think green

Workshops for Young Researchers

6TH WORKSHOPS FOR YOUNG RESEARCHERS 2026

BOOK OF ABSTRACTS

Institute of Agrophysics, PAS

17 November 2026



INSTITUTE OF AGROPHYSICS PAS

PAN POLISH ACADEMY OF SCIENCES Lublin Branch

PAN POLISH ACADEMY OF SCIENCES

MOST PAN



Workshops for Young Researchers

6TH WORKSHOPS FOR YOUNG RESEARCHERS BOOK OF ABSTRACTS

6. WARSZTATY DLA MŁODYCH BADACZY - KSIĄŻKA ABSTRAKTÓW

Organisers:

Institute of Agrophysics, Polish Academy of Sciences

Polish Academy of Sciences, Lublin Branch

Co-organisers:

Doctoral School of Quantitative and Natural Sciences

Interdisciplinary Doctoral School of Agricultural Sciences

Lublin, 17.11.2026

Editors: Artur Nosalewicz, Agata Pacek-Bieniek

Book composition: Agata Pacek-Bieniek

Publisher: Institute of Agrophysics, Polish Academy of Sciences, Doświadczalna 4, Lublin 20-290, Poland

ISBN 978-83-68333-00-8

FUNDING

Project co-financed by the Polish Academy of Sciences under the 'MOST PAN' grant scheme.

The workshops are also co-organised with the support of the Polish Academy of Sciences under its Science Dissemination and Promotion Activities programme (UiPDN PAN).





Copyright © 2026 by Institute of Agrophysics, Polish Academy of Sciences
Open Access, Creative Commons Licence CC BY 4.0

Scientific Committee

Dr hab. Aneta Andronowska, prof. IARFR PAS

Dr hab. Artur Nosalewicz, prof. IA PAS

Dr hab. Aleksandra Szcześ, prof. UMCS

Prof. dr hab. Artur Zdunek, Corresponding Member of PAS

Organising Committee

Artur Nosalewicz

Agata Pacek-Bieniek

Jarosław Zdunek

INVITED KEYNOTE LECTURES

Dr Tsvetina Nikolaeva Ilieva-Paparkova | "Nikola Poushkarov" – Agricultural Academy, Bulgaria
"Structural and Hydrological Properties of Epicalcic Chernozems Under Different Land Use"

Dr Víctor Rolo | University of Extremadura, Spain
"The Dehesa: Threats and Opportunities for a Mediterranean Silvopastoral System Paradigm"

Dr María Vivas | University of Extremadura, Spain
"The Relevance of the Microbiota as an Early Marker of Tree and Soil Health for a Sustainable Management of the Dehesa System"

Contents

1. Structural and Hydrological Properties of Epicalcic Chernozems under Different Land Use 7

Paparkova Ts. .....

2. The Dehesa: Threats and Opportunities for a Mediterranean Silvopastoral System Paradigm 9

Rolo V., Vivas M. , Moreno G. .....

3. The Relevance of the Microbiota as an Early Marker of Tree and Soil Health for a Sustainable Management of the Dehesa System 10

Vivas M., Rolo V., Moreno G. .....

4. Mediator Recruitment Defines ARF Activation 12

Hernandez-Garcia J., Dipp-Alvarez M., de Roij M., Guillem-Bernal M., Roosjen M., Baltaci Z., Smith H.W., Pereira D., Borst J.W., Holehouse A.S., Lee H.O., Weijers D. .....

5. Insights into Diversity Versus Compositional Effects of Pesticide Mixtures on Soil Microbial Functions and Community Dynamics 13

Mei S., Lewak K., Sura-de Jong M., Salles J.F. .....

6. Tracking Water Losses from Paddy Fields Using Chemical Mass Balance and Digital Filtering 15

Navas R., Zubelzu S. .....

7. Wastewater-derived Organic Matter and Bisphenol A Complexation: Implications for Agricultural Water Reuse 18

Paolella G., Fabbricino M., Locascio A., Boguta P. .....

8. Fava Bean-winter Wheat Intercropping Promotes the Yield Intensification and the Ecosystem Service Provision Under Zero-N Conditions 20

Picone R., Gentsch N., Pietramellara G., Guggenberger G., de la Fuente A., Schaks M., Gohlke A., Koza M., Marchetti G., Steinkraus B., Pathan S.I. .....

9. From Halophytes to Wheat: Beyond Classical PGP Traits Toward Ecologically Adapted Microbial Consortia 22

Shahabirokni M., Etesami H., Raheb A., Razavi B.S. .....

10. Influence of Biochar Type and Application Rate on Wettability and Hydraulic Conductivity of Sandy Soil 24

Chandramohan M.S., Šurda P., Vítková J. .....

11. Postharvest Performance, Storage Grain Quality, and Postharvest Losses of Pearl Millet (*Pennisetum glaucum*) and Sorghum (*Sorghum bicolor*) in Semi-arid Ghana: Influence of Farmer Practices, Moisture Status, Storage Insect Pest, and Storage Systems 26

Apuri S., Rosentrater K.A., Kumah P. .....

12. Impact of Seed Inoculation on the Bacterial Community Structure of Coriander Microgreens Revealed by NGS 28

Barańska D., Panek J., Pertile G., Gryta A., Oszust K., Siegieda D., Różalska S., Frąc M. .....

13. Exploring the Diversity of Algerian Carob: Properties and Food Applications .. 30

Bougriou N., Bujor O., Benatallah L., Ion V., Brahmi N., Petre A., Zugravu M., Dobrin A., Zdunek A. .....

14. Aerobic Metabolism of Organophosphonates as an Environmental Source of Methane 31

Furtak A., Pytlak A., Tkaczyk P., Bieganowski A. .....

15. Mathematical Models for Forecasting Photovoltaic Power Production 33

Hampejs J., Libra M., Beránek V. .....

16. Interplay of pH and Distinct Post-harvest Storage Conditions in Shaping the Structural and Rheological Properties of Apple-derived Pectin Fractions 34

Kalappurackal Muhammadaly S.A., Chibrikov V., Fila-Loranty K., Zdunek A., Cybulska J. .....

17. An Axis-translation Experimental Platform for Investigating Hysteresis of Unsaturated Hydraulic Conductivity 36

Kozyra M., Lamorski K., Sławiński C. .....

18. Role of ABA in Modulating PVY Infection and Aphid Vector Interactions in Tomato 37

Kumari D., Frąckowiak P., Wieczorek P., Obrępalska-Stęplowska A. .....

19. Identification and Comparative Analysis of Hydrophobin Candidates Diversity in Three Entomopathogenic *Akanthomyces* Strains 39

Lenga A., Siegieda D., Panek J., Różalska S., Frąc M. .....

20. From Plant Seeds to Painting Binders: Chemical Composition and Modern Analytical Approaches 41

Licznar K., Dziągwa-Becker M. .....

21. Cadmium Adsorption in Aqueous Solution Using Biochar and Activated Carbons Derived from *Hermetia illucens* 42

Molua E. I., Siryk O., Nowicki P., Bulak P., Szewczuk-Karpisz K. .....

22. **Biochar in Insect Rearing: Opportunities and Limitations** 44

Nycz A., Kaczor M., Krzyżaniak M., Przemieniecki S., Szewczuk-Karpisz K., Bulak P. ....

23. **Determination of the Quantity Characterising the Susceptibility of Soils to Splash Erosion - Doctoral Thesis Concept** 46

Pelczar R., Sochan A. .....

24. **Methane Oxidation Potential in Grassland soils – Preliminary Results of a Laboratory Experiment** 48

Rafalska A., Walkiewicz A. .....

25. **Cold- and Hot-water-extractable Carbon as Complementary Indicators for Soil Organic Carbon Monitoring in Cropland Profiles** 50

Ren T., Debaene G., Ukalska-Jaruga A., Smreczak B. .....

26. **Ecotoxicological Assessment of $NH_{3(aq)}$-modified Biochar: Effects on Early Seedling Development and Ostracods Growth** 51

Sama D.K., Kaczor M., Szewczuk-Karpisz K. .....

27. **Soil Bacterial Communities Under Wheat Monocropping and Intercropping Across Contrasting Production Systems** 53

Sisodia P., Gryta A., Siegieda D., Panek J., Oszust K., Pylak M., Mącik M., Feledyn-Szewczyk B., Pathan S.I., Pietramellara G., Frąc M. .....

28. **Effects of Viral Suppressor of Post-transcriptional Gene Silencing on Three-way Virus-aphid-tomato Interactions. Role of 2b CMV in Modification of Insect Vector Behaviour** 55

Zalewski P., Wieczorek P., Obrępalska-Stęplowska A. .....

Structural and Hydrological Properties of Epicalcic Chernozems under Different Land Use

Paparkova Ts.

Institute of Soil Science, Agrotechnologies and Plant Protection "Nikola Poushkarov", 1331 Sofia, Bulgaria; ts.paparkova@issapp-pushkarov.org

The aim of this study is to assess the structural and hydrological characteristics of Epicalcic Chernozems under different land use conditions, landscape settings, and conventional and conservation agricultural practices. The results for key physical soil quality indicators were statistically analyzed to determine the effects of applied agricultural technology, crop type, season, and sampling depth under the erosion-control field experiment. A methodological approach has been developed for evaluating the impact of soil conservation practices on indicators of the physical quality of Epicalcic Chernozem in a field experiment with winter wheat–maize rotation, including selection of indicators, statistical analyses, and evaluation criteria. The effect of minimum tillage and inclusion of cover crop for erosion control is more pronounced for packing density, relative field capacity, and S index (Dexter) in the wheat–maize–wheat rotation. The maize–wheat–maize rotation shows a stronger effect on water stability of soil aggregates and plant available water capacity (PAWC) due to the double inclusion of a cover crop as green manure before maize. The interaction between biotic and physical soil properties is well illustrated in this rotation through two relationships: between microbial carbon and water-stable aggregates, and between soil organic carbon (SOC) and PAWC. Based on the obtained complex data set of physical quality indicators, a new, lower threshold value of the structural index (SI) has been proposed to distinguish degraded Epicalcic Chernozems from those at high risk of degradation. The evaporation method using a TDR/MUX/mpts (ETEST SP. Z O.O.) System has been tested and applied for simultaneous measurement of soil water potential and moisture for determining water retention and hydraulic conductivity of Epicalcic Chernozems at low matric potential values under unsaturated conditions. The results indicate that no stable improvement in the physical quality of moderately eroded Epicalcic Chernozem can be detected after three years of applying soil conservation technologies. The findings can serve as a basis for assessing long-term changes in the physical quality of Epicalcic Chernozems under sustained implementation of measures aimed at reducing subsoil compaction and erosion on sloping terrains, which are the main degradation processes affecting these soils.

Acknowledgments

The research was carried out thanks to my scientific supervisors, to the management of the Institute of Soil Science, Agrotechnologies and Plant Protection "N. Poushkarov", and to my colleagues from the Department of soil physics, erosion, soil biota for their assistance in conducting the experiments. The funding of the

research activities received was from the National Science Fund under grant agreement КП-06 Н 46/1 from 27/11/2020 (project "Efficiency of erosion control agrotechnologies for improvement of soil quality and water regime and mitigation of greenhouse gas emissions").

Bibliography

Dexter, A.R., 2006. Application of S-theory in tillage research. In: 17th Triennial Conference. Proceedings of ISTRO 17. Christian-Albrechts-University, Kiel, Germany, 429–442. CD-ROM. (ISBN 3-9811134-0-3).

Manual FOM/mts and TDR/MUX/mpts and TDR/MUX/mpts/dlog, v1.41, 2013. Institute of Agrophysics, PAS, Lublin, Poland

The Dehesa: Threats and Opportunities for a Mediterranean Silvopastoral System Paradigm

Rolo V., Vivas M. , Moreno G.

Forest Research Group, INDEHESA, University of Extremadura, 10600, Plasencia, Spain; rolo@unex.es

Southwestern Iberian Peninsula landscapes are dominated by the largest silvopastoral system in Europe, locally called *dehesa* in Spain. This manmade ecosystem, characterized by scattered oak trees within an extensively grazed grassland, has been largely considered as an outstanding example of sustainability due to their social, economical and environmental values. Similarly to other agroecosystems of Europe, many *dehesas* are undergoing a process of either intensification or abandonment with shear consequences in their persistence. Overgrazing, soil erosion, lack of tree regeneration or low economical profitability are among the main threats, that may be magnified in a context of climate change. In this context, there is an increasing need for solutions that could halt the degradation of the ecosystem and simultaneously provide social and economical benefits, the so-called nature based solutions (NBS). However most of these solutions lacks of scientific evidence in a Mediterranean context and those that have been evaluated often focus on a few indicators and overlooks the ecosystem scale. In this work, we provide an overview of the *dehesa,* the main drivers of its degradation and how NBS application, such as adaptive grazing, legume sowing, biochar application or rainwater harvesting, affects dehesa ecosystem functioning. We will go from the effects on soil microbiota and carbon sequestration (Carrascosa et al., 2025) through biomass production and ecosystem fluxes (Carrascosa et al., 2026) and use process based models to optimize tree cover at the landscape level (Fernández-Habas et al., 2026). Overall, nature-based solutions offer an opportunity to improve system sustainability while taking into account biodiversity conservation and human well-being, there is a large number with a lack of evidence on its feasibility and efficacy. These solutions would never be operational without the engagement of the stakeholders.

Acknowledgments

This work was part of the project "DigitAF" (Grant agreement ID: 101059794) funded by European Union's "Horizon Europe" research and innovation program.

Bibliography

Carrascosa, A., Moreno, G., Carrara, A., Nadolski, L., Lee, S.-C., Rolo, V. 2026. Improved management reduces carbon losses in semi-arid grasslands: An analysis of upscaled CO_2 fluxes from portable chambers. Agricultural and Forest Meteorology, 385, 111215.

Carrascosa, A., Moreno, G., Cotrufo, M. F., Frade, C., Rodrigo, S., Rolo, V. 2025. Improved management increases soil mineral-protected organic carbon storage via plant-microbial-nutrient mediation in semi-arid grasslands. Soil, 11(2), 911-937.

Fernández-Habas, J., Moreno, G., Carrascosa, A., López-Díaz, M. L., Carrara, A., Dupraz, C., Eden, J., Gosme, M., Herzog, F., Jarosch, K. A., Lecomte, I., Martín, M. P., Rolo, V. 2026. Climate change adaptation of Iberian dehesa: A simulation approach using the Hi-sAFe model. Agronomy for Sustainable Development, 46(4), 56.

The Relevance of the Microbiota as an Early Marker of Tree and Soil Health for a Sustainable Management of the Dehesa System

Vivas M., Rolo V., Moreno G.

Forest Research Group, INDEHESA, University of Extremadura, 10600, Plasencia, Spain; vivas@unex.es

Plant-associated microbial communities play a fundamental role in host health, development, and ecological interactions (Friesen, 2011; Vannier et al., 2015), serving as key components of the plant's extended phenotype (Vivas et al., 2015) and acting as early indicators of tree vigour (Encinas-Valero et al., 2024). While the influence of land management on soil microbial communities is well documented (e.g. He et al., 2006; Moora et al., 2014), its effect on tree-associated microbiota—spanning both aboveground (foliar) and belowground (root, rhizosphere) compartments—remains poorly understood and how these patterns are related to tree health and vigour. This gap is critical in vulnerable Mediterranean silvopastoral systems like the Dehesa, where increasing tree defoliation is driven by interacting biotic, abiotic, and management stressors intensified by climate change (Carnicer et al., 2011; Godinho et al., 2016).

This work evaluates how land management influences tree health and system resilience, specifically testing the hypothesis that microbial communities mediate these physiological and soil responses (Fig. 1). Employing a multidisciplinary approach combining microbiology, plant ecophysiology, and soil health metrics, our group investigates tree and soil responses across management regimes and contrasting climatic gradients. By characterizing multi-compartment microbial co-occurrence and assemblage, this research aims to identify early functional and microbiological indicators of system health. Ultimately, this work provides critical insights into the functional links sustaining silvopastoral ecosystems, delivering practical innovations to enhance Dehesa resilience and inform climate change adaptation strategies across Mediterranean scattered-tree systems.

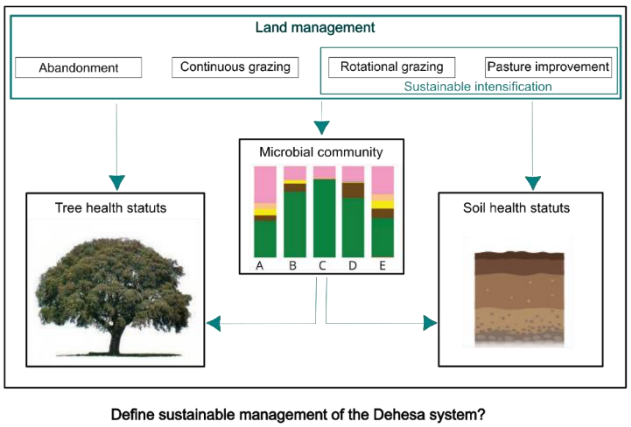


Figure 1. A hypothetical representation of the effects of land management on the microbial communities of the system (soil, root and leaf) and its potential mediating role on the health status of the tree and soil.

Acknowledgments

The research and MV is co-financed 85% by the European Union, the European Regional Development Fund and the Regional Government of Extremadura. Managing Authority: Ministry of Finance. Grant File Number: IB24162.

Bibliography

Carnicer J., Coll M., Ninyerola M., Pons X., Sánchez G., Peñuelas J. 2011. Widespread crown condition decline, food web disruption, and amplified tree mortality with increased climate change-type drought. Proceedings of the National Academy of Sciences of the United States of America, 108, 1474-1478.

Encinas-Valero M., Esteban R., Hereş A.M., Vivas M., Solla M., Moreno G., Corcobado T., Odriozola I., Garbisu C., Epelde L., Curiel Yuste J. 2024. Alteration of the tree–soil microbial system triggers a feedback loop that boosts holm oak decline. Functional Ecology, 38, 374-390.

Friesen M.L., Porter S.S., Stark S.C., vonWettberg E.J., Sachs J.L., Martinez-Romero E. 2011. Microbially mediated plant functional traits. Annual Review of Ecology, Evolution, and Systematics, 42, 23–46.

Godinho S., Guiomar N., Machado R., Santos P., Sá-Sousa P., Fernandes J.P., Neves N., Pinto-Correia T. 2016. Assessment of environment, land management, and spatial variables on recent changes in Montado land cover in southern Portugal. Agroforestry Systems, 90, 177–192.

He J., Xu Z., Hughes J. 2006. Molecular bacterial diversity of a forest soil under residue management regimes in subtropical Australia. FEMS Microbiology Ecology, 55, 38–47.

Moora M., Davison J., Öpik M., Metsis M., Saks Ü., Jairus T., Vasar M., Zobel, M. 2014. Anthropogenic land use shapes the composition and phylogenetic structure of soil arbuscular mycorrhizal fungal communities. FEMS Microbiol Ecology, 90, 609-621.

Vannier N., Mony C., Bittebière A-K., Vandenkoornhuyse P. 2015. Epigenetic mechanisms and microbiota as a toolbox for plant phenotypic adjustment to environment. Frontiers in Plant Science, 6, 1159.

Vivas M., Kemler M., Slippers M. 2015. Maternal effects on tree phenotypes: Considering the microbiome. Trends in Plant Science, 20, 541-544.

Mediator Recruitment Defines ARF Activation

Hernandez-Garcia J.[1,2], Dipp-Alvarez M.[1], de Roij M.[1], Guillem-Bernal M.[2], Roosjen M.[1], Baltaci Z.[3], Smith H.W.[3], Pereira D.[1], Borst J.W.[1], Holehouse A.S.[4,5], Lee H.O.[3], Weijers D.[1]

[1]Laboratory of Biochemistry, Wageningen University, Stippeneng 4, 6708WE Wageningen, the Netherlands

[2]Centro de Biotecnología y Genómica de Plantas, Universidad Politécnica de Madrid (UPM) – Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA/CSIC), Campus de Montegancedo UPM, 28223 Pozuelo de Alarcón, Spain

[3]Department of Biochemistry, University of Toronto, Toronto, Ontario, Canada

[4]Department of Biochemistry and Molecular Biophysics, Washington University School of Medicine, St. Louis, MO, USA

[5]Center for Biomolecular Condensates (CBC), Washington University in St. Louis, St. Louis, MO, USA; j.hernandez@csic.es, dolf.weijers@wur.nl

Auxin-dependent transcription relies on the antagonistic activities of AUXIN RESPONSE FACTORs (ARFs), yet how transcriptional activation is molecularly specified remains unclear. Here, we identify a minimal region within the intrinsically disordered middle region of an A-class ARF that is necessary and sufficient for transcriptional activation. This region mediates selective recruitment of the Mediator complex, thereby establishing a mechanistic link between ARF identity and co-activator engagement. Beyond simple recruitment, we show that ARFs form subnuclear condensates that selectively partition distinct cofactors: activator ARFs enrich Mediator, whereas repressor ARFs concentrate the co- repressor TOPLESS. This spatial segregation depends on the presence of our newly found activation domain and is consistent with some kind of phase separation-driven organization of transcriptional complexes. Strikingly, transfer of the activator region into a repressive B-class ARF is sufficient to reprogram it into an activator, indicating that cofactor recruitment operates as a dominant, modular switch. Our findings support a model in which biochemical features of ARFs—specifically intrinsically disordered regions—govern the nuclear partitioning of cofactors, thereby controlling transcriptional outputs. This work reveals a biophysical mechanism underpinning auxin-responsive gene regulation and provides insight into how activator functions may originate during evolution.

Acknowledgments
The research was carried out thanks to PID2024-155921NA-I00.

Bibliography

Hernandez-Garcia, J., Dipp-Alvarez, M., de Roij, M., Guillem-Bernal, M., Roosjen, M., Baltaci, Z., Smith, H. W., Pereira, D., Borst, J. W., Holehouse, A. S., Lee, H. O., Weijers, D. 2026. Subnuclear cofactor partitioning underlies auxin-dependent transcriptional regulation, DOI: 10.64898/2026.04.29.721720.

Insights into Diversity Versus Compositional Effects of Pesticide Mixtures on Soil Microbial Functions and Community Dynamics

Mei S.[1], Lewak K.[2], Sura-de Jong M.[2], Salles J.F.[1]

[1] *Microbial ecology cluster, University of Groningen, The Netherlands*

[2] *Protein Transition Research Group, Hogeschool Van Hall Larenstein, The Netherlands*

Understanding how pesticide mixtures affect soil microbes and their biogeochemical functions is critical for realistic environmental risk assessment [1]. However, whether soil microbial degradation and functional shifts are driven primarily by total pesticide load or by specific component identities and non-additive interactions remains widely debated[2–4].

Here, using a soil microcosm experiment, we evaluated the impacts of 15 combinations of four widely used pesticides, comprising fungicides (prothioconazole, P; tebuconazole, T), an herbicide (bentazon, B), and an insecticide (acetamiprid, A), applied at field-recommended rates on microbial oxidative activity (dehydrogenase, DHA), nutrient-cycling enzymes (β-glucosidase, arylsulphatase, phosphatase), and bacterial/fungal communities across two timepoints (1 and 5 weeks).

Our results indicate that soil microbial functional responses appeared to be driven largely by pesticide identity and specific component combinations rather than pesticide diversity level alone. Enzyme responses exhibited marked functional and temporal divergence: phosphatase showed early (1 week) inhibition in complex mixtures (e.g., TBA and PTBA), arylsulphatase displayed higher-than-additive activity in the PT mixture, and DHA varied significantly among treatments at 5 weeks. Amplicon sequencing revealed kingdom-level differences: bacterial communities were significantly restructured by pesticide treatments at 5 weeks, whereas fungal communities were predominantly influenced by temporal dynamics. Furthermore, functional variations correlated with specific microbial taxa, showing positive associations between bacterial genera (e.g., *Blastococcus*, *Comamonadaceae*) and phosphatase activity, alongside inverse associations with select fungal genera.

Overall, these findings highlight candidate non-additive mixture effects and divergent sensitivities between bacterial and fungal communities under laboratory conditions, providing hypotheses to guide future crop-soil interaction studies.

Bibliography

Silva, V. *et al.* 2019. Pesticide residues in European agricultural soils - A hidden reality unfolded. Science of the Total Environment, 653, 1532–1545.

Backhaus, T. & Faust, M. 2012. Predictive environmental risk assessment of chemical mixtures: a conceptual framework. Environmental Science & Technology, 46, 2564–2573.

Cedergreen N. 2014. Quantifying Synergy: A Systematic Review of Mixture Toxicity Studies within Environmental Toxicology, PLoS ONE, 9, e96580.

Rillig, M. C. *et al.* 2019. The role of multiple global change factors in driving soil functions and microbial biodiversity. Science, 366, 886–890.

Tracking Water Losses from Paddy Fields Using Chemical Mass Balance and Digital Filtering

Navas R.[1], Zubelzu S.[2]

[1]*Departamento de Ingeniería Agroforestal, Escuela Técnica Superior de Ingeniería Agronómica, Alimentaria y de Biosistemas, Universidad Politécnica de Madrid, Madrid, 28040, Spain; rafael.navas@alumnos.upm.es*

[2]*Departamento de Ingeniería Agroforestal, Escuela Técnica Superior de Ingeniería Agronómica, Alimentaria y de Biosistemas, Universidad Politécnica de Madrid, Madrid, 28040, Spain; sergio.zubelzu@upm.es*

Quantifying irrigation return flows is essential for sustainable water management, yet catchment-scale estimation remains challenging due to complex drainage networks and high temporal variability. This study develops a sub-daily flow-partitioning framework combining continuous electrical conductivity (EC) monitoring, chemical mass balance and digital filtering to quantify overland return flow in the 12.7 km² Sarandí catchment, northwestern Uruguay.

The framework separates streamflow into baseflow, direct runoff, overland irrigation return flow and point-source contributions. EC-based chemical mass balance (Cartwright, 2022) is combined with a Lyne–Hollick digital filter (Rets et al., 2022) to constrain baseflow separation. The approach was evaluated during the 2024–2025 growing season, when rice fields were continuously flooded from December to March.

The digital filter and EC-based chemical mass balance showed close agreement during the non-irrigation period, supporting EC as a practical tracer for distinguishing streamflow sources. During dry spells between rainfall events, overland return flow contributed a median of 11.5% and up to 69.8% of total streamflow, while accounting for approximately 2–25% of applied irrigation water. Pronounced sub-daily streamflow fluctuations occurred even without rainfall, with an approximately eight-hour lag relative to evapotranspiration, indicating rapid hydrological responses to changes in paddy-field water balance.

The proposed framework provides a practical, low-cost approach to quantifying rapidly responding irrigation losses using in-stream observations. It offers potential applications in irrigation management, catchment-scale water allocation and environmental flow assessment, particularly in agricultural basins where field-scale monitoring is difficult to implement.

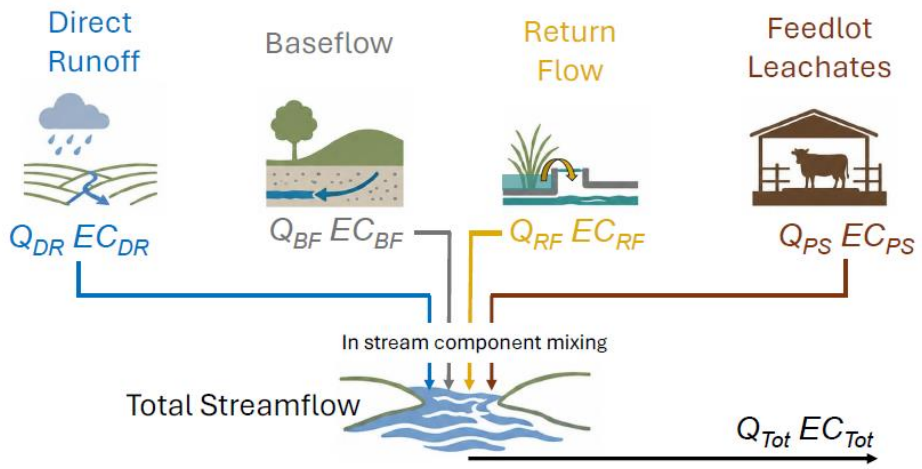


Figure 1. Schematic representation of flow components (Q) and their characteristic electrical conductivity (EC) signatures in the Sarand´ı Catchment. Flow components include direct runoff (DR), return flow (RF), baseflow (BF), feedlot leachates represented as point sources (PS), and total streamflow (Tot).

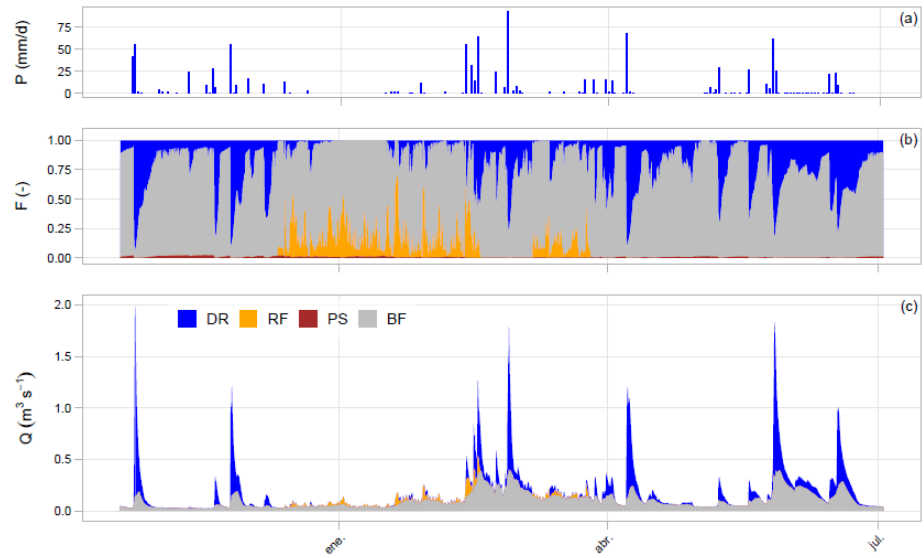


Figure 2. Temporal evolution of the estimated streamflow components. (a) Daily precipitation. (b) Fractional decomposition of streamflow into direct runoff (DR), baseflow (BF), irrigation return flow (RF), and point sources (PS), showing their relative contributions to total streamflow. (c) Estimated absolute contributions of DR, BF, RF, and PS to total streamflow.

Acknowledgments

The authors thank Donistar S. en C. for funding and supporting fieldwork.

Bibliography

Cartwright, I. 2022. Implications of variations in stream specific conductivity for estimating baseflow using chemical mass balance and calibrated hydrograph techniques. Hydrology and Earth System Sciences, 26(1), 183–195.

Rets, E.P., Kireeva, M.B., Samsonov, T.E., Ezerova, N.N., Gorbarenko, A.V.,Frolova, N.L. 2022. Algorithm grwat for Automated Hydrograph Separation by B.I.Kudelin's Method: Problems and Perspectives. Water Resources, 49(1), 23–37.

Wastewater-derived Organic Matter and Bisphenol A Complexation: Implications for Agricultural Water Reuse

Paolella G.[1,2], Fabbricino M.[1], Locascio A.[2], Boguta P.[3]

[1]*Department of Civil, Architectural and Environmental Engineering, University of Naples Federico II, Via Claudio 21, 80125 Naples, Italy, email: giulia.paolella@unina.it; fabbrici@unina.it*

[2]*Department of Biology and Evaluation of Marine Organisms, Stazione Zoologica Anton Dohrn, Villa Comunale 1, 80121 Naples, Italy, email: giulia.paolella@szn.it; annamaria.locascio@szn.it*

[3]*Institute of Agrophysics, Polish Academy of Sciences, Doświadczalna 4 st., 20-290 Lublin, Poland, email: p.boguta@ipan.lublin.pl*

Whilst the reuse of treated wastewater for agricultural irrigation offers an opportunity to reduce freshwater consumption, it also raises questions about the fate of emerging contaminants that may be introduced into agricultural soils. Understanding the interactions between effluent organic matter (EfOM) and organic contaminants is therefore essential for assessing the environmental implications of reusing treated water.

This study investigates the complexation mechanisms between two samples of EfOM from a wastewater treatment plant and bisphenol A (BPA), an emerging contaminant of environmental concern. Although the capacity of EfOM to form complexes with metals is well established, its interactions with emerging organic contaminants such as BPA remain less understood. EfOM characterisation and EFOM/BPA interactions were investigated using complementary analytics techniques, including UV-Vis spectroscopy, fluorescence excitation-emission matrix (3DEEM), Fourier-transform infrared spectroscopy (FTIR) and proton-releasing analysis.

The results indicate that EfOM interacts with BPA through multiple mechanisms, primarily driven by hydrogen bonding involving hydroxyl and carboxylic groups, and hydrophobic interactions. Fluorescence measurements revealed strong binding capacity, with clear difference between the EfOMs/BPA signal and that obtained for the individual, unmixed components. FTIR spectroscopy showed clear structural changes in O-H stretching and carboxylic regions, confirming functional group involvement. Proton release studies further supported these findings, indicating ligand exchange mechanisms and multi-site binding behavior. Seasonal variations in EfOM composition were observed, resulting in variable BPA binding capacity.

Obtained results highlight the role of EfOM in BPA complexation and its potential influence on contaminant transport, bioavailability, and persistence in aquatic systems. These interactions may also affect BPA removal during conventional wastewater treatment and its subsequent behaviour following the reuse of treated wastewater for agricultural irrigation. Therefore, integrating organic matter characterisation with contaminant-specific analyses is essential to better assess the quality of reclaimed water and understand the potential implications of emerging contaminants for agricultural soils.

Acknowledgments

The research was carried out thanks to the financial support provided by the University of Naples Federico II and the Stazione Zoologica Anton Dohrn (Naples, Italy). This work was carried out in collaboration with the Institute of Agrophysics of the Polish Academy of Sciences.

Bibliography

Mordechay E. B., Mordehay V., Tarchitzky J., Chefetz B. 2022. Fate of contaminants of emerging concern in the reclaimed wastewater-soil-plant continuum. Science of The Total Environment, 822, 153574.

Khan U.A., Löffler P., Spilsbury F., Wiberg K., Lundborg C. S., Lai F. Y. 2024. Towards sustainable water reuse: A critical review and meta-analysis of emerging chemical contaminants with risk-based evaluation, health hazard prediction and prioritization for assessment of effluent water quality. Journal of Hazardous Materials, 480, 136175.

Zhu F-D., Choo K-H, Chang H-S, Lee B. 2012. Interaction of bisphenol A with dissolved organic matter in extractive and adsorptive removal processes. Chemosphere, 87, 857-864.

Fava Bean-winter Wheat Intercropping Promotes the Yield Intensification and the Ecosystem Service Provision Under Zero-N Conditions

Picone R.[1], Gentsch N.[2], Pietramellara G.[3], Guggenberger G.[4], de la Fuente A.[5], Schaks M.[6], Gohlke A.[7], Koza M.[8], Marchetti G.[9], Steinkraus B.[10], Pathan S.I.[11]

[1]First institution: Department of Agriculture, Food, Environment and Forestry (DAGRI), University of Florence; Piazzale delle Cascine 28, 50144 Florence, Italy; Second Institution: Institute of Earth System Sciences, Section Soil Science, Leibniz Universität Hannover; Herrenhäuser Str. 2, 30419 Hannover, Germany; riccardo.picone@unifi.it

[2]Institute of Earth System Sciences, Section Soil Science, Leibniz Universität Hannover; Herrenhäuser Str. 2, 30419 Hannover, Germany; gentsch@ifbk.uni-hannover.de

[3]Department of Agriculture, Food, Environment and Forestry (DAGRI), University of Florence; Piazzale delle Cascine 28, 50144 Florence, Italy; giacomo.pietramelllara@unifi.it

[4]Institute of Earth System Sciences, Section Soil Science, Leibniz Universität Hannover; Herrenhäuser Str. 2, 30419 Hannover, Germany; guggenberger@ifbk.uni-hannover.de

[5]Institute of Earth System Sciences, Section Soil Science, Leibniz Universität Hannover; Herrenhäuser Str. 2, 30419 Hannover, Germany; andrino@ifbk.uni-hannover.de

[6]Soilytix GmbH; Dammtorwall 7A, 20354 Hamburg, Germany; mschaks@soilytix.com

[7]Deutsche Saatveredelung AG; Steimker Weg 7, 27330 Asendorf, Germany; andre.gohlke@gmx.de

[8]Department of Geoecology, Martin Luther University; Halle-Wittenberg, Von-Seckendorff-Platz 4, 06120 Halle (Saale), Germany; moritz.koza@geo.uni-halle.de

[9]Department of Agriculture, Food, Environment and Forestry (DAGRI), University of Florence; Piazzale delle Cascine 28, 50144 Florence, Italy; gemma_marchetti@outlook.it

[10]Soilytix GmbH; Dammtorwall 7A, 20354 Hamburg, Germany; bruno@soilytix.com

[11]Department of Agriculture, Food, Environment and Forestry (DAGRI), University of Florence; Piazzale delle Cascine 28, 50144 Florence, Italy; shamina.pathan@unifi.it

Intensifying the crop production while supporting the service provision by agroecosystem is increasingly important for the future of humanity. One possible solution to couple these two aims is the intercropping of legumes and cereals, based on the physiological complementarity of the two crop types. However, the extent of the benefits in the soil-plant carbon and nutrient cycling, and the microbial dynamics remains not fully elucidated. To address this knowledge gap, this study investigated the effects of co-culturing fava bean and winter wheat over the whole cropping season under two contrasting nitrogen (N) fertilization levels (standard and zero N). The findings highlighted that the intercropping could support an enhancement of the plant performance and a yield intensification compared to the sole cropping, but only under the zero N. Concurrently, the zero-N intercropping allowed to prevent some shifts of the

soil N-cycling potential that were induced by the standard N dose and that might have been associated with a higher N-loss potential. Moreover, very consistent shifts were observed in the rhizosphere soil bacterial and fungal community composition, albeit they were limited in the bulk soil, and even more in the plant roots. Consequently, the intercropping supported an increase of both the bacterial and the fungal community α-diversities. These likely resulted from the shifts observed in the plant-induced niche filtering from the bulk to the rhizosphere soil to the plant roots. Moreover, the intercropping induced a complete restructuring of the co-occurrence networks in almost all the compartments. Comprehensively, the changes in the microbial interaction dynamics suggested that the intercropped plants relied more on the fungal than the bacterial communities. This deduction is further corroborated by the fact that the co-culture supported a higher redundancy of the fungal saprotrophy, symbiotrophy, and endophytism under the zero N, but limitedly to the rhizosphere soil and the plant roots. Ultimately, the intercropping favored a higher soil multifunctionality compared to the sole fava bean under the zero N. Overall, the intercropping system without the N fertilizer application emerged as an optimal strategy to intensify the crop production while supporting the soil-plant ecosystem service provision under the zero-N conditions.

From Halophytes to Wheat: Beyond Classical PGP Traits Toward Ecologically Adapted Microbial Consortia

Shahabirokni M.[1], Etesami H.[2], Raheb A.[3], Razavi B.S.[4]

[1] *Christian-Albrechts University of Kiel, Germany; mahdi.shahabirokni@email.uni-kiel.de*

[2]*University of Tehran, Iran; hassanetesami@ut.ac.ir*

[3] *University of Tehran, Iran; araheb@ut.ac.ir*

[4]*Christian-Albrechts University of Kiel, Germany; brazavi@phytomed.uni-kiel.de*

Climate change and increasing soil salinization threaten global food security, highlighting the need for sustainable strategies to improve crop resilience. Although plant-growth-promoting rhizobacteria (PGPR) offer promising solutions (Etesami and Emami, 2023), strong in-vitro growth-promoting traits frequently fail to translate into improved plant performance. This discrepancy highlights the overlooked role of plants as active selectors of microbial partners and the importance of ecological compatibility and metabolic tradeoffs under stress.

Plant–microbe interactions are shaped by evolutionary adaptation, resource exchange, and environmental constraints. Under salinity stress, metabolically costly growth-promoting functions may become less advantageous than survival-oriented strategies (Kramer et al., 2020). Halophytes, having evolved alongside stress-adapted microbiota, therefore represent potential reservoirs of beneficial microbial functions.

We isolated approximately 500 bacteria from coastal halophytes along the Oman Sea (Iran). Salt-tolerant isolates (>10% NaCl) were grouped into 16 consortia and evaluated using four wheat genotypes (Pishgam, Ofogh, Bam, and Arg) under seawater irrigation. Based on plant performance (figure 1), isolates from the best- and a low-performing consortium were selected for the assessment of classical PGP traits. Additionally, rhizosphere microbial community structure and predicted microbial functions were investigated across treatments using 16S rRNA amplicon sequencing.

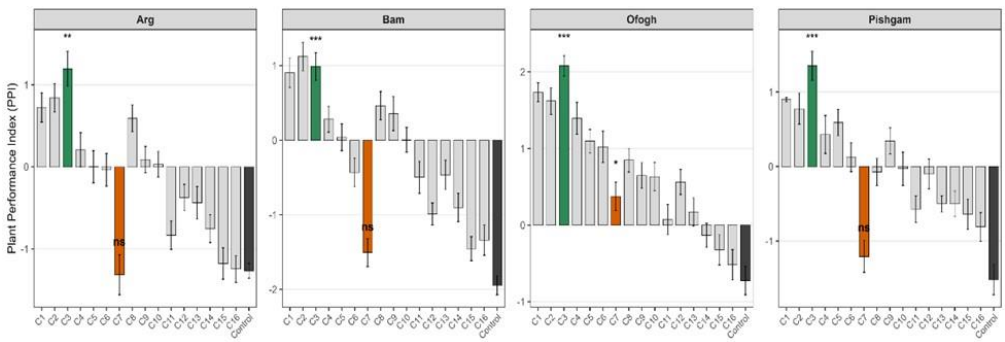


Figure 1. Selection of contrasting microbial consortia based on plant performance across four wheat genotypes. Asterisks indicate significant differences compared with the control within each genotype (*P < 0.05, **P < 0.01, ***P < 0.001; ns = not significant).

Consortium 3 (C3) consistently improved plant performance across all genotypes, whereas Consortium 7 (C7) showed limited effectiveness despite exhibiting stronger phosphate solubilization, auxin production, and siderophore activity. Although inoculation influenced individual bacterial taxa and genotype-dependent enrichment patterns, overall rhizosphere community composition did not differ significantly between consortia. Functional predictions revealed greater representation of biofilm formation, antioxidant defense, stress-response, and quorum-sensing genes under C3, while C7 was associated with iron acquisition, ACC deaminase, and phosphate-solubilization functions.

These findings suggest that microbial contributions to plant salinity tolerance depend more on stress-adaptive functionality and ecological compatibility than on conventional in-vitro PGP traits or broad taxonomic shifts. They further highlight the potential importance of plant-mediated microbial selection, functional redundancy, and resource-allocation tradeoffs in shaping beneficial interactions.

Overall, halophyte-associated microbiomes offer promising sources of stress-adapted microorganisms, supporting a shift from trait-based PGPR screening toward plant-centered ecological selection for sustainable agriculture under increasing salinity.

Bibliography

Etesami H. Emami S. 2023. Soil microbial inocula: an eco-friendly and sustainable solution for mitigating salinity stress in plants. In Plant stress mitigators (pp. 341-357). Academic Press, DOI: 10.1016/B978-0-323-89871-3.00028-8.

Kramer J. Özkaya Ö. Kümmerli R. 2020. Bacterial siderophores in community and host interactions. Nature Reviews Microbiology, 18(3), 152-163, DOI: 10.1038/s41579-019-0284-4.

Influence of Biochar Type and Application Rate on Wettability and Hydraulic Conductivity of Sandy Soil

Chandramohan M.S.[1,2], Šurda P.[1], Vítková J.[1]

[1]Institute of Hydrology, Slovak Academy of Sciences, Dúbravská cesta 9, 841 04 Bratislava, Slovakia; e-mails: chandramohan@uh.savba.sk, surda@uh.savba.sk; vitkova@uh.savba.sk

[2]Faculty of Horticulture and Landscape Engineering, Slovak University of Agriculture in Nitra, Hospodárska 7, 949 76 Nitra, Slovakia

Sandy soils are susceptible to rapid drainage and water loss because of their coarse texture and limited water-holding capacity. Biochar amendment may modify soil pore structure and soil–water interactions, with effects depending on biochar properties and application rate (Blanco-Canqui, 2017; Chen et al., 2018; Šurda et al., 2025). This study evaluated the effects of two biochars with contrasting wettability on soil wettability and saturated hydraulic conductivity (K_s) in sandy soil.

A controlled laboratory experiment was conducted using sandy Regosols from four contrasting land-use systems in the Záhorská nížina, Slovakia. All soils were classified as Sand according to the USDA system, with sand contents of 89.8–97.3 %. Two commercial wood-derived biochars produced at approximately 850 °C were incorporated at 2, 6 and 10 % (w/w), with untreated soil as the control. The Austrian biochar, produced from processed wood, cereal husks and cellulose fibres, was hydrophilic (CA = 0°), whereas the Czech biochar, produced from woody biomass, was subcritically water repellent (CA ≈ 60°).

Biochar addition did not improve soil wettability: the control had a mean contact angle of 60.3°, while amended samples showed higher values of 63.0–69.1°. In contrast, K_s decreased with increasing application rate of both biochars, from 366.9 cm day^{-1} in the control to 182.4 cm day^{-1} for the Austrian biochar and 123.1 cm day^{-1} for the Czech biochar at 10 %. The reduction in K_s is attributed to macropore clogging by fine biochar particles for the hydrophilic Austrian biochar, whereas the Czech biochar combines pore clogging with increased hydrophobicity. In sandy soils, the reduction in K_s may be beneficial by slowing rapid drainage and water loss from the root zone.

Keywords: biochar; sandy soil; soil wettability; contact angle; saturated hydraulic conductivity; soil hydrology

Acknowledgements

This work was supported by the Scientific Grant Agency VEGA, projects No. 2/0065/24 and No. 2/0037/24.

Bibliography

Blanco-Canqui H. 2017. Biochar and soil physical properties. Soil Science Society of America Journal, 81, 687–711.

Chen C., Wang R., Shang J., Liu K., Irshad M.K., Hu K., Arthur E. 2018. Effect of biochar application on hydraulic properties of sandy soil under dry and wet conditions. Vadose Zone Journal, 17, 180101.

Šurda P., Vitková J., Lichner Ľ., Botková N., Toková L. 2025. Effect of wettable and hydrophobic biochar addition on properties of sandy soil. Biologia, 80, 1247–1258.

Postharvest Performance, Storage Grain Quality, and Postharvest Losses of Pearl Millet (*Pennisetum glaucum*) and Sorghum (*Sorghum bicolor*) in Semi-arid Ghana: Influence of Farmer Practices, Moisture Status, Storage Insect Pest, and Storage Systems

Apuri S.[1], Rosentrater K.A.[2], Kumah P.[3]

[1]Polytechnic University of Cartagena, member of European University of Technology EUT+. Department of Agronomic Engineering, Institute of Plant Biotechnology. Paseo Alfonso XIII, 48, 30203, Cartagena, Murcia, Spain; samuel.apuri@edu.upct.es

[1]Bolgatanga Technical University, Department of Ecological Agriculture, Bolgatanga, Ghana.

[2]Iowa State University, Department of Agricultural and Biosystems Engineering, Elings Hall, 1340, 605 Bissell Rd, Ames, IA 50011, USA; karosent@iastate.edu

[3]Kwame Nkrumah University of Science and Technology, Faculty of Horticulture, Kumasi, Ghana; pkumah.agric@knust.edu.gh

Postharvest losses are a serious challenge to global food security. Postharvest losses in cereals are almost 20% in sub-Saharan Africa and about 30% in cereals and legumes in Ghana. The economic impact of postharvest losses in Sub Saharan Africa could be as high as 4 billion dollars annually. Seed security, improved postharvest management and storage are important tools necessary to improve postharvest food safety, tackle postharvest food losses, improving food security and alleviating rural poverty. Millet (*Pennisetum glaucum*) and sorghum (*Sorghum bicolor*) are important food security crops in Ghana, Africa and many regions of the world. These crops are considered as climate resilient food security crops due to their ability to perform in hot climates with poor rainfall. Despite the importance of these crops, the impact of postharvest management on postharvest losses and food security, and the importance of seed security in tackling food insecurity, there have been fewer postharvest studies on millet and sorghum grains and seeds when compared to other cereals like maize in Sub-Saharan Africa. In Ghana, there is inadequate data regarding preharvest and postharvest practices of millet and sorghum and its influence on grain quality, safety and postharvest losses. There is also insufficient data on the quality and safety of millet and sorghum grains and farmer-saved seeds during storage and after storage. Furthermore, there is a lack of adequate research identifying major storage insect pest of stored millet and sorghum in semi-arid Ghana. Equally important is the lack of research on the influence of millet and sorghum storage insect pest, moisture variation, and storage systems on grain and seed quality, safety, and postharvest losses in Ghana. This study therefore aims to integrate, for the first time, field diagnosis, laboratory analysis and laboratory experiments to evaluate how farmer practices, storage insect pest, moisture status, and storage systems influence stored grain and seed quality, safety, and postharvest losses of millet and sorghum in semi-arid Ghana. This research will provide evidence-based

recommendations to enhance postharvest handling and storage of millet and sorghum thus improving postharvest safety, quality, and ultimately improving food security through reduced postharvest losses in Ghana.

Acknowledgments

This research work is carried out thanks to the supervision of Prof. Kurt A. Rosentrater and Dr. Patrick Kumah. I also acknowledge the support of my PhD academic tutor and Head of the TAIDA PhD programme at the *Polytechnic University of Cartagena, Prof. Palop Gómez Alfredo.*

Bibliography

Adams, F., Aidoo, R., Mensah, J. O., Mensah, A., Etuah, S., Akey, E. A., & Quaye, J. 2023. The synergy between farmers' declaration of qualitative and quantitative maize postharvest losses in the transition agroecological zone of Ghana. Journal of Stored Products Research, 104, 102198.

Ariong, R. M., Okello, D. M., Otim, M. H., & Paparu, P. 2023. The cost of inadequate postharvest management of pulse grain: Farmer losses due to handling and storage practices in Uganda. Agriculture & Food Security, 12(1), 20.

Costa, S. J. 2014. Reducing food losses in sub-saharan Africa. An 'Action research'evaluation trial from Uganda and Burkina Faso.

Darfour, B., & Rosentrater, K. A. 2016. Agriculture and Food Security in Ghana. In 2016 ASABE Annual International Meeting (p. 1). American Society of Agricultural and Biological Engineers.

Food and Agriculture Organization. 2001. The state of food insecurity in the world 2001: Food insecurity – when people live with hunger and fear starvation. https://www.fao.org/4/y1500e/y1500e00.htm Accessed on 8th July 2026.

Food and Agriculture Organization. 2011. Global food losses and food waste – Extent, causes and prevention. Rome https://www.fao.org/4/mb060e/mb060e.pdf Accessed on 8th July 2026.

Midega, C. A., Murage, A. W., Pittchar, J. O., & Khan, Z. R. 2016. Managing storage pests of maize: Farmers' knowledge, perceptions and practices in western Kenya. Crop Protection, 90, 142-149.

Nath, B., Chen, G., O'Sullivan, C. M., & Zare, D. 2024. Research and Technologies to Reduce Grain Postharvest Losses: A Review. Foods, 13(12), 1875. https://doi.org/10.3390/foods13121875

Stathers, T. & Holcroft, D. 2024. Promising interventions for inclusion in investment to reduce postharvest losses of key food crops in sub-Saharan Africa and South Asia. 33 pp. https://www.grtd.fcdo.gov.uk/wp-content/uploads/2025/06/Food-loss-Promising-interventions-for-PHL-reduction.pdf Accessed on 8th July 2026.

Impact of Seed Inoculation on the Bacterial Community Structure of Coriander Microgreens Revealed by NGS

Barańska D.[1], Panek J.[1], Pertile G.[1], Gryta A.[1], Oszust K.[1], Siegieda D.[1], Różalska S.[2], Frąc M.[1]

[1]*Institute of Agrophysics, Polish Academy of Sciences, 20-290 Lublin, Poland; m.frac@ipan.lublin.pl*

[2]*Department of Industrial Microbiology and Biotechnology, Faculty of Biology and Environmental Protection, University of Lodz, 90-237 Lodz, Poland*

Microgreens are edible seedlings harvested shortly after germination, which are increasingly recognized as nutrient-dense foods with considerable potential in modern plant production systems. Their popularity is associated with a high concentration of health-promoting compounds, desirable sensory characteristics, and the possibility of obtaining fresh biomass within a relatively short cultivation period (Wojdyło et al., 2020; Bhaswant et al., 2023). The limited space required for their production and their compatibility with controlled-environment agriculture also make microgreens suitable for urban farming and vertical cultivation systems (Partap et al., 2023). However, their rapid growth and delicate tissues make them highly vulnerable to adverse environmental conditions, particularly water deficit, which may negatively affect plant performance, accelerate wilting, reduce postharvest quality, and alter the accumulation of valuable metabolites (Paradiso et al., 2018). One strategy that may improve plant tolerance to unfavorable conditions is the use of beneficial microorganisms capable of modifying plant–microbe interactions (Admassie et al., 2022; Fadiji et al., 2023; Woo et al., 2020, Barańska et al. 2025). In the present study, seeds of coriander microgreens were subjected to inoculation with the beneficial strain *Bacillus megaterium* B107/23, isolated from fermented products (Barańska et al. 2026) The aim of the study was to evaluate changes in the bacterial community associated with coriander microgreens before and after seeds inoculation using high-throughput next-generation sequencing performed on the Illumina MiSeq platform. The obtained data enabled characterization of the taxonomic composition and diversity of bacterial communities and allowed assessment of inoculation-related shifts in microbiome structure. The study therefore provides insight into the influence of beneficial bacterial inoculation on the microbiome associated with coriander microgreens and may contribute to a better understanding of plant-microbiome interactions during the early stages of plant development.

Acknowledgments

The study was funded by the Polish National Science Centre (NCN), under the project OPUS-23, title "Interactions of microgreens and microbiomes as functional regulators of its quality, resistance and shelf-life – a case study for selected herbs (coriander, basil) and vegetables (radish, beet) in response to climate changes", acronym MICROGREENS (Grant number: 2022/45/B/NZ9/04254).

Bibliography

Wojdyło, A., Nowicka, P., Tkacz, K., Turkiewicz, I. P. 2020. Sprouts vs. Microgreens as novel functional foods: Variation of nutritional and phytochemical profiles and their in vitro bioactive properties. Molecules (Basel, Switzerland), 25(20), E4648.

Bhaswant, M., Shanmugam, D. K., Miyazawa, T., Abe, C., Miyazawa, T. 2023. Microgreens-A comprehensive review of bioactive molecules and health benefits. Molecules (Basel, Switzerland), 28(2), 867.

Partap, M., Sharma, D., Hn, D., Thakur, M., Verma, V., Ujala, & Bhargava, B. 2023. Microgreen: A tiny plant with superfood potential. Journal of Functional Foods, 107(105697), 105697.

Paradiso, V. M., Castellino, M., Renna, M., Gattullo, C. E., Calasso, M., Terzano, R., … Santamaria, P. 2018. Nutritional characterization and shelf-life of packaged microgreens. Food & Function, 9(11), 5629–5640, DOI:10.1039/c8fo01182f.

Admassie, M., Woldehawariat, Y., Alemu, T., Gonzalez, E., & Jimenez, J. F. 2022. The role of plant growth-promoting bacteria in alleviating drought stress on pepper plants. Agricultural Water Management, 272(107831), 107831.

Fadiji, A. E., Yadav, A. N., Santoyo, G., & Babalola, O. O. 2023. Understanding the plant-microbe interactions in environments exposed to abiotic stresses: An overview. Microbiological Research, 271(127368), 127368.

Woo, O.-G., Kim, H., Kim, J.-S., Keum, H. L., Lee, K.-C., Sul, W. J., & Lee, J.-H. 2020. Bacillus subtilis strain GOT9 confers enhanced tolerance to drought and salt stresses in Arabidopsis thaliana and Brassica campestris. Plant Physiology and Biochemistry, 148, 359–367.

Barańska, D., Panek, J., Różalska, S., Turnau, K., & Frąc, M. 2025. Microgreens as the future of urban horticulture and superfoods, supported by post-harvest innovations for shelf-life increase: a review. Scientia Horticulturae, 350(114303), 114303.

Barańska, D., Panek, J., Pertile, G., Gryta, A., Różalska, S., & Frąc, M. 2026. Comparative genomic, metabolic and transcriptomic profiling of bacterial isolates reveals strain-specific adaptation and safety traits. International Journal of Molecular Sciences, 27(19), 8734.

Exploring the Diversity of Algerian Carob: Properties and Food Applications

Bougriou N.[1,2], Bujor O.[3], Benatallah L.[2], Ion V.[3], Brahmi N.[1], Petre A.[3], Zugravu M.[3], Dobrin A.[3], Zdunek A.[4]

[1]Université de Bejaia, Faculté Des Sciences de La Nature Et de La Vie, Laboratoire de Biomathématiques, Biochimie Biophysique Et Scientométrie (L3BS), Bejaia 06000, Algérie; nada.bougriou@univ-bejaia.dz

[2]Laboratory of Agro-Food Engineering (GENIAAL), Institute of Nutrition, Food and Agro-Food Technologies (INATAA), Brothers Mentouri Constantine 1 University, INATAA 7 km, Constantine 25000, Algeria

[3]Research Centre for Studies of Food Quality and Agricultural Products, University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59, Marasti Blvd., Bucharest, 011464, Romania

[4]Institute of Agrophysics, Polish Academy of Sciences, ul.Doświadczalna 4, Lublin 20-290, Poland

Carob remains an underutilised crop in the Mediterranean region, particularly in Algeria. According to FAO statistics, Algerian production has risen steadily, from 3,402.3 tonnes in 2022 to 3,434.9 tonnes in 2023 and 3,444.8 tonnes in 2024. Despite this agricultural potential, carob is still undervalued in food consumption. By characterising the variability among carob populations and identifying the applications best suited to each, this work seeks to reveal carob fruit diversity in Algeria to support the development of industrial sectors. Building on this objective pod morphology was measured, and the physicochemical, nutritional, and functional properties of the powder were characterised, including hydration behaviour. Nutritional profiling covered crude protein, dietary fibre, and individual sugars, while phytochemical analysis included total polyphenol and flavonoid contents, radical scavenging activity, and a phenolic profile. Pod weight and length ranged from 5.10 to 20.19 g and 70.88 to 130.30 mm, respectively. Fibre (4.33 – 13.44%), protein (5 – 6.7%), total polyphenols (12.54 - 54.22 mg GAE/g), and DPPH activity (309.1 - 1000.8 mg TEAC/g) varied markedly among populations. Sucrose was the predominant simple sugar (104.91 - 230.66 mg/g). Multivariate analysis revealed substantial variability, highlighting the potential of carob fruit as a nutritionally dense raw material for functional food formulations and other industrial applications.

Acknowledgments

The research was carried out thanks to the University Agency of Francophonie (AUF) through the ''Eugen Ionescu" Doctoral Mobility Scholarship Programme, which funded a research stay at Research Centre for Studies of Food Quality and Agricultural Products, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania.

Aerobic Metabolism of Organophosphonates as an Environmental Source of Methane

Furtak A.[1], Pytlak A.[1], Tkaczyk P.[2], Bieganowski A.[1]

[1]*Institute of Agrophysics, Polish Academy of Sciences, Doświadczalna 4, 20-290 Lublin, Poland, a.furtak@ipan.lublin.pl*

[2]*Department of Agricultural and Environmental Chemistry, University of Life Sciences in Lublin, Akademicka 15, 20-950 Lublin, Poland*

In June 2026, the global mean atmospheric methane (CH_4) concentration reached approximately 1,934.75 ppb. According to the IPCC, methane emissions contributed an estimated 0.3 – 0.8 °C to global warming in 2010 – 2019 relative to 1850 – 1900. This potent greenhouse gas enters the atmosphere through natural processes and anthropogenic activities. Notably, uncertainties in the global CH_4 budget persist, reflecting incomplete understanding of the processes governing methane sources and sinks. For many years, it was believed that the main biological source of CH_4 was related to the activity of methanogenic microorganisms found in anaerobic soil and water systems. In 2007, the CH_4 emission from oxygen-rich waters was described, challenging the conventional understanding of methane production and giving rise to the term "*marine methane paradox*". This phenomenon was elucidated in 2016, when CH_4 production in oxygenated waters was linked to phosphorus acquisition from organophosphonates, with methane released as a by-product of this process rather than through anaerobic methanogenesis.

Organophosphonates degradation is mediated by the C-P lyase enzyme complex and has been observed across diverse environments. However, to date, the occurrence of aerobic CH_4 release through this process has only been described in saltwater and freshwater bodies, with soil environments remaining unexplored in this regard.

This study outlines the research focus and presents preliminary results from the SAMEMO project, which aims to address this knowledge gap.

Acknowledgments

The research was carried out thanks to the PRELUDIUM 24 research project: "In the search for Soil Aerobic Methane Emission as a result of Microbial metabolism of Organophosphonates" no. 2025/57/N/NZ8/01154 funded by the National Science Centre, Poland.

Bibliography

Furtak, A., Szafranek-Nakonieczna, A., Furtak, K., Pytlak, A. (2024). A review of organophosphonates, their natural and anthropogenic sources, environmental fate and impact on microbial greenhouse gases emissions–identifying knowledge gaps. Journal of Environmental Management, 355, 120453.

Lan, X., Thoning, K.W., Dlugokencky, E. J. 2026-10. Trends in globally-averaged CH4, N2O, and SF6 determined from NOAA Global Monitoring Laboratory measurements.

Nisbet, E. G., Jones, A. E., Pyle, J. A., Skiba, U. 2022. Rising methane: is there a methane emergency? Philosophical Transactions of the Royal Society A, 380(2215).

Repeta, D. J., Ferrón, S., Sosa, et al. 2016. Marine methane paradox explained by bacterial degradation of dissolved organic matter. Nature Geoscience, 9(12), 884-887.

Mathematical Models for Forecasting Photovoltaic Power Production

Hampejs J.[1], Libra M.[1], Beránek V.[2]

[1]*Czech University of Life Sciences Prague, Kamýcká 129, 16500 Prague, Czech Republic*

[2]*Solarmonitoring, Ltd., Poděbradova 275, 439 23 Lenešice, Czech Republic*

Reliable short-term forecasting of photovoltaic (PV) power is essential for efficient plant operation, energy scheduling, and grid integration. This study develops and compares five approaches to forecasting the output of a 1,293 kWp PV power plant located in Kunžak, Czech Republic. The evaluated methods include a historical hourly-average baseline, conventional and incidence angle modifier (IAM)-corrected physical models, and convolutional neural network–long short-term memory (CNN–LSTM) models. Hybrid LSTM–convolutional architectures have also been investigated in previous PV forecasting research (Wang et al., 2019). Hourly measurements collected between 2020 and 2025 were combined with meteorological forecasts from MeteoSource, solar-position features, and temporal variables. The dataset was divided into training and testing sets using an 80:20 split, with 3,907 records in the test set. Performance metrics were calculated only for time steps with positive PV output.

The historical baseline achieved a normalized mean absolute error (nMAE) of 12.48%, while the conventional physical model reached 7.60% and the IAM-corrected model 6.60%. The CNN–LSTM model using historical data alone achieved an average nMAE of 11.26% over a 24-hour forecast horizon. The best performance was obtained by incorporating forecasted meteorological variables, reducing the average nMAE to 6.31%, with a mean absolute error (MAE) of 81.70 kW and a coefficient of determination (R^2) of 0.84. The nMAE ranged from 6.05% for the first forecast hour to 6.88% for the 24th hour. SHAP analysis identified global solar radiation and historical PV output as the most influential predictors, with forecasted meteorological variables becoming increasingly important at longer horizons. The results demonstrate that combining historical measurements with weather forecasts substantially improves day-ahead PV power prediction and can support operational planning, grid integration, and financial decision-making by PV plant operators.

Bibliography

Wang, K., Qi, X., Liu, H. 2019. A comparison of day-ahead photovoltaic power forecasting models based on deep learning neural network. Applied Energy, 251, 113315, DOI: 10.1016/j.apenergy.2019.113315.

Interplay of pH and Distinct Post-harvest Storage Conditions in Shaping the Structural and Rheological Properties of Apple-derived Pectin Fractions

Kalappurackal Muhammadaly S.A.[1], Chibrikov V.[1], Fila-Loranty K.[1], Zdunek A.[1], Cybulska J.[1]

[1]*Institute of Agrophysics, Polish Academy of Sciences, Doświadczalna 4, 20-290 Lublin, Poland; j.cybulska@ipan.lublin.pl*

Pectin significantly influences apple texture, and its structure changes as the fruit ripens and is stored. This study examined how pH and post-harvest storage jointly shape the structure and rheology of water-soluble (WSP), chelator-soluble (CSP) and dilute alkali-soluble (DASP) pectin fractions isolated from apples (*Malus domestica* cv. Golden Delicious) at optimal harvest (O), after 12 days of shelf life (S) and after 6 months of cold storage (C). Fruit softening was confirmed by a fall in firmness (~0.81 to ~0.31 N/mm²). Fractions were characterised by monosaccharide composition, degree of methylation (DM), zeta potential (pH 4-11), shear sweep and small-amplitude oscillatory rheology at 20 °C, and atomic force microscopy (AFM) at pH 4, 7, 9 and 11. Zeta potential was negative in all fractions and most negative at pH 7-9 owing to carboxyl ionisation; the high-DM WSP (48-71%) was least charged, while Na^+ shielding reduced the apparent charge at pH 11. In alkaline media WSP and CSP showed pH drops of up to -2.3 units within 24 h, attributed to saponification of methyl esters (WSP) and to arabinose loss (17.91 to 4.32%) exposing the polygalacturonate backbone (CSP); DASP remained stable (Renard & Thibault, 1996). All fractions were shear-thinning ($n < 1$) and generally exhibited viscous-dominated behavior with loss modulus(G") > storage modulus (G'). pH was the dominant factor: pH 4 gave the highest consistency index, viscosity and moduli, whereas pH 11 caused polymer degradation and minimal viscosity ($\eta_5 \leq 0.034$ Pa·s). Storage affected the fractions differently: WSP moduli decreased, whereas CSP strengthened during cold storage, forming its densest network at pH 4 (CSP_C: $K = 0.727$ Pa·s^n, $\eta_5 = 0.573$ Pa·s). PCA explained 89.4% of the variance (PC1 54.9%, PC2 34.5%) and separated DASP as a distinct, shear-sensitive, low-viscosity group, while highlighting the pH-dependent plasticity of CSP. AFM revealed pH- and storage-dependent chain conformations, including ion-induced aggregation of DASP at higher pH. These findings show that pectin fraction identity, pH and storage act together to control pectin functionality.

Acknowledgments

This work was supported by the National Science Centre, Poland, as part of the OPUS26 program (grant no – 2023/51/B/NZ9/02121).

Bibliography

Renard C.M.G.C., Thibault J.-F. 1996. Degradation of pectins in alkaline conditions: kinetics of demethylation. Carbohydrate Research, 286, 139-150.

An Axis-translation Experimental Platform for Investigating Hysteresis of Unsaturated Hydraulic Conductivity

Kozyra M., Lamorski K., Sławiński C.

[1]*Institute of Agrophysics PAS, Doświadczalna 4, 20-290 Lublin; m.kozyra@ipan.lublin.pl*

Although hysteresis of the soil water retention curve has been extensively documented and is commonly accounted for in contemporary models of unsaturated flow, considerably less is known about hysteresis in unsaturated hydraulic conductivity (UHC). This knowledge gap largely results from the experimental difficulties involved in obtaining reliable UHC measurements. In particular, the factors controlling UHC hysteresis have not yet been fully established. It is still uncertain whether this behaviour is determined mainly by soil water content (SWC), soil water potential (SWP), or by the interaction between these two variables. Addressing this uncertainty is important for a more complete description of water transport in unsaturated soils and for the development of improved hydraulic conductivity models.

The experimental determination of UHC requires simultaneous measurements of SWC and SWP, particularly when hydraulic conductivity is evaluated under transient flow conditions. One approach that facilitates such measurements over an extended range of matric potentials is the axis-translation technique. In this method, a soil sample is placed in a pressure-controlled chamber in which the air pressure is increased above atmospheric pressure. The application of elevated air pressure makes it possible to impose increasingly negative matric potentials while maintaining the water phase pressure at relatively moderate values, thereby reducing the risk of air bubble presence in microtensiometers and facilitating reliable SWP measurements. In the present experimental procedure, a saturated soil sample is subjected to a gradual increase in chamber air pressure up to 2000 hPa (absolute), followed by maintaining this pressure until hydraulic equilibrium is established within the sample. Subsequently, the wetting process is initiated by gradually reducing the chamber pressure to atmospheric conditions. This pressure cycle enables the main drying and wetting branches to be investigated. Additional experiments involving analogous pressure cycles can be performed to obtain the primary wetting and drying branches of UHC. Simultaneous monitoring of SWC and SWP throughout these processes provides the experimental data required to investigate hydraulic conductivity and its hysteretic behaviour along different hydraulic paths.

Acknowledgments

The research was funded by NCN under contract number: 2021/43/B/ST10/03143.

Role of ABA in Modulating PVY Infection and Aphid Vector Interactions in Tomato

Kumari D., Frąckowiak P., Wieczorek P., Obrępalska-Stęplowska A.

Department of Molecular Biology and Biotechnology, Institute of Plant Protection – National Research Institute, Poznań, Poland

Abscisic acid (ABA) phytohormone is best known for its role in abiotic stress tolerance, yet its function in plant–virus interactions remain poorly understood. Depending on the virus species, host plant and crosstalk with other hormone pathways, ABA can act as either a positive or a negative regulator of plant defense. Hormone-deficient mutants are therefore a valuable genetic tool for dissecting its physiological role. In our study we used the ABA-deficient *flacca* mutant and tomato wild-type Ailsa Craig cultivar, to investigate the tripartite interaction among tomato, potato virus Y (PVY; *Potyvirus* genus, in the family *Potyviridae*) and the green peach aphid *Myzus persicae* Sulz., one of its most efficient vectors, which transmits PVY in a non-persistent manner. The objectives were to determine how the ABA deficiency affects viral RNA accumulation, the transcriptional regulation of SA- and JA-dependent defense pathways, and aphid-vector interactions in tomato. We hypothesized that endogenous ABA influences PVY accumulation, tomato defence responses and interactions with the aphid vector.

PVY RNA accumulation, expression of salicylic acid (SA)- and jasmonic acid (JA)-related defense genes, and virus transmission were quantified by RT-qPCR. Aphid preference for plant volatiles was tested by olfactometer analysis, aphid reproduction was assessed by nymph production, and PVY RNA acquired by aphids was quantified by droplet digital PCR (ddPCR).

A time-course analysis of pathogenesis revealed that PVY accumulation and the expression of SA- and JA-related defense genes differed between the ABA-deficient mutant and wild-type plants. ABA deficiency also affected aphid reproduction, the amount of virus acquired by aphids, and the efficiency of virus transmission.

In conclusion, we identify ABA as an important phytohormone shaping plant-virus-insect interactions and viral transmission outcomes.

Acknowledgments

I thank Prof. Dr. hab. Aleksandra Obrępalska-Stęplowska for her guidance and support throughout this work, and the members of the Department of Molecular Biology and Biotechnology for their technical assistance and helpful discussions. This study was funded by the National Science Centre (NCN), Poland, Grant No. UMO-2021/43/B/NZ9/02626 (OPUS-22).

I am grateful to the Polish Academy of Sciences for supporting my participation in this workshop.

Bibliography

Alazem, M. and Lin, N.S. 2017. Antiviral roles of abscisic acid in plants. Frontiers in plant science, 8, p.1760.

Mauch-Mani, B. and Mauch, F., 2005. The role of abscisic acid in plant–pathogen interactions. Current opinion in plant biology, 8(4).409-414.

Asselbergh, B., De Vleesschauwer, D. and Höfte, M., 2008. Global switches and fine-tuning—ABA modulates plant pathogen defense. Molecular Plant-Microbe Interactions, 21(6), 709-719.

Boquel, S., Giordanengo, P. and Ameline, A., 2011. Divergent effects of PVY-infected potato plant on aphids. European Journal of Plant Pathology, 129(4), 507-510.

Mello, A.F.S., Olarte, R.A., Gray, S.M. and Perry, K.L., 2011. Transmission efficiency of Potato virus Y strains PVYO and PVYN-Wi by five aphid species. Plant Disease, 95(10), 1279-1283

Identification and Comparative Analysis of Hydrophobin Candidates Diversity in Three Entomopathogenic *Akanthomyces* Strains

Lenga A.[1], Siegieda D.[1], Panek J.[1], Różalska S.[2], Frąc M.[1]

[1]*Institute of Agrophysics, Polish Academy of Sciences, Lublin; m.frac@ipan.lublin.pl*

[2]*Department of Industrial Microbiology and Biotechnology, Faculty of Biology and Environmental Protection, University of Łódź*

Hydrophobins are small, cysteine-rich proteins involved in determining the surface properties of filamentous fungi and mediating their interactions with hosts and the environment. The diversity of their sequences may contribute to the adaptation of fungi and the fulfilment of their ecological functions (Lameu et al. 2026).

This study aimed to identify and compare hydrophobins candidates in three entomopathogenic strains of the genus *Akanthomyces*: G1/26 (*A. lecanii*), G3/26 (*Akanthomyces* sp.) and G7/26 (*A. muscarius*).

Genome sequencing was carried out using next-generation sequencing data obtained on the Illumina MiSeq platform, and the genomes were assembled using the SPAdes programme. Gene prediction was carried out using the GeneMark-ES as part of the funannotate workflow. Functional annotation was carried out using the DeepKOALA algorithm, drawing on annotations from the KEGG database and the presence of characteristic Pfam and InterPro domains, including PF01185, PF06766 and PF22354. The protein length, cysteine content and predicted signal peptides were examined. Candidates annotations were further assessed using BLASTp searches against the NCBI non-redundant protein database. Pairwise sequence comparisons were carried out for precursor proteins and predicted mature protein sequences.

An initial screening identified 35 candidate hydrophobin sequences: 3 in G1/26, 10 in G3/26 and 22 in G7/26. Of these, 20 were associated with PF01185, 14 with PF06766 and 1 with PF22354. A total of 23 candidates contained 8 cysteine residues. Comparative analysis revealed identical precursor sequences of PF01185-associated proteins across all 3 strains, as well as an identical pair of PF06766-associated sequences in G3/26 and G7/26. High sequence conservation was also observed among selected predicted mature proteins from G3/26 and G7/26.

These results indicate the presence of a diverse set of hydrophobins in the analysed *Akanthomyces* strains, combining highly conserved sequence variants with potential diversity characteristic of individual strains. These findings provide a basis for further functional characterisation and phylogenetic studies of hydrophobin families in entomopathogenic fungi. Further research into their diversity and mechanisms of action will not only deepen our understanding biology of this fungi but also expand their potential as natural components of innovative and sustainable biotechnological solutions.

Keywords: *Akanthomyces*; hydrophobins; genome analysis; BLASTp; sequence diversity; entomopathogenic fungi.

Acknowledgments

The research was carried out thanks to National Science Centre (NCN), Poland, under the OPUS 27 programme, grant no. 2024/53/B/NZ9/01058

Bibliography

Lameu S de C, Galvão MH, Mello IT, Squina FM. 2026. Fungal Hydrophobins: Taxonomic Distribution, Functional Roles, Physicochemical Properties, and Biotechnological Applications. Journal of Fungi, 12(8), 587, DOI: 10.3390/jof12080587.

From Plant Seeds to Painting Binders: Chemical Composition and Modern Analytical Approaches

Licznar K., Dziągwa-Becker M.

Zakład Herbologii, Instytut Uprawy Nawożenia i Gleboznawstwa PIB, ul.Orzechowa 61, 50-540 Wrocław

Plant-derived oils have been used for centuries as raw materials for oil painting binders. Among the most important sources are flax (*Linum usitatissimum*), poppy (*Papaver somniferum*) and walnut (*Juglans regia*), whose seeds contain oils with different fatty acid compositions and physicochemical properties. These differences influence drying behaviour, oxidative polymerisation and the long-term stability of oil-based materials. The high content of unsaturated fatty acids promotes reactions with atmospheric oxygen, resulting in the formation of cross-linked polymeric structures. During prolonged ageing, further chemical transformations, including lipid oxidation and hydrolysis, occur, leading to changes in material properties and the formation of characteristic degradation products.

This presentation reviews the relationship between the botanical origin, chemical composition, and ageing behaviour of plant-derived oil binders, with particular emphasis on modern analytical methods used for their characterisation. Raman and Fourier-transform infrared (FTIR) spectroscopy provide information on functional groups and chemical changes, while gas chromatography coupled with mass spectrometry (GC–MS) and liquid chromatography–mass spectrometry (LC–MS) enable the identification of fatty acids, triglycerides and lipid degradation products. Chemometric analysis and chemical imaging complement these techniques by facilitating the interpretation of complex datasets and the spatial characterisation of materials. The advantages and limitations of these approaches are considered, particularly in relation to sample size, analytical sensitivity, selectivity, and the challenges posed by aged materials. Understanding the botanical and chemical diversity of plant-derived oils, together with the application of complementary analytical techniques, is essential for characterising historical painting binders and investigating their degradation. This knowledge supports advances in analytical chemistry and contributes to the scientific study and preservation of cultural heritage.

Bibliography

Rigante E. C. L., Calvano C. D., Ventura G., Cataldi T. R. I. 2024. Look but don't touch: Non-invasive chemical analysis of organic paint binders – A review. Analytica Chimica Acta.

Manzano E., Rodriguez-Simón L. R., Navas N., Checa-Moreno R., Romero-Gámez M., Capitan-Vallvey L. F. 2011. Study of the GC–MS determination of the palmitic–stearic acid ratio for the characterisation of drying oil in painting. Talanta, 84(4), 1148–1154.

Tammekivi E., Vahur S., Vilbaste M., Leito I. 2021. Quantitative GC–MS analysis of artificially aged paints with variable pigment and linseed oil ratios. Molecules, 26(8), 2218.

Cadmium Adsorption in Aqueous Solution Using Biochar and Activated Carbons Derived from *Hermetia illucens*

Molua E. I.[1], Siryk O.[1], Nowicki P.[2], Bulak P.[1], Szewczuk-Karpisz K.[1]

[1]*Institute of Agrophysics, Polish Academy of Sciences, Doświadczalna 4, m.elis-bright@ipan.lublin.pl*

[2]*Department of Applied Chemistry, Faculty of Chemistry, Adam Mickiewicz University in Poznań, Uniwersytetu Poznańskiego 8, 61-614 Poznań, Poland.*

Cadmium (Cd) is a highly toxic heavy metal that contaminates soil and water, posing a significant threat to all living organisms and humans. Cd enters the environment through agricultural activities (phosphate fertilizers and pesticides) and industrial activities (Shaari et al., 2022; Jadaa and Mohammed, 2023). The proper management of Cd in the environment is paramount to prevent health risks to humans, animals, and the entire ecosystem. Adsorption is an effective basic strategy for the removal of Cd^{2+} ions from aqueous media (Burakov et al., 2023). This study aimed to investigate the potential of biochar (BC) and two activated carbons (AC) derived from dead imagoes of *Hermetia illucens* for the adsorption of Cd^{2+} ions from aqueous solution.

BC was produced by pyrolysis of biomass at 500 °C, then activated with water vapor at 800 °C to obtain first type of activated carbon (ACI). The second activated carbon (ACD) was obtained by directly activating the biomass at 750 °C. Batch adsorption method was used in the study. For isotherm experiments, initial Cd^{2+} concentrations ranged from 10 to 150 mg/L. Each material (0.01 g) was added to test tubes containing 10 mL of the solution, and pH was adjusted to pH 5. Adsorption was carried out for 24 h. The kinetics experiment assessed adsorption over contact times of 20 min to 24 h using a similar procedure with 100 mg/L Cd^{2+}. The Cd^{2+} concentration was measured using an atomic absorption spectrometer with a graphite cuvette (ContrAA® 800, Analytik Jena).

Analysis of the sorption isotherms showed that both ACs possess a higher sorption capacity toward Cd^{2+} ions than BC. Furthermore, the ACI exhibited the highest sorption capacity (~70 mg/g), removing more than 99% of the Cd^{2+} from solutions with concentrations below 35 mg/L. Kinetic studies showed that Cd removal increased gradually with contact time, and sorption equilibrium was reached after 6–8 h.

Overall, this study demonstrated a great potential of carbon materials produced from dead imagoes of *Hermetia illucens,* especially ACI, for the removal of Cd^{2+} ions from aqueous solutions.

Acknowledgments

The study was funded by the National Science Centre, Poland (Weave-Unisono, 2024/06/Y/NZ9/00183).

Bibliography

Jadaa, W., Mohammed, H. 2023. Heavy metals–definition, natural and anthropogenic sources of releasing into ecosystems, toxicity, and removal methods–an overview study. Journal of Ecological Engineering, 24(6), 249-271.

Shaari, N. E. M., Tajudin, M. T. F. M., Khandaker, M. M., Majrashi, A., Alenazi, M. M., Abdullahi, U. A., Mohd, K. S. 2022. Cadmium toxicity symptoms and uptake mechanism in plants: a review. Brazilian Journal of Biology, 84, e252143.

Burakov, A. E., Galunin, E. V., Burakova, I. V., Kucherova, A. E., Agarwal, S., Tkachev, A. G., Gupta, V. K. 2018. Adsorption of heavy metals on conventional and nanostructured materials for wastewater treatment purposes: A review. Ecotoxicology and environmental safety, 148, 702-712.

Biochar in Insect Rearing: Opportunities and Limitations

Nycz A.[1], Kaczor M.[1], Krzyżaniak M.[2], Przemieniecki S.[3], Szewczuk-Karpisz K.[1], Bulak P.[1]

[1]*Institute of Agrophysics, Polish Academy of Sciences, Doświadczalna 4, Lublin 20-290, Poland*

[2]*Department of Genetics, Plant Breeding and Bioresource Engineering, Faculty of Agriculture and Forestry, University of Warmia and Mazury in Olsztyn, Plac Łódzki 3, 10-724 Olsztyn, Poland*

[3]*Department of Entomology, Phytopathology and Molecular Diagnostics, Faculty of Agriculture and Forestry, University of Warmia and Mazury in Olsztyn, Prawocheńskiego 17, 10-720 Olsztyn, Poland*

Biochar, a carbon-rich material produced through the pyrolysis of biomass, is increasingly considered as a potential feed additive in animal production. Research conducted to this point indicates that supplementing diets with biochar at levels of approximately 0.1–4% of daily feed intake may have a beneficial effect on growth rate, feed efficiency, and the quality of animal products such as meat, milk, and eggs (Nair et al., 2023). Benefits from the use of biochar have been observed in various groups of farm animals, including ruminants, pigs, poultry, and fish. Its presence in the diet may support animal health by positively influencing the gut microbiome and increasing disease resistance. In laying hens, improved nutrient absorption has been demonstrated, particularly for minerals such as calcium and phosphorus (Kazemi, 2025). Furthermore, the results of studies conducted on cattle, goats, pigs, poultry, and fish indicate the potential to increase weight gain while simultaneously reducing the feed conversion ratio (FCR), which demonstrates a more efficient utilization of nutrients (Man et al., 2020).

In contrast to livestock, studies on the effects of biochar on insects have focused less on its nutritional potential and more on assessing its impact on biological processes and the development of specific species. Cook et al. (2018), analysed the survival rates of four species of forest insects exposed to direct contact with biochar and observed a significant decrease in survival rates in three of them. In addition, studies on members of the order *Lepidoptera*, including *Manduca sexta* and *Spodoptera frugiperda*, showed that the presence of biochar in an experimental diet or culture medium generally had a negative effect on growth, survival, and the course of metamorphosis (Wagle et al., 2025). Different observations refer to *Hermetia illucens*, a species characterized by a high ability to adapt to variable environmental conditions. Reyer et al. (2025) did not observe improved larval growth following the addition of biochar; however, they did note increased calcium levels in the larvae and a reduction in the abundance of potential intestinal pathogens, such as *Escherichia* and *Shigella*. In contrast, Beesigamukama et al. (2020), on the other hand, demonstrated that adding a 5% biochar supplement to the culture medium resulted in the highest waste decomposition efficiency by *H. illucens* larvae.

The current results therefore indicate that biochar has different effects on insects, depending, among other things, the species studied, the experimental conditions, and the characteristics of the biochar itself. There is still a lack of conclusive evidence to determine whether its use in the rearing of insects intended for feed and food purposes can consistently support their growth and development. The aim of this presentation is to present the current state of knowledge regarding the use of biochar in insect nutrition and to discuss the effects of its use observed so far.

Acknowledgments

This work was funded by the National Science Centre, Poland, Opus 28 number 2024/55/B/NZ9/02474.

Bibliography

Beesigamukama D. et al. 2020. Biochar and gypsum amendment of agro-industrial waste for enhanced black soldier fly larval biomass and quality frass fertilizer. PLoS ONE, 15, e0238154.

Cook S. P. et al. 2018. Laboratory evaluation of the direct impact of biochar on adult survival of four forest insect species. Northwest Science, 92, 1–8.

Kazemi M. 2025. Biochar in animal agriculture: Enhancing health, efficiency and environmental sustainability. Veterinary Medicine and Science, 11, e70629.

Man K. Y. et al. 2020. Use of biochar as feed supplements for animal farming. Critical Reviews in Environmental Science and Technology, 51, 187–217.

Nair P. S. et al. 2023. Beneficial impacts of biochar as a potential feed additive in animal husbandry. Journal of Experimental Biology and Agricultural Sciences, 11, 479–499.

Reyer H. et al. 2025. Microbial profiling of black soldier fly larvae reared on substrates supplemented with different mineral sources originating from phosphorus recycling technologies. Animal Microbiome, 7, 14.

Wagle N. et al. 2025. Biochar suppresses growth, pupation and eclosion success of a specialist (*Manduca sexta*) and a generalist (*Spodoptera frugiperda*) insect herbivore. Journal of Sustainable Agriculture and Environment, 4, e70069.

Determination of the Quantity Characterising the Susceptibility of Soils to Splash Erosion - Doctoral Thesis Concept

Pelczar R., Sochan A.

Institute of Agrophysics PAS, Doswiadczalna St. 4; 20-290 Lublin, r.pelczar@ipan.lublin.pl; a.sochan@ipan.lublin.pl

Water erosion poses a serious threat to agricultural land in Europe (1). Its initial stage is splash erosion, which occurs when raindrops (or hailstones) come into contact with the soil surface. This phenomenon leads to the detachment of soil particles from the surface, the destruction of soil aggregates, and may result in localised compaction and the formation of a surface crust (2), which facilitates further stages of soil erosion. Despite the significant importance of this phenomenon, there is no universal, accurate parameter defining the susceptibility of soils to splash erosion.

The main objective of the research is to develop and validate an index or set of indices that quantitatively differentiates the susceptibility of soils to splash erosion. The study will cover 100 soils representative of the Central European region. The experiments will be based on the single-drop or drop-sequence method, with drops generated by a precision dosing system at a controlled height, thereby enabling their energy to be controlled. The dynamic interaction of the drops with the soil will be recorded using a synchronised system of three so-called high-speed cameras, connecting to particle tracking software (3D-PTV)(3). This allows for the precise determination of velocity vectors, trajectories and ejection angles, as well as the number of ejected soil particles. The second method based on a structural light scanner will enable the parametrisation of the surface deformation (4). A comparison of the soil surface before and after drop impact allows the resulting crater to be characterised, including the calculation of its depth, diameter and volume. The use of a splash cup with an internal trough will provide the collection and analysis of the splashed material during the drop impact onto soil Surface (5). This methodolgy the mass ratio of splashed particles to be determined, including their separation into the ejected liquid phase (water) and a solid phase (soil particles).

The physical parameters obtained will be used to formulate a susceptibility index, which will be correlated with the fundamental physico-chemical properties of soils (e.g. grain size, moisture content, aggregate stability, organic carbon content and pH). The results will be used to develop a soil splashability classification scheme and will provide essential input for process-based land degradation models, thereby reducing their uncertainty and supporting the implementation of the European Green Deal's objectives (6).

Acknowledgments

The study was partially funded by the National Science Centre, Poland, in the frame of project no. 2024/55/B/ST10/01326.

Bibliography

Panagos P., Ballabio C., Himics M., Scarpa S., Matthews F., Bogonos M., Poesen J., Borrelli P. 2021. Projections of soil loss by water erosion in Europe by 2050. Environmental Science & Policy, 124, 380-392.

Beczek M., Ryżak M., Sochan A., Mazur R., Polakowski C., Hess D., Bieganowski A. 2020. Application of 3D Particle Tracking Velocimetry for tracing splash phenomenon of soil particles. Geoderma, 378, 114592.

Sochan A., Beczek M., Mazur R., Polakowski C., Ryżak M., Bieganowski A. 2023. Analysis of soil splash phenomena using high-speed cameras and 3D structural light scanning. PLoS ONE, 18, e0285611.

Beczek M., Mazur R., Ryżak M., Sochan A., Polakowski C., Beczek T., Bieganowski A. 2022. How much raindrop energy is used for transportation of the two-phase splashed material? Geoderma, 425, 116034.

Hu F., Liu J., Xu C., Wang Z., Liu G., Li H., Zhao S. 2018. Soil aggregate breakdown and crust formation under simulated rainfall. Geoderma, 320, 43.

Panagos P., Vieira D., Eekhout J.P.C., Biddoccu M., Cerdà A., Evans D.L., Tavoularis N., Bezak N., Negrel P., Katsoyiannis A., Borrelli P. 2024. The EU Soil Observatory (EUSO) erosion monitoring network. Environmental Research, 248, 118319.

Methane Oxidation Potential in Grassland soils – Preliminary Results of a Laboratory Experiment

Rafalska A., Walkiewicz A.

Institute of Agrophysics, Polish Academy of Sciences, Doświadczalna 4, 20-290 Lublin, Poland; adrianna.rafalska@ipan.lublin.pl

Soils play a role in methane (CH_4) cycle through microbial production and oxidation. Aerobic methanotrophs can act as a biological filter, limiting CH_4 emissions and contributing to the uptake of atmospheric CH_4 (Wang et al., 2023; Lim et al., 2024). Organic and mineral soils may co-occur within the same grassland, particularly where pastures have been established on former peatlands. In these areas, soil moisture, oxygen availability and organic matter content can vary over short distances resulting in different conditions for CH_4 production and oxidation. Although it has been shown that microbial activity determines the spatial heterogeneity of CH_4 fluxes in wetlands (Arnold et al., 2023), such small-scale heterogeneity remains poorly characterized in temperate pastures, which are often treated as homogeneous units in sampling and emission studies. Examining spatial variation in CH_4 oxidation potential in grassland soils may therefore provide information on its relationships with local soil conditions. The aim of this study was to assess the small-scale spatial variability of methane oxidation potential in the transition zone between organic and mineral soil on pasture and to investigate its relationships with soil properties.

Soil samples were collected along transects within a permanent pasture in eastern Poland. Methane oxidation was assessed in laboratory soil incubations under controlled temperature and the two moisture conditions with CH_4-enriched headspace. Changes in CH_4 concentrations were monitored by gas chromatography, and spatial variation in CH_4 oxidation potential and its relationships with selected soil properties were examined.

The CH_4 oxidation potential varied among sampling points under both moisture conditions, with localized differences along transects. Spatial variability differed between the two soil moisture levels. Correlations were found between CH_4 oxidation potential and selected physicochemical and biological parameters, including pH, organic carbon, total nitrogen, ammonium nitrogen, soil texture and dehydrogenase activity.

These results highlight substantial small-scale heterogeneity in CH_4 oxidation potential within a single pasture, and its relationship with the edaphic conditions. The observed patterns suggest that local soil conditions should be taken into account when interpreting soil methanotrophy, alongside with the distinction between organic and mineral soils. Sampling at multiple locations helped to capture differences that might have been overlooked with sparse sampling. Accounting for this variability may therefore improve the representativeness of soil sampling and the interpretation of

laboratory measurements. The results describe potential methanotrophs activity, however further field measurements and repeated sampling are needed to assess whether these spatial patterns persist over time and correspond to differences in methane exchange under natural conditions.

Acknowledgments

The research was carried out partly thanks to the Polish National Centre for Research and Development within the framework of the HOLOSEU project (ICTAGRIFOOD/III/64/HOLOSEU/2025), ERA-NET CO-FUND ICT-AGRI-FOOD programme.

Bibliography

Arnold, W., Taylor, M., Bradford, M., Raymond, P., Peccia, J. 2023. Microbial activity contributes to spatial heterogeneity of wetland methane fluxes. Microbiology Spectrum, 11(5), e02714-23.

Lim, J., Wehmeyer, H., Heffner, T., Aeppli, M., Gu, W., Kim, P. J., Horn, M. A., Ho, A. 2024. Resilience of aerobic methanotrophs in soils; spotlight on the methane sink under agriculture. FEMS Microbiology Ecology, 100(3), fiae008.

Wang, Y., Cai, Y., Hou, F., Bowatte, S., Jia, Z. 2023. Elevated and atmospheric-level methane consumption by soil methanotrophs of three grasslands in China. Grassland Research, 2(2), 85-95.

Cold- and Hot-water-extractable Carbon as Complementary Indicators for Soil Organic Carbon Monitoring in Cropland Profiles

Ren T., Debaene G., Ukalska-Jaruga A., Smreczak B.

Department Soil Science and Environmental Analyses, Institute of Soil Science and Plant Cultivation-State Research Institute, Puławy, Poland; tren@iung.pulawy.pl

Cold-water extraction (CWE) and hot-water extraction (HWE) recover operationally different fractions of soil dissolved organic matter (DOM), but how the amount of dissolved organic carbon (DOC) and DOM composition differ between the methods, and how this contrast varies with depth, remains unclear. We combined a global database (2,911 observations, 137 studies) with a long-term field experiment sampled to 90 cm. Globally, HWE recovered four to five times as much DOC as CWE, both after covariate adjustment and within studies applying both methods to the same soils, whereas CWE-recovered DOM had higher aromaticity per unit carbon. The field profile reproduced both contrasts. HWE released two to nearly four times more DOC than CWE, and HWE-recovered DOM had lower SUVA280 and higher E4/E6. The method difference narrowed with depth (method × depth, $p < 0.001$), as HWE-DOC declined by 79% from 0-30 to 60-90 cm versus 58% for CWE-DOC. The CWE:HWE ratio of DOC rose from 0.27 to 0.53 and correlated positively with clay, the clay-to-organic-carbon ratio, pH and cation exchange capacity, and negatively with available phosphorus and other nutrient and organic-matter indicators. Cropping system did not affect the ratio but changed the share of soil organic carbon (SOC) recovered by hot water, which under rotation was highest in the topsoil and declined steeply with depth. The two extractions thus separate a management-responsive fraction, captured by extractable DOC and its share of SOC, from a depth- and mineral-associated partitioning captured by the CWE:HWE ratio, providing a simple indicator for SOC monitoring.

Acknowledgments

The European Joint Project COFUND (EJP SOIL) – "Towards climate smart sustainable management of agricultural soils" (862695) financially supported this work.

Bibliography

Ghani, A., Dexter, M., & Perrott, K. W. 2003. Hot-water extractable carbon in soils: a sensitive measurement for determining impacts of fertilisation, grazing and cultivation. Soil Biology and Biochemistry, 35(9), 1231-1243.

Chantigny, M. H., Harrison-Kirk, T., Curtin, D., Beare, M. 2014. Temperature and duration of extraction affect the biochemical composition of soil water-extractable organic matter. Soil Biology and Biochemistry, 75, 161-166.

Ecotoxicological Assessment of $NH_{3(aq)}$-modified Biochar: Effects on Early Seedling Development and Ostracods Growth

Sama D.K., Kaczor M., Szewczuk-Karpisz K.

Institute of Agrophysics, Polish Academy of Sciences; d.kwayela-sama@ipan.lublin.pl

Processing post-harvest residues into biochar yields a material with a wide range of applications, aligning with the latest circular economy strategy, which includes the "European Green Deal". It has been demonstrated that biochar holds immense potential for removing pollutants, improving soil fertility, enhancing microbial activity, increasing nutrient and water retention, boosting crop yields, and reducing greenhouse gas emissions. (da Costa et al., 2024). However, when applied incorrectly, it may be harmful to the environment (Godlewska et al., 2021; da Costa et al., 2024). This occurs both indirectly through environmental changes and directly through the release of harmful compounds (Godlewska et al., 2021). This research aimed to examine the ecotoxicity of $NH_{3(aq)}$-modified biochar on the germination and development of cress and sorghum, as well as on the growth of ostracods.

Three ecotoxicological assessment methods were employed: (1) plant assay using liquid extracts of the solid samples, (2) plant assay using OECD soil, and (3) ostracod *Heterocypris incongruens* assay using OECD soil. The aqueous extract assay followed the method described by Siryk et al. (2024). Briefly, 0.1 g of each solid sample was mixed with 10 mL of distilled water and shaken for 24 h. Later, 5 mL of the supernatant was transferred to a Petri dish containing an ashless filter paper, and 10 seeds of either cress or sorghum were added. The dishes were incubated for 72 h. Plant and ostracods assays using OECD soil were performed in accordance with the ISO 18763 and ISO 14371 standards, respectively. The solids were applied at a dosage of 1% (by mass of soil). Root and shoot lengths were measured with ImageJ, and biomass was determined with a balance.

The modified biochar showed decreased ecotoxicological effects and improved biological performance across all three assessments. In the plant assays using extracts and OECD soil, the growth index (GI) increased by 6–65% relative to the control. In the ostracod assay, a growth stimulation was noted, which ranged from 2 to 3%.

These findings suggest that the developed $NH_{3(aq)}$-modified biochars reduce ecotoxicological effects, promoted early seedling development of cress and sorghum, and biostimulated ostracod growth.

Keywords: Environmental safety, biostimulation, chemically modified-biochar

Bibliography

da Costa, V. B., Ogura, A. P., Alexandre, D. S., Soares, M. B., Alleoni, L. R. F., Espíndola, E. L. G., da Silva Pinto, T. J. 2024. How much biochar is safe? Exploring potential ecotoxicological consequences for soil invertebrates and plants. Applied Soil Ecology, 202, 105552.

Godlewska, P., Ok, Y. S., & Oleszczuk, P. 2021. The dark side of black gold: Ecotoxicological aspects of biochar and biochar-amended soils. Journal of hazardous materials, 403, 123833.

Siryk, O., Wnuk, A., Galaburda, M., Goncharuk, O., Guzenko, N., Kondracki, B., & Szewczuk-Karpisz, K. 2024. Separation of plant protection products from complex aqueous bodies using carbon-mineral composites incorporated with double metals (Ni/Mn orNi/Fe). Chemosphere, 362, 142917

Tomczyk, B., Siatecka, A., Bogusz, A., & Oleszczuk, P. 2021. Ecotoxicological assessment of sewage sludge-derived biochars-amended soil. Environmental Pollution, 275, 116484.

Soil Bacterial Communities Under Wheat Monocropping and Intercropping Across Contrasting Production Systems

Sisodia P.[1], Gryta A.[1], Siegieda D.[1], Panek J.[1], Oszust K.[1], Pylak M.[1], Mącik M.[1], Feledyn-Szewczyk B.[2], Pathan S.I.[3], Pietramellara G.[3], Frąc M.[1]

[1]*Institute of Agrophysics, Polish Academy of Sciences, Lublin, Poland;* m.frac@ipan.lublin.pl

[2] *Institute of Soil Science and Plant Cultivation – State Research Institute, Pulawy, Poland*

[3]*Department of Agriculture, Food, Environment and Forestry, University of Florence, Italy*

This study examined soil bacterial diversity and community composition in a spring wheat field experiment at the Osiny Experimental Station, Poland. We compared conventional, integrated, and organic wheat monocropping with integrated wheat-red clover and organic wheat-red clover-grass intercropping. Bulk soil collected at the wheat kernel development stage was analysed using 16S rRNA gene amplicon sequencing, with ANCOM-BC2 used to identify differentially abundant taxa.

Bacterial alpha diversity did not differ significantly among the five management variants, whereas community composition differed significantly (PERMANOVA, p = 0.001). Conventional monocropping was separated from the other variants in the ordination. Robust genus-level differences were confined to the comparison between organic intercropping and conventional monocropping: *Cellulomonas* was more abundant in organic intercropping, while *Massilia*, *Nitrosospira*, and *Deinococcus* were more abundant in conventional monocropping. Family-level analysis revealed additional differences among the long-term management variants. However, no robust genus- or family-level differences were detected between intercropping and monocropping within either the integrated or organic system.

Overall, the sampled management plots differed in bacterial community composition and selected taxa without significant differences in alpha diversity. The clearest differential-abundance signals occurred between organic intercropping and conventional monocropping, while the within-system comparisons provided limited evidence of additional taxonomic differentiation associated with intercropping.

Acknowledgments

The presented research was supported by the project entitled “Legume-cereal intercropping for sustainable agriculture across Europe” within the framework of the Horizon Europe Program, funded by the European Commission, agreement no. Project 101082289 – LEGUMINOSE.

Bibliography

Djemiel C., Maron P.A., Terrat S., Dequiedt S., Cottin A., Ranjard L. 2022. Inferring microbiota functions from taxonomic genes: a review, GigaScience, 11, giab090, DOI: 10.1093/gigascience/giab090

Fu Y., Tang X., Sun T., Lin L., Wu L., Zhang T., Gong Y., Li Y., Wu H., Xiong J., Tang R. 2024. Rare taxa mediate microbial carbon and nutrient limitation in the rhizosphere and bulk soil under sugarcane–peanut intercropping systems. Frontiers in Microbiology, 15:1403338, DOI: 10.3389/fmicb.2024.1403338.

Ma H., Surigaoge S., Xu Y., Li Y.-C., Christie P., Zhang W.-P., Li L. 2024. Responses of soil microbial community diversity and co-occurrence networks to interspecific interactions in soybean/maize and peanut/maize intercropping systems. Applied Soil Ecology, 203, 105613, DOI: 10.1016/j.apsoil.2024.105613.

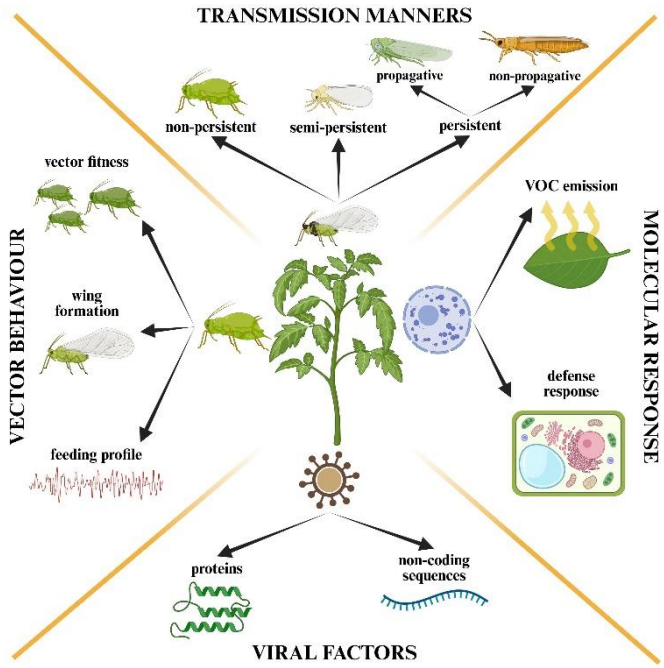
Zhang S., Li S., Meng L., Liu X., Zhang Y., Zhao S., Zhao H. 2024. Root exudation under maize/soybean intercropping system mediates the arbuscular mycorrhizal fungi diversity and improves the plant growth. Front. Frontiers in Plant Science, 15:1375194, DOI: 10.3389/fpls.2024.1375194.

Effects of Viral Suppressor of Post-transcriptional Gene Silencing on Three-way Virus-aphid-tomato Interactions. Role of 2b CMV in Modification of Insect Vector Behaviour

Zalewski P., Wieczorek P., Obrępalska-Stęplowska A.

Institute of Plant Protection – National Research Institute, 20 Władysława Węgorka Street, 60-318 Poznań; Poland, p.zalewski@iorpib.poznan.pl

Cucumber mosaic virus (CMV; *Cucumovirus*, *Bromoviridae*) infects numerous crop species, including tomato (*Solanum lycopersicum* L.). It also serves as a model organism in studies of tripartite virus-plant-insect interactions (Palukaitis & García-Arenal, 2003). In this context, viral suppressors of post-transcriptional gene silencing (PTGS), which is induced as one of the plant's defense responses, may play an important role in virus transmission process. In cucumoviruses, the 2b protein functions as the PTGS suppressor. The green peach aphid (*Myzus persicae*) is one of the aphid species that transmit CMV in a non-persistent manner (Ziebell et al., 2011). Here we hypothesized that the CMV 2b protein promotes viral spread by altering plant-vector interactions.



The aim of this study was to determine the influence of CMV 2b protein on vector-mediated viral transmission and the fitness and behavior of insect vectors.

The study utilized the wild-type CMV virus (Fny-CMV), its mutant lacking the 3' end of gene encoding 2b (CMVΔ2b), three tomato profile cultivars (Ailsa Craig, Castlemart, and UC82B), their mutants with impaired phytohormone synthesis pathways and *M. persicae* aphids. To achieve established objectives following methods were exploited: orientation preferences by olfactometer, population growth evaluation and feeding profile examination by EPG.

In the presented research model, differences in the analyzed parameters were observed depending on the CMV variants used, as well as on the genetic background of the plant host. In conclusion, our results showed that the CMV 2b protein modulate the attraction of infected tomato plants for aphids and alter their reproduction rate and feeding profile.

Acknowledgments

The research was funded by the National Science Centre (NSC), Poland, under the OPUS project no. 2021/43/B/NZ9/02626.

Bibliography

Palukaitis, P., García-Arenal, F. 2003. Cucumoviruses. Advances in virus research, 62, 241-323.

Ziebell, H., Murphy, A. M., Groen, S. C., Tungadi, T., Westwood, J. H., Lewsey, M. G., ... Carr, J. P. 2011. Cucumber mosaic virus and its 2b RNA silencing suppressor modify plant-aphid interactions in tobacco. Scientific reports, 1(1), 187.

ISBN 978-83-68333-00-8
FREE COPY / EGZEMPLARZ BEZPŁATNY

think green

Workshops for Young Researchers

ORGANISERS

INSTITUTE OF AGROPHYSICS PAS

PAN POLISH ACADEMY OF SCIENCES Lublin Branch

Project co-financed by the Polish Academy of Sciences under the 'MOST PAN' grant scheme.

The 6th Workshops for Young Researchers 2026 are also co-organised with the support of the Polish Academy of Sciences as part of its Science Dissemination and Promotion Activities programme (UiPDN PAN).



MOST PAN

PAN POLISH ACADEMY OF SCIENCES