *Bacillus thuringiensis*, (d) *Artemisia vulgaris*,

and (e) the untreated control sample, which serves as a comparison to the controlled test samples.

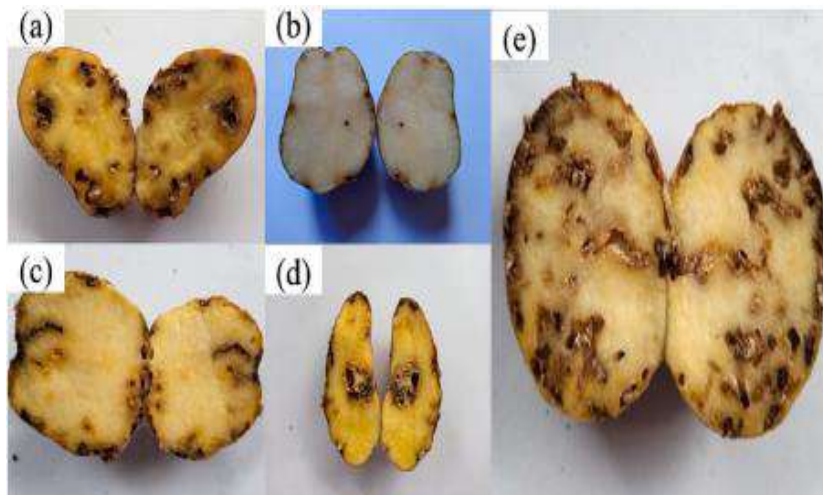


Figure 4 Samples of different degrees of tuber damage after treatment with bioinsecticides: (a) *Azadirachta indica*, (b) *Acorus calamus*, (c) *Bacillus thuringiensis*, (d) *Artemisia vulgaris*, (e) untreated control sample [9]

The research results of Adhikari *et al.* [9] confirmed that the applied biopesticides can be used as alternatives to synthetic pesticides in order to control moths. Their study presented the effects of different types of biopesticides on moth pests in three different regions of Nepal. However, the investigations also confirmed that these biopesticides cannot be used independently, as their effectiveness is lower compared to synthetic pesticides.

CONCLUSION

The mechanism of action of biopesticides is not easily determined experimentally because plants possess numerous enzymes and proteins that affect the target species in various ways. Biopesticides, in fact, still require additional research and investigation to more precisely determine their mechanism of action, which is currently insufficiently understood. The advantage of biopesticides lies in their specific activity and their action on a particular type of target species. Some authors argue that biopesticides exhibit a safe level of toxicity and that their impact on the environment is not negative, while others point out a certain level of toxicity associated with biopesticides. The goal of authors involved in the development and design of new-generation biopesticides is the preservation and protection of the environment. However, certain studies indicate that biopesticides also have negative effects on pollinating insects, causing disturbances and diseases in many pollinators. For these reasons, due to incomplete and contradictory analyses by scientists, it is necessary to constantly conduct experiments and research to assess the environmental risks of biopesticides, as well as their impact on the surrounding plant and animal life. Additionally, it is crucial to continually monitor and adhere to specific regulations prescribed for each type of biopesticide, as mandated by law.

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