

11th International Scientific Meeting EURASIAN SOIL CONGRESS 2025

International Congress on
"Innovations in Soil Science and Plant
Nutrition under Climate Change"

1 – 4 September 2025
Ondokuz Mayıs University, Samsun, TÜRKİYE

11th

ABSTRACT BOOK



**emiSS
Master**



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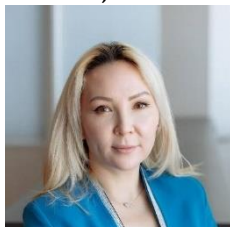
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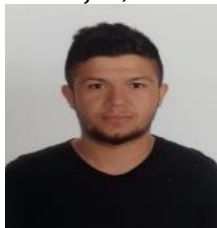
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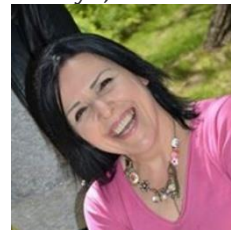
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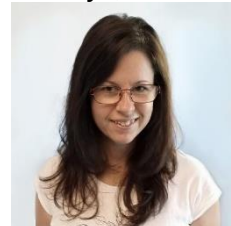
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Preface I

Distinguished Participants,

It is with great pleasure and honor that I welcome you to the 11th International Congress on Innovations in Soil Science and Plant Nutrition under Climate Change (Eurasian Soil Congress 2025), held on 1–4 September 2025 in Samsun, Türkiye, under the auspices of Ondokuz Mayıs University, in collaboration with the Soil Science Society of Turkey (SSST), the Federation of Eurasian Soil Science Societies (FESSS), and the Erasmus Mundus Master in Soil Science (emiSS) program.

This congress serves as a significant platform for scientists, researchers, policymakers, and industry representatives to exchange knowledge, share experiences, and discuss the latest advances in soil science, plant nutrition, and sustainable agricultural practices under the challenges of climate change. The participation of delegates from various countries reflects the truly international nature of our scientific community and fosters cooperation beyond borders.

Following the evaluation process by the Scientific Committee, a total of 87 papers submitted by researchers from 18 different countries have been accepted for presentation—either as oral or poster sessions—at this congress. This number clearly demonstrates both the scientific diversity and the global relevance of our meeting.

The Abstract Book compiles the summaries of all accepted oral and poster presentations, offering an overview of the diversity and depth of topics addressed during the congress. The Book of Proceedings further extends this knowledge base by publishing full-text contributions, ensuring that the valuable findings presented here remain accessible to the scientific community for years to come.

On behalf of the Organizing Committee, I express my deepest gratitude to all authors, reviewers, session chairs, invited speakers, and sponsors whose efforts have contributed to the success of this congress. I also extend my sincere appreciation to our international and national participants for their interest, enthusiasm, and active engagement.

It is my hope that the ideas and collaborations generated during this congress will inspire new research, innovative practices, and sustainable solutions to the pressing challenges facing our soils and agricultural systems in a changing climate.

I wish you all an intellectually stimulating and fruitful congress, and I look forward to the outcomes and collaborations that will emerge from our discussions in Samsun.



Prof. Dr. Rıdvan Kızılkaya
Chair of the Congress
Eurasian Soil Congress 2025



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Preface II

Dear participants,

It is my great pleasure to attend the International Congress on “Innovations in Soil Science and Plant Nutrition under Climate Change” as a part of organizing committee. This Congress has been organized by the Federation of Eurasian Soil Science Societies (FESSS) collaborating with ERASMUS MUNDUS Joint Master Degree in Soil Science (emiSS) programme. The emiSS programme has been founded with the support of the Erasmus+ Programme of the European Union and organized by a consortium of the universities: Ondokuz Mayıs University (OMU-Turkey), University of Agriculture in Krakow (UAK-Poland), Agricultural University Plovdiv (AU - Bulgaria), Southern Federal University (SFedU - Russia) and Jordan University of Science and Technology (JUST- Jordan) in 2019. The aim of emiSS programme is to raise and meet the need for qualified and skilled soil scientists at the master level through a higher educational programme under the training in soil science, soil management, soil fertility, soil ecosystem with intercultural competence and language skills. So far, 73 international students from the different geographical parts of the World (Europe, Africa, Latin America, Central Asia, Pacific's, Middle East etc.) have been graduated with MSc degree in Soil Science between 2020-2025. Some of emiSS students are among us and make an oral presentation during the Congress. I hope that the mission of the congress will be successful with sharing novel access that fulfill the needs of applications in soil science and plant nutrition field, and identifying new directions for future researches and developments in soil science area. At the same time, this symposium will give researchers and participants a unique opportunity to share their perspectives with others interested in the various aspects of soil science. I hope this symposium also will be helpful to increase young soil scientists' knowledge and their presentation skills front of the audience. Once more I would like to thank the all supporting organizations and all participants to their helps and sharing their scientific knowledge in this congress.



Prof. Dr. Coşkun GÜLSER
emiSS Coordinator



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Preface III

Distinguished Scientists and Dear Participants,

On behalf of the Eurasian Soil Science Federation, it is my great honor to welcome you all to the 11th International Eurasian Soil Congress and this significant scientific gathering with the theme “Innovations in Soil Science and Plant Nutrition under Climate Change”, here in Samsun, on the beautiful shores of the Black Sea.

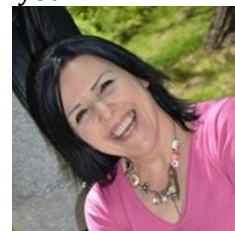
This congress is not merely a scientific meeting, but also a global platform that brings together collective wisdom, science, and innovative solutions for our common future. Soil is the foundation of agriculture, ecosystems, and human life. Yet today, global challenges such as climate change, increasing population pressure, soil degradation, water scarcity, and biodiversity loss seriously threaten the productivity and sustainability of soils. Therefore, the discussions we will have here and the solutions we will generate are of vital importance, not only from an academic standpoint but also in socio-economic and environmental contexts. The theme of our congress aims to address innovative approaches in soil science and plant nutrition, particularly in the context of adaptation to and mitigation of climate change. Today, a wide range of scientific presentations will be delivered, covering topics from precision agriculture technologies to the use of biofertilizers and biostimulants, and from the development of carbon sinks to circular economy models. These approaches will enable us to take important steps toward both increasing production efficiency and protecting soil health.

Interdisciplinary cooperation is crucial in mitigating the impacts of climate change and ensuring the sustainability of agricultural production. We must integrate knowledge from geology, ecology, microbiology, chemistry, engineering, and the social sciences into a holistic perspective of soil science. This congress provides a valuable opportunity to bring together scientists, researchers, policymakers, and private sector representatives from different disciplines, allowing us to develop comprehensive and applicable solutions for the future.

The Eurasian region is uniquely rich in terms of agricultural production, biodiversity, and natural resources. However, this richness also comes with shared challenges. Threats such as soil erosion, salinization, organic matter loss, acidification, and pollution know no borders. Therefore, our solutions must be shaped through international solidarity and knowledge sharing. In this regard, this congress stands as one of the best examples of scientific diplomacy.

The historical and cultural heritage of Samsun adds a special value to our congress. This beautiful city of the Black Sea is a developed center in many areas, from agricultural production to industry, and from natural resources to cultural heritage. I believe that the scientific discussions to be held here will pave the way for new collaborations on both regional and global scales. Before I conclude, I would like to thank the entire organizing committee, scientific boards, our sponsors, and all researchers who have contributed to the organization of this congress. I wish that our scientific exchanges will be fruitful and lead to new friendships and collaborations.

I wish you all a successful, productive, and inspiring congress. Thank you.



Prof. Dr. Ayten NAMLI,
President of the Soil Science Society of Türkiye (SSST)
President of the Federation of Eurasian Soil Science Societies (FESSS)



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Abstracts





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Soil, water and agriculture in the global climate change and world situation change processes

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ABSTRACT

There is no doubt that climate change and world changing processes play significant role in our human activities such as water management, agriculture, environment and in fact in our daily life. There are several main key drivers influencing agriculture, water management, and food production. Compared to the situation around 2020 the sequence of importance of key drivers has been changed. First key driver seems to be an access to water resources with combination of soil resources. It must be noted, that in 2025 farming "consumes" more than 70 % of all world freshwater withdrawals! Definitely, this is not the right business the human society might do in the future. There are other limiting factors like: population growth, urbanization, war conflicts and political instability, dietary change, globalization, biofuel production, and hydropower. However, water resources have become dominant. The UN estimated the World population in 2021 around 7.5 billion. The expectation is the population increases by 1.5 billion (to 9 billion) in 2050. So, it is necessary to find food resources for such as population and to protect the environment as much as possible. The keynote speech discusses all listed factors. It also shows the estimates of needs in 2050. It is clearly documented, that for an application so called "business as usual" is almost impossible to get relevant water resources in the World.

Key words: Water resources, soil, irrigated agriculture, rainfed agriculture, food production

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Pedogenetic conditions of the deriving soils in the Carpathian Mountains

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ABSTRACT

The aim of this study was to characterize soil cover and the influence of abiotic and biotic factors on its development in the Polish part of the Carpathians, encompassing the Foothills, Beskids, Pieniny, Bieszczady, and Tatra Mountains. These areas differ in their topography, geology, and soil parent material, as well as climatic and water conditions. The Carpathians are also diverse in terms of vegetation. The synthesis was based on scientific publications, soil maps from Carpathian national parks, and many years of experience in conducting soil science research in the Carpathians in Poland. Soil taxonomic units are presented according to the FAO WRB 2014 classification. In the Polish Carpathians, Cambisols and Luvisols occupy the largest areas. Cambisols (Dysric or Eutric) dominate the areas covered by the weathered rocks of the Carpathian flysch. Luvisols occur in areas of loess cover, where Phaeozems also have a small share. In smaller areas, depending on the geological substrate or parent material, and water conditions, the following topographic features have developed: Leptosols, Regosols, Podzols, Fluvisols, and Gleysols or Stagnosols. The dominant role of the geological substrate and parent material is most evident in the low and middle mountain areas at altitudes of 300-1200 m above sea level. The role of topographic features in shaping the soil cover of the Carpathians is most evident in areas with highly diverse morphology, above the upper timberline (>1300 m above sea level) in the Tatra Mountains, where morphogenetic processes are highly active. Climatic conditions resulting from the absolute altitude also have a significant impact on the development of vegetation, influencing the course and development of soil-forming processes – the accumulation and decomposition of organic material and the movement of mineral and organic components within the soil profile.

Key words: Soil genesis, mountain soils, soil map

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Impact of long-term power station emissions on the distribution of priority polycyclic aromatic hydrocarbons in soil

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ABSTRACT

Soils near industrial sites often contain polycyclic aromatic hydrocarbons (PAHs), which are carcinogenic and persistent organic contaminants. To develop a remediation strategy and understand the risks to the environment, it is important to study how PAHs accumulating and degrading over the time. The objectives of this research was to study how the increasing of industrial activity affects the types and amounts of 15 priority PAHs in soils affected by a large power plant in the southern Russia. Methods of research: Over the ten years, soil samples were collected to study the tendencies of 15 important PAHs distribution due to increasing of industrial pollution. Quantitative determination of PAHs in the extracts was carried out by high-performance liquid chromatography (HPLC) using an Agilent 1260 system with a fluorescence detector, in accordance with the international standard ISO 13877-2005. Results: The study found that between 2012 and 2022, the total amount of 15 priority PAHs, as well as the levels of individual PAH compounds, increased significantly in the affected soils. This tendencies were particularly noticeable for the more easily degrading low-molecular-weight PAHs compounds, indicating that the soil's biodegradation potential to PAHs was limited by the continuous input of new contaminants. Conclusions: The main source of PAHs accumulation in the topsoil was the strength of the pollution sources combined with the area's typical wind distribution according the prevailing wind direction rose. In addition the main feature of aerotechnogenic pollution in the studied zone was accumulation of the high-molecular-weight compounds like fluoranthene and pyrene, which becomes more prevalent.

Key words: Environmental impact, Pollutant accumulation, Soil contamination, Technogenic load, Coal burning, Electric Power Station

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Dynamics in soil properties across different cropping systems in soils of Dadin Kowa, Gombe State, Nigeria

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ABSTRACT

This study aimed at evaluating changes in physical and chemical characteristics of soils across three cropping systems (rice, tomato and mango) in Dadin kowa, Gombe State. To achieve this aim, two soil profile pits were dug in each of the cropping systems, described and sampled. The collected soil samples were then analyzed using standard Laboratory procedures. The results revealed that mean sand content (69.18 - 85.6%) was found to be the dominant particle size, while bulk density, particle density and total porosity values varied between 1.58 - 1.68 g/cm³, 2.45 - 2.67 g/cm³ and 36.02 - 39.09%, respectively. The soil reaction was slightly acidic to neutral (pH 6.51 – 6.72), while organic carbon, total nitrogen and available phosphorus content of the studied soils were rated high, low and low, respectively. The results further revealed that most of the soil properties were rarely influence by differences in cropping systems. It was also observed, that the major agronomic constraint of the studied soils was low nutrient reserve. For sustainable agriculture, management strategies start by mitigating the continuous loss of soil nutrients through continuous cultivation dominantly practiced in rice and tomato cropping system through crop residues retention, crop rotation and agro-forestry practice.

Key words: Cropping Systems, Dynamics, Porosity, Soil Properties, Sustainable

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Enhanced rock weathering: A promising geoengineering strategy for atmospheric CO₂ removal and acid soil reclamation – Evidence from Indian Conditions

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ABSTRACT

A possibly important but yet-to-be-better-understood carbon di-oxide (CDR) option is the enhanced weathering (EW) of rocks. The mineralogical composition of basalt rock dust (BRD) originating from the Saurashtra region, India was analyzed through an X-ray diffractometer and its behavior was continuously assessed in acid-aqueous solutions of different pH levels. An incubation experiment was performed for 128 days at 25 °C temperature to study the effect of BRD, with and without the addition of organic matter (OM) on cumulative C emission (C_t). The BRD was dominated by feldspars and exhibited an alkaline pH. The BRDs effectively increased the pH of acidic aqueous solutions, moving them toward neutrality irrespective of the initial pH level, signifying that BRDs have a greater neutralizing effect in more strongly acidic conditions. The C_t from treatments containing only BRDs was similar to that from control throughout the incubation period. The addition of lime led to a significant increase in C_t. The organic matter amended treatments *i.e.*, OM, OM + BRD_{2.5}, OM + BRD₅, OM + BRD₁₀ and OM + BRD₂₅ showed significantly higher C_t compared to the lime-amended treatment. However, treatments with higher BRD doses (OM + BRD₅, OM + BRD₁₀ and OM + BRD₂₅) exhibited significantly lower C_t than the treatment with only OM-amended soil. The low heavy metal content of BRDs from the Saurashtra region, India supports their safe and effective use in acid soils, making them a valuable component of sequestering atmospheric carbon. The study suggested that BRDs could be recommended at an application rate of 8 t ha⁻¹, combined with organics at 10 t ha⁻¹ to achieve a carbon dioxide removal (CDR) potential of 356 kg ha⁻¹.

Key words: Climate change, Negative emission technologies, Incubation experiment, Carbon emission, Carbon dioxide removal

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Sustainable agriculture with *Citrobacter freundii* AF-56: Reducing chemical footprint for a healthier environment

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ABSTRACT

Intensified agricultural practices have led to soil degradation, compromising ecosystem services and human health. To address this, microbial inoculants have emerged as a promising strategy. This study isolated and characterized a potent plant root-associated beneficial bacterium, *Citrobacter freundii* AF-56, from soil of a completely unexplored area of subdivision Dhirkot, AJK. AF-56 exhibited multiple plant growth-promoting traits, including IAA production ($22.67\mu\text{g mL}^{-1}$), nitrogenase activity ($31.68\mu\text{g mL}^{-1}$), and phosphorus solubilization ($41.4\mu\text{g mL}^{-1}$) showing significant decrease in pH (from 7 to 4.74) due to the production of oxalic acid, malic acid and gluconic acid. It also demonstrated metabolic diversity, antibiotic resistance, and antagonistic activity against *Fusarium oxysporum*. Inoculation with AF-56 significantly enhanced sunflower growth in hydroponic, sterilized soil, and field conditions along with yield, and oil content. Moreover, AF-56 was able to colonize sunflower roots forming a biofilm like structure; documented through *yfp*-labelling by confocal laser scanning microscopy as well as through immunogold labeling coupled with transmission electron microscope. This study highlights the potential of *Citrobacter freundii* AF-56 as a biofertilizer candidate, offering a sustainable solution to enhance sunflower yield while reducing chemical fertilizer application and mitigating pollution crises. The findings of this study contribute to the development of eco-friendly agricultural practices.

Key words: Microbial Inoculants, N₂ Fixation, Colonization potential, Sustainable Development

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The effect of clinoptilolite on the movement of nickel heavy metal in soil and plants

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ABSTRACT

Soil contamination, particularly the accumulation of heavy metals, poses a significant threat to environmental sustainability and agricultural productivity. Nickel (Ni), a heavy metal, is naturally present in soils; however, its concentration can increase due to industrial pollution, excessive fertilizer use, and mining activities, leading to toxic effects on plants. Heavy metal toxicity negatively impacts plant growth and development by reducing nutrient uptake, decreasing biomass production, and adversely affecting germination rates. Furthermore, it disrupts various metabolic activities in plants, thereby reducing overall productivity. Zeolite minerals, particularly clinoptilolite, offer an effective solution by enhancing the adsorption of heavy metals in the soil. This study aims to determine the critical threshold of nickel toxicity in wheat plants and evaluate the potential of clinoptilolite in mitigating Ni toxicity. The experiment was conducted in two stages. In the first stage, Ni toxicity in plants was assessed by applying 0-5-10-15-20-25-30-40-50-60-70-100-150-200-300 500-750-1000 mg/kg Ni of $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ solution to the soil. Germination rates, biomass production, and Ni concentrations in plant tissues were measured. Results revealed that the lowest germination rate was observed in soil containing 200 mg/kg Ni, demonstrating the toxic effect of Ni. In the second stage, clinoptilolite ($\text{Ø} < 200 \mu\text{m}$) was applied to soils containing 200 mg/kg Ni at doses of 25-50-100-150 ve 200 kg/da. Among the clinoptilolite treatments, the lowest plant tissue Ni content was recorded at 50 kg/da (36.969 mg/kg). The findings suggest that clinoptilolite reduces the uptake of Ni by plants but exhibits complex, dose-dependent effects on biomass production. The application of 50 kg/da clinoptilolite resulted in low Ni uptake and high biomass yield, indicating its potential as an optimal balance point for plants. However, the potential effects of clinoptilolite on the availability of essential micronutrients should be considered and validated through further comprehensive studies.

Key words: Clinoptilolite, Heavy metal, Nickel toxicity, Nickel uptake, Pot experiment, Soil, Wheat

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Temporal changes in soil physical quality parameters from 2005 to 2020 in Tekkeköy, Samsun, Türkiye

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ABSTRACT

Soil is a dynamic structure that constantly changes in terms of physical, chemical and biological properties. Continuous monitoring of these changes that may occur provides important information in terms of understanding the soil structure. In this study, changes in some soil physical quality parameters in agricultural areas in Tekkeköy district of Samsun province between 2005 and 2020 were examined. Within the scope of the study, pH, EC, Lime, Soil Texture, Bulk Density, Organic Matter, Soil Erodibility, Soil Crust Factor and Soil Compaction analyzes were carried out in 38 soil samples taken from agricultural areas between 2005 and 2020. In the analysis, it was observed that there were statistically significant changes at the level of 5% in Soil Crust Factor, Soil Compaction, EC and Silt data between 2005 and 2022. When it is considered that the soil samples cover agricultural areas, it can be seen because of intensive agricultural practices over a 15-year period. In addition, when the pH, Sand, Clay and Bulk Density data are examined, it is expected that no statistical change has been seen. As a result of the study, it is an important data that the changes in soil physical quality parameters have been revealed due to the intensive agricultural practices that agricultural soils have been exposed to over the years.

Key words: Soil Erodibility, Soil Crust Factor, Soil Compaction, Organic Matter, Tekkeköy

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Determination of the relationships between soil phosphorus forms and related enzymes and their spatial variations: A case study in Bartın hazelnut fields

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ABSTRACT

Understanding the spatial characteristics of soil properties will facilitate the identification of their relationships and the development of region-specific management techniques. The aim of this study was to obtain basic information on the variability of soil P form concentrations and phosphatase activities in hazelnut growing areas and to investigate the relationship between phosphorus forms, related enzymes, and some physicochemical properties. Soil samples were collected from hazelnut cultivation areas at depths of 0-30 cm. Phosphorus forms (eP, Ca_P, Fe_P, Al_P, Solv_P, RedSol_P-Solv_P), alkaline phosphatase, and acid phosphatase enzyme analyses were used to determine some physicochemical properties of the soil. The data were evaluated using classical statistical and geostatistical methods. The study determined the general order of change of inorganic phosphorus fractions as Ca_P>Fe_P>Al_P>RedSolsolv_P>Solv_P. Statistically significant relationships were identified between available P availability in soils and some soil properties and phosphorus fractions.

Key words: Soil phosphorus forms, soil phosphatase activity, geostatistics

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Effect of elemental sulfur treatment to high lime and alkaline soils on available micronutrient elements (Fe, Zn and Mn) contents

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ABSTRACT

Plants need microelements for optimum development. In arid and semiarid soils, high lime, pH and oxide compounds limit the uptake of micronutrients such as iron (Fe), zinc (Zn) and manganese (Mn) by plants. The aim of this study is to determine the effect of raw phosphate material and elemental sulfur (S^0) treatment to a highly calcareous and alkaline soil on some available microelements (Fe, Zn and Mn). The study was carried out in pots according to the randomized plot design with 3 replications. Elemental S^0 was applied to pots containing one (1) kg of soil at the rate of 0, 20, 40 and 80 kg da^{-1} and mixed homogeneously. Soil samples were taken from the pots brought to field capacity on the 45th, 90th and 135th days and with DTPA extractable Fe, Zn and Mn concentrations were determined. According to the obtained data, the increase in available Fe, Zn and Mn concentrations in the soils with the increase in elemental S^0 application doses was found to be statistically significant. As a result, it was determined that elemental S^0 application to high calcareous and alkaline soils increased the available Fe, Zn and Mn contents.

Key words: Soil, elemental sulfur, raw phosphate, iron, zinc, manganese



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Bioencapsulation formulation of phosphate-solubilizing bacteria for enhancing phosphorus availability, growth, and yield of maize

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ABSTRACT

Phosphorus (P) deficiency limits maize (*Zea mays*) productivity in tropical soils due to low availability and uptake inefficiency. The rapid population decline in biofertilizers is a significant challenge for their effectiveness upon application. This research evaluated the efficiency of an alginate-based bioencapsulation formulation, including a mixture of starch and kaolin, of phosphate-solubilizing bacteria (PSB) to address this issue and enhance P availability and crop performance. The bioencapsulation technique is shown to maintain high PSB viability and effectiveness, improving nutrient uptake. Results demonstrated a strong positive correlation between available P and 100-grain weight, emphasizing the critical role of P in yield enhancement. Phosphorus uptake correlated positively with root length, highlighting improved nutrient acquisition, while agronomic effectiveness showed positive associations with 100-grain weight and chlorophyll index. These findings highlight alginate-based bioencapsulation, including starch and kaolin, as an effective strategy to enhance P uptake, optimize physiological traits, and boost maize productivity in P-deficient soils.

Key words: Soil, elemental sulfur, raw phosphate, iron, zinc, manganese

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Evaluation of different carrier materials for the shelf life of *Bacillus megaterium* RK01 using GGE biplot analysis

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ABSTRACT

The effectiveness of microbial fertilizers varies depending on the type of microorganism used and the properties of the carrier material. The aim of this study is to reveal the relationship between the physicochemical properties of various organic and inorganic solid carriers and the shelf-life performance of the *Bacillus megaterium* RK01 strain formulated with these carriers using GGE Biplot analysis. In the study, the local strain *Bacillus megaterium* RK01 was used as the microbial inoculant. The carrier materials tested included Biochar (BC), Tea Compost (TC), Compost (C), Leonardite (L), Vermicompost (V), Imported Peat (IP), Domestic Peat (DP), Gavurdağ Peat (GP), Bentonite (B), Rock Phosphate (RP), Perlite (P), Pumice (Pu), Light Expanded Clay (LEC), and Zeolite (Z). The following properties of the carriers were analyzed: pH, EC (electrical conductivity), WHC (water holding capacity), OC (organic carbon), C/N ratio, and the content of Fe, Cu, Zn, Mn, Mg, K, Ca, P, and N. The shelf life of the RK01 strain within each carrier was monitored at room temperature by measuring the colony-forming unit (CFU) counts on days 15, 30, 60, 90, 120, 150, 180, 210, 240, 270, and 300. Additionally, the pH, EC, and moisture content of the carriers were tracked throughout the storage period. According to GGE Biplot analysis, BC and TC were identified as the most ideal carrier materials, and the 11th month was determined to be the optimal shelf life period. Scatter plot matrix analysis showed strong positive correlations between BC and TC and all examined properties, except for nitrogen. Furthermore, GGE Biplot graphs were found to be effective tools for evaluating carrier material performance and shelf-life studies.

Key words: Phosphate-solubilizing bacterium (PSB), Carrier material, Shelf life, GGE Biplot Technique, Scatter Plot Matrix

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Enhancing soil classification resolution in Türkiye using AI-based modeling approaches

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ABSTRACT

Soil classification systems form the foundation for agricultural planning, ecological monitoring, and land-use decisions. This study aims to enhance the spatial resolution of Türkiye's national soil map by leveraging Artificial Intelligence (AI) models based on the existing "Büyük Toprak Grupları (BTG)" map published by the Ministry of Agriculture and Forestry. Using a machine learning-based approach, we developed a high-resolution soil group map employing point-based BTG labels as training data. The original soil group dataset had a spatial resolution of 3000 m × 3000 m, which was enhanced to a finer 300 m × 300 m resolution using model predictions. Key predictors (features) included land use type (CORINE), elevation, slope, aspect, mean temperature, mean humidity, total precipitation, clay content, silt content, sand content, soil pH, soil organic carbon (SOC), x and y coordinates, parent material (lithology), erosion class, and land capability classification. Due to class imbalance in the dataset, the Synthetic Minority Oversampling Technique (SMOTE) was applied to balance the number of samples across 18 distinct soil classes. We employed a multi-input Deep Neural Network (DNN) architecture that processed numerical and categorical variables separately through dedicated input layers. Each input stream was enriched with residual dense blocks, which combine residual and dense connections to improve feature propagation and learning capacity. The learned representations were later concatenated and passed through fully connected layers to produce the final classification. Evaluation metrics included overall accuracy, F1-score, precision, and recall. Additionally, a permutation importance analysis was conducted to assess the contribution of individual features to model performance. Results showed that the model achieved a classification accuracy of 94% across 18 soil groups based on 17 input features. Feature analysis revealed that spatial coordinates, humidity, and temperature were among the most influential variables in determining soil group distribution. Our model, based on the Turkey's national Great Soil Groups classification system based on the Baldwin-Thorp framework, demonstrates the utility of AI techniques in refining legacy soil maps for more precise environmental modeling and decision support. In the next phase of this study, we aim to convert the resulting classification into the World Reference Base for Soil Resources (WRB) system developed by FAO and IUSS. This transformation is expected to be feasible through the inclusion of soil properties required by the WRB classification scheme into the dataset, potentially enabling the generation of a new soil group map aligned with international standards. of AI techniques in refining legacy soil maps for more precise environmental modeling and decision support.

Key words: Soil classification, Artificial Intelligence, Deep Learning, Residual Dense Networks, SMOTE, Türkiye, BTG map, permutation importance

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Immediate and residual effect of biochar on selected soil properties of coarse-textured Ultisols and agronomic performance of maize

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ABSTRACT

Managing huge abattoir waste generated in most cities and metropolis of the world including Nsukka in southeastern Nigeria has been a serious environmental concern. This study investigated the immediate and residual effects of cow dung biochar on selected properties of coarse-textured Ultisols and agronomic response of maize in Nsukka southeastern Nigeria. The pot trial was conducted in a greenhouse belonging to the Department of Soil Science, University of Nigeria, Nsukka. The treatment was biochar rates: 0, 10, 20 and 30 t ha⁻¹ replicated six times in a Completely Randomized Design and using maize (*Zea mays*) as test crop. Agronomic data were collected throughout the experiment that lasted for 12 weeks while soil samples were collected and analyzed at the end of the study. Soil and agronomic data collected were analyzed statistically using the GenStat software. The results showed that biochar amended plots had significant ($P < 0.05$) effect on most of the soil and agronomic properties investigated. The results showed that pH, OM, TN, Av. P, Ca²⁺, leaf length, leaf width, plant height and number of leaves increased with increasing rates of biochar application for both the 2020 and residual planting seasons. In addition, macro, micro and total porosities, saturated hydraulic conductivity, Mg²⁺, H⁺, CEC, and plant girth significantly increased with increasing biochar application rates at 2020 planting season only whereas Al³⁺ was not significant at both planting seasons. However, bulk density decreased with increasing rate of biochar application for both the 2020 and residual planting seasons. The study concluded that cow dung biochar improved soil properties and agronomic performance of maize and recommended minimum application rate of 10 t ha⁻¹ for improved properties and productivity of Ultisols, and maize yield.

Key words: Cow dung biochar, agronomy, soil quality, soil productivity, abattoir waste, environment.

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Estimation of soil temperature at different depths of soil profile

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ABSTRACT

Prediction of soil temperature is one of the most important components in sustainable crop production. Heat diffusivity is known factor to predict soil temperature. The aim of this study is to determine soil temperatures from soil surface to 50 cm soil depth using the heat diffusivity coefficient values obtained from the functional relationship using measured meteorological data. Heat diffusivity values were estimated for 5, 10, 20 and 50 cm soil depths according to mean daily soil temperature values of Meteorology Station between May – July 2012, and heat diffusivity values for these soil layers were predicted using a parabolic function. Root Mean Square Error values between soil temperature estimated from the meteorological data and from the function for 5, 10, 20 and 50 cm soil depths were determined as 0.054, 0.093, 0.099 and 0.012, respectively. As a conclusion, daily soil temperature changes can be estimated for non-measured soil temperatures in different soil depth using the heat diffusivity values estimated from the parabolic functions.

Key words: Soil depth, temperature, heat diffusivity, estimation, parabolic function.



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A new simplified method for estimating quantity-intensity parameters and plant availability of soil potassium through statistical tools

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ABSTRACT

Soil potassium (K) availability can be effectively assessed using quantity-intensity (Q/I) parameters such as the equilibrium activity ratio (AR_e^K), non-specifically held K ($-\Delta K_0$), potential buffering capacity (PBC^K), and standard free energy of exchange (ΔG^0). However, studying Q/I relationships is complex, time-consuming, and requires specialized expertise. This study aims to develop a simplified procedure for estimating Q/I parameters. We analyzed 25 soils from different regions of India, including alluvial, red-lateritic, and black soils, with diverse physicochemical properties, and Q/I parameters were measured. A greenhouse pot experiment with wheat was conducted to assess aboveground biomass yield, K concentration, and K uptake at the maximum vegetative stage. The soils exhibited significant variations in physicochemical properties and K-related variables. The AR_e^K , $-\Delta K_0$, and PBC^K showed wide variations. The ΔG^0 ranged from -4198 to -2443 cal mol⁻¹, influencing plant dry matter yield, K concentration, and K uptake. Regression analysis of AR_e^K and $-\Delta K_0$ against AR^K and ΔK under different equilibrium conditions (varied soil-to-solution ratios and initial K concentrations) showed that AR_e^K and $-\Delta K_0$ could be accurately estimated using just two soil-solution equilibration conditions: a 1:10 ratio with 10 mg K L⁻¹ initial concentration and a 1:80 ratio with 0 mg K L⁻¹ initial concentration. This two-point method also accurately predicted ΔG^0 ($R^2 = 0.95$, $p < 0.001$) and could replace direct ΔG^0 measurements for predicting soil K availability without significant accuracy loss. The Q/I parameters of soil K can be estimated by the newly developed simple two-point method without losing much accuracy.

Key words: Available potassium, Non-exchangeable potassium, Quantity/intensity relationship, Standard free energy change, Potassium uptake, Multiple linear regression

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The impact of microplastics on arable soil properties: A case study

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ABSTRACT

Fertile alluvial plains in Serbia focus on vegetable production with growing plastic farming practices, while nearby forests and riverbanks have become sites of the wild dumping of plastic waste. The main objective of this study was to identify the possible changes in the physical, chemical, and biological properties of soil in greenhouses in three major valleys of Serbia. The soils of the studied sites are alluvial loam (Sava), clay loam (Danube), and sandy loam (Morava). Chemical parameters studied were: electrical conductivity, soil acidity, cation exchange capacity, total carbon and nitrogen content, plant-available phosphorus and potassium content, and trace element content. Physical parameters studied were: particle size distribution, volumetric mass, specific mass, and porosity. Three-composite sample was formed from six subsamples collected from the greenhouses of the three locations in November 2022 and 2023 at a depth of 0–15 cm. Soils from the adjacent open fields were sampled to compare the content of MPs. Biological parameters studied were microbial respiration and labile carbon. The obtained data were processed using network analysis (NA) to identify the complex relationships between MP content and soil parameters. The NA results support the main findings that the presence of microplastics leads to the destruction of soil structure, which reduces bulk density and increases soil porosity. A strong positive correlation of MPs with soil particles < 0.02 mm and a negative correlation with CEC were found. In the Danube Valley, soil respiration was 78% higher in the open ground compared to a plastic greenhouse. The results contribute to a better understanding of the influence of MPs on soil properties and its ecological functions.

Key words: Microplastics; plasticulture; mulching; labile carbon; soil properties; network analysis

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Assessment of physicochemical properties of soils in the Kurdamir region of Azerbaijan and reclamation strategies

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ABSTRACT

Soil degradation, particularly salinization, is a critical environmental issue affecting agricultural productivity and ecosystem stability. The Kurdamir region in Azerbaijan faces significant challenges due to soil salinity, which reduces fertility and limits plant growth. Understanding the physicochemical properties of these soils is essential for developing effective reclamation strategies. This study aims to assess the degree of soil salinity in the Kurdamir region, analyze key soil properties, and propose effective measures for soil restoration and agricultural sustainability. Four soil profiles were examined, each reaching depths up to 2.0 meters. Soil samples were collected following standard methodology. Parameters such as pH, organic matter, nitrogen, phosphorus, potassium, calcium, magnesium, sodium, and electrical conductivity (EC25) were analyzed using appropriate laboratory techniques, including the Walkley-Black method for organic matter and the Kjeldahl method for nitrogen determination. The findings indicate that soil salinity levels range from weakly to highly saline, with sulfate-chloride as the predominant salinization type. The organic matter content varied between 1.2% and 1.82%, while pH levels ranged from 7.8 to 8.9, indicating alkaline conditions. High sodium concentrations were observed in all profiles, adversely affecting soil structure and fertility. Poor drainage and inefficient irrigation systems contribute to soil degradation by increasing salt accumulation. The soils in the Kurdamir region require targeted reclamation strategies. Moderately saline soils can benefit from improved irrigation and organic amendments, while highly saline soils necessitate comprehensive measures such as drainage improvement, gypsum application, and salt-tolerant crop selection. Implementing these practices can enhance soil productivity and sustainability.

Key words: Soil, physico-chemical properties, soil profile

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The impact of inappropriate soil management on soil physical properties

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ABSTRACT

Soil management practices significantly influence soil physical properties, which are critical for supporting plant growth and ensuring sustainable agricultural practices. The management of soil affects not just the physical characteristics such as bulk density, porosity, and water retention but also broader soil health indicators, including organic matter content and microbial activity. Inappropriate soil management practices can significantly degrade soil physical properties, which are crucial for sustaining agricultural productivity and ecological health. Inappropriate soil management practices have a profound negative impact on soil physical properties. The implications of such degradation extend beyond mere agricultural productivity, affecting broader ecological systems and threatening food security. The several researchers reported that Inappropriate soil management practices not only lead to soil erosion but also compromise soil structure and fertility, necessitating the adoption of sustainable management strategies.

Key words: Soil, management, physical properties, quality.

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Plant nutrient management for sustainable agriculture in semiarid climate conditions

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ABSTRACT

Sustainable agriculture has emerged as a paradigm that integrates ecological health, economic viability, and social equity into agricultural practices. In semiarid climate conditions, where water scarcity and nutrient limitations are prevalent, effective plant nutrient management is crucial for enhancing agricultural productivity while minimizing environmental impact. Implementing tailored management strategies that account for the unique challenges posed by this environment can significantly enhance agricultural productivity and sustainability. Sustainable agricultural practices in semiarid climates involve a combination of crop rotation, cover cropping, efficient water management, and agroforestry systems. Together, these practices have the potential to enhance agricultural resilience against climatic stresses while promoting long-term soil health and productivity. Effective nutrient management strategies must also incorporate an understanding of climatic variability and its implications for soil and crop management. Climate is a complex interplay of soil health, moisture availability, and adaptive agricultural practices.

Key words: Sustainable agriculture, plant, nutrient, management, semiarid climate



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Digital mapping of soil organic carbon using topographic and climatic variables

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ABSTRACT

The application of digital soil mapping for soil organic carbon (SOC) is crucial for accurately assessing its spatial distribution over large areas to support sustainable land management. The study was conducted in a part of the Sakarya Basin, Türkiye. A total of 472 soil samples were collected from the soil surface (0–20 cm). We have used elevation, slope, aspect, hillshade, curvature, topographic roughness index (TRI), topographic position index (TPI), and topographic wetness index (TWI) as topographic variables and have used mean temperature (tavg), min temperature (tmin), max temperature (tmax), solar radiation (srad), vapor pressure (vapr), and reference evapotranspiration (et) as climatic variables. The objective of this study is to produce SOC distribution maps at a 100 m × 100 m resolution using these covariates with two machine learning algorithms (Random Forest and Cubist). We evaluate the performance of these models and identify the most influential environmental variables contributing to the spatial prediction of SOC in the study area.

Key words: Soil organic carbon, digital soil mapping, machine learning, Cubist, Random forest.

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Temporal effect of diatomite on acidic and alkaline soils

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ABSTRACT

The aim of this study is to investigate the effect of diatomite on the cation exchange capacity (CEC) of soils with acidic and alkaline characteristics. For this purpose, different doses of diatomite were applied, and soil samples were collected at specific time intervals for analysis. Diatomite was applied to the soil at rates of 1%, 2%, and 4% (w/w). The pH of the acidic soil was 5.11, and its texture was sandy loam. The pH of the alkaline soil was 7.63, and it had a sandy texture. According to the analysis results, a decreasing trend was observed in soil pH, while an increasing trend was detected in the cation exchange capacity (CEC).

Key words: Clinoptilolite, Heavy metal, Nickel toxicity, Nickel uptake, Pot experiment, Soil, Wheat

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Eco-friendly capsicum production using Bonacraft P24 biofertilizer

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ABSTRACT

This study investigated the efficacy of Bonacraft P24, a biofertilizer containing phosphate-mobilizing bacteria, in enhancing the growth, yield, and quality of Capsicum (variety Superbell F1) across four agro-ecological zones in Kenya: Kiambu, Kirinyaga, Machakos, and Murang'a. The objectives were to determine the optimal application rate of Bonacraft P24 and assess its impact on growth parameters, yield components, and soil characteristics. A randomized complete block design (RCBD) with three replicates was used. Treatments included three application rates of Bonacraft P24 (150, 200, and 250 kg/ha), a reference product (Sporemax), and an untreated control. Data on seedling vigor, plant height, branch and leaf count, individual fruit weight, fruit count, and yield (tons/ha) were collected bi-weekly. Soil samples were analyzed for nutrient content before and after the trial. Bonacraft P24 significantly improved seedling vigor, with higher branching and foliage compared to the untreated control. At the highest application rate (250 kg/ha), Capsicum yield reached 26.32 tons/ha, marking a 201% increase over the untreated control in Kirinyaga. Improvements were also observed in fruit weight and quality. Bonacraft P24 performed comparably to the reference product and demonstrated additional benefits, including enhanced soil organic matter, nutrient availability, and pH stability. Bonacraft P24 proved to be an effective biofertilizer for Capsicum production, improving both crop yield and soil health. It is recommended for commercial registration in Kenya at a rate of 150 kg/ha applied at planting.

Key words: Capsicum, biofertilizer, Bonacraft P24, sustainable agriculture, Kenya, soil enhancement, yield optimization



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Relationships between soil physical, chemical and mechanical properties and bean (*Phaseolus vulgaris*) plants: A case study of Bursa Yenişehir, Türkiye

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ABSTRACT

The material of this study consists of soil (0-20 cm depth) and bean plant leaf samples taken from 20 different parts of Bursa Yenişehir Plain. The structural stability index, atterberg limits, volume weight and porosity were determined in the soil samples. Plant nutrients were determined in leaf samples. Relationships between some properties belong to soil samples and plant nutrient's contents of bean's leaf samples are examined and some coloration results are found. Similar to the negative relationship between the structure stability index and the plant Fe content (-0.475*), a negative relationship was also observed between the volume weight and the plant Ca- (0.503*) and Mg (-0.451*) contents. One of the findings obtained from the study is the positive relationship between the liquid limit and the plant P (0.466*) content. Structure stability index results (above 25-30) illustrate that bean's soil have soil compaction in this region. As an another result high volume weights have been observed on soil samples. This situation indicates that there are fewer gaps in the soil. It can be interpreted that both the structural stability index and volume weight values being high will negatively affect plant's roots development and the uptake of the plant nutritions. According to the hydrometric structure analysis, although the clay fraction is generally low in the soils, high plasticity is observed. The fact that the clay fraction is low but the effect is high suggests the presence of expanded clay minerals.

Key words: Beans, Liquid Limit, Plastic Limit, Soil Mechanics, Soil Physics

This article was based on a Master thesis

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Using analytical hierarchy approach in determining landslide susceptibility - İmranlı example

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ABSTRACT

Considering the topographic and geological features, landslides are among the natural disasters that can cause serious loss of life and property in regions with complex topography. In the study conducted to reveal the spatial distribution of landslide susceptibility within the borders of İmranlı district of Sivas province; eleven parameters were taken into consideration, namely slope, aspect, elevation, large soil groups, annual average precipitation, normalized difference vegetation index (NDVI), distance to roads, fault lines and stream beds, geological features and land use patterns. The importance values of the parameters were calculated with the Analytical Hierarchy Process (AHP) method and a susceptibility map was created by applying these weights in the Geographic Information Systems (GIS) environment. The results show that five classes with different levels of susceptibility were distinguished in terms of landslide risk throughout the İmranlı district. According to the analysis, approximately 8.78% of the study area shows high and very high landslide susceptibility, 33.62% shows medium landslide susceptibility, while approximately 58% shows low and very low susceptibility. Since climate change and the fluctuations in weather events increase the pressure on natural resources significantly, it is important that decisions regarding the protection and sustainability of resources are included in land use policies.

Key words: Analytical hierarchical process, GIS, İmranlı, Landslide susceptibility, land use.



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Calibration and temperature effect on accuracy of three selected soil moisture sensors

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ABSTRACT

Recent developments resulted in more affordable dielectric soil moisture sensors which can be employed in large numbers to monitor soil moisture dynamics. Sensor type selection is based on their accuracy, ease of installation and price. Since the soil dielectric permittivity decreases with increasing temperature, the effect of temperature variations is expectable, but so far insufficiently explored. To explore performance of three selected low-cost soil moisture sensors and evaluate the effect of applied calibration and temperature variations. Three replicates of each sensor type, TMS-4 (TOMST, Czech Republic), SoilWatch 10 (PINO-TECH, Poland) and MT22B (INFWIN, China), were tested in this study. Own calibrations for 2 texturally different soils (Loamy Sand, Loam) were carried out. The accuracy of the measurements and the temperature effect for three temperature levels (4 °C, 20 °C and 35 °C) were assessed. The results were statistically evaluated (ME, RMSE, ANOVA). Own calibrations considerably improved the measurement accuracy of all three types of sensors (the RMSE values decreased from 0.054-0.103 cm³/cm³ to 0.014 to 0.029 cm³/cm³). The most stable readings across the whole range of tested temperatures was observed for MT22B sensors, for which only a small linear decrease in soil moisture readings was measured for the increasing temperatures. SoilWatch 10 and TMS-4 showed good stability only for temperatures of 4 °C and 20 °C, while a larger decrease in readings was observed for the temperature of 35 °C. The need to perform own (sensor site-specific) calibration has been proven. Considerable decrease in soil moisture content at 35 °C was observed for SoilWatch 10 and TMS-4, while stable outcomes were observed from MT22B sensor.

Key words: Soil moisture content, accuracy, calibration, temperature variation, TMS-4, SoilWatch 10, MT22B

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The impact of climate change on tea cultivated soils

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ABSTRACT

Tea is an important product that significantly affects the lives of people and producer in the Eastern Black Sea Region of Turkey, in the evaluation of own resources, in creating employment, in supplying raw materials to other industries, and with its high added value. However, as is the case all over the world, climate change is an important problem that will affect tea agriculture in Türkiye. Climate change not only causes changes in temperature, precipitation, relative humidity, number of rainy days and number of sunny days per year, but also affects soil pH and moisture content, soil organic matter and soil nutrients. The increase in temperature accelerates the loss of biodiversity in soil organic matter, while reducing the time required for the release of nutrients from chemical fertilizers. The heavy daily rainfall caused by climate change can lead to severe flooding or landslides that destroy fertile topsoil. The above-mentioned problems seen in world tea plantations will also be seen in Türkiye as the effects of climate change become more intense. In addition, the most important soil-related problem in tea plantations in Türkiye is low pH. The rehabilitation of acidic soils is a major global issue. If measures are not taken, the excessive rainfall that will occur as a result of climate change will further increase soil acidity. In addition, it is known that the soils in orchards where tea has been cultivated for many years in Türkiye have become poor in terms of nutrients and that nutrient deficiencies occur in the soil, and this situation is known to increase with the effect of climate change. In this article, the possible effects of climate change on tea agricultural lands were examined in detail.

Key words: Climate change, soil, organic matter, soil acidity, soil biology

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Micropedological paradigms of profile-forming processes diagnosing in soils of Georgia

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ABSTRACT

Understanding the mechanism behind forming specific soil profiles is crucial for studying soil genesis and requires a comprehensive research approach. The micropedological method is the most reliable way to identify soil-forming processes. The primary aim of the research was to identify, at the micro-level, the diagnostic features of leading profile-forming processes (humification, argillization, podzolization, lessivage, ferrugination, gleization, carbonization) contributing to the specific soil groups' formation. Micromorphological analysis of Georgia's soils ranked these processes by intensity. Groups of processes for each soil were determined. The mapping principle was developed to illustrate the identified processes. Detailed microscopy research of Humification (soil organic matter) allowed us to identify five morphotypes in Georgia's soils: Mor-humus, Mor-Moder/Moder-Mor, Moder-humus, Moder-Mull/Mull-Moder, and Mull-humus. Argillization (in situ weathering process) is classified into three categories based on the intensity of clay formation: intense, moderate, and weak. Lessivage, diagnosed by optically oriented clay-cutans, was categorized into the clay-, silty, and complex curtains found in vertical transit pores and on the mineral grains' edges. A key characteristic of Podzolization is the downward movement of products of the breakdown of primary minerals from the upper horizons to lower depths in the profile. As a profile-forming process, it's rarely observed and has only an intra-horizon limited significance. Gleization process was identified by the contrasting distribution of Fe-hydroxides in bleached plasma and their segregation into clots. It was categorized based on intensity levels: strong, medium, and weak. Ferruginous processes occur in two forms: as different morphogenetic types concretions and as various forms impregnated in plasma. Carbonization, which is typically diagnosed based on the calcite crystals' size and the morphogenetic groups of carbonates, is categorized into concretions and carbonized plasma with strong, average, and weakly calcareous intensity. All findings from the micromorphological study regarding the character of profile-forming processes were depicted on the relevant maps.

Key words: Argillization, Carbonization, Ferrugination, Gleization, Humification, Lessivage, Micropedology, Podzolization.

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Prospects for the use of soil resources in the East Zangezur economic region of Azerbaijan in Agriculture

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ABSTRACT

The newly established East Zangezur Economic Region (comprising the Zangilan, Gubadli, Jabrayil, Lachin, and Kalbajar administrative districts), as a major agricultural region playing an important role in Azerbaijan's economy, has favorable soil and climatic conditions, creating vast opportunities for the development of crop production and livestock farming. The total area of the East Zangezur Economic Region is 744.8 thousand hectares. The research involved ecological, botanical, mathematical-statistical, visual-observational, cartographic, and laboratory methods. A soil map of the East Zangezur Economic Region at a scale of 1:100,000 was compiled, providing a classification of 14 subtypes and 50 soil varieties included in the soil fund. According to the research data, the predominant soils in the economic region are mountain-meadow soils (30.90%), followed by mountain-brown soils (23.64%). An assessment of the agricultural soils in the economic region based on their designated purpose has been conducted, revealing that the lands are most suitable for pastures and hayfields (69.03%) as well as arable land (19.51%). Administratively, the largest share of cultivated agricultural crops (34.57%) and perennial plantations (65.45%) is concentrated in the Jabrayil district, while the majority of pastures are located in the Kalbajar district (36.42%). The prospects for agricultural development in the East Zangezur Economic Region have been studied, and the structural indicators of the projected land areas have been analyzed. It has been deemed appropriate to allocate the largest areas for grain crops in the Jabrayil (10.4 thousand ha) and Gubadli (6.3 thousand ha) districts, for fruit and berry orchards in the Gubadli (2.5 thousand ha) and Zangilan (2.2 thousand ha) districts, for vineyards in the Jabrayil district (1.2 thousand ha), and for tobacco, potatoes, and vegetables in the Gubadli district (400 ha). According to livestock development forecasts for the economic region, the Lachin and Kalbajar districts have the greatest potential for this sector.

Key words: East Zangezur, agriculture, soil map, pastures, arable lands, perennial plantations.

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Minimal disturbance, maximum effect: Soil physical benefits of surface-applied compost

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ABSTRACT

Conservation agriculture emphasizes practices that protect and enhance soil health, such as minimizing soil disturbance and maintaining continuous soil cover. Surface application of compost without incorporation supports these principles by improving soil structure and reducing the need for tillage. However, its impact on soil physical and chemical properties remains insufficiently explored. This study aimed to assess the effects of surface-applied, stable, and mature compost on key soil physical parameters, such as saturated hydraulic conductivity, aggregate stability, and penetration resistance. A semi-operational field experiment was conducted at two agricultural sites in the Czech Republic: Site A (Blatnice, USDA texture class: loam) and Site B (Jevíčko, USDA texture class: silty clay loam), both classified as Cambisol. Treatments included surface compost application (SCA) at four annual doses of 30 t/ha (Site A) and one-time dose of 200 t/ha (Site B), compared to untreated controls (CON). Crops grown included wheat (A), maize (A, B), and cover crops. Compost application started in 2022, with field measurements and soil sampling conducted during the 2023 and 2024 growing seasons. SCA significantly improved soil parameters ($p < 0.05$ or lower). Soil organic matter content increased by 27.8% (A) and 58.1% (B), while volumetric water content rose by 5.3% (A) and 11.0% (B). Soil pH, electrical conductivity, and the proportion of water-stable aggregates increased at both sites. Dry bulk density decreased by 10.5% (A) and 15.7% (B). Improvements in saturated hydraulic conductivity (28.6%) and penetration resistance were observed at Site B. Surface application of stable and mature compost without soil incorporation can enhance soil structure, water retention, and biological activity, supporting sustainable soil management in line with conservation agriculture principles.

Key words: Conservation agriculture; compost maturity; compost stability; water stable aggregates; penetration resistance; erosion control.

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Effect of different waste-based protein hydrolysates on growth and mineral element concentrations of lettuce plant

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ABSTRACT

In order to meet the food demands of increasing world population, it is necessary to enhance the fertility of agricultural soils. Sheep wool, chicken feather and human hair are among the wastes generated from agricultural production that cannot be utilised as construction material, clothing, feed or feed additives. This types of wastes can apply to agricultural soils directly or hydrolysed after acid or alkaline solutions. In this study, these wastes, which pose a risk of environmental pollution when not evaluated correctly, were hydrolyzed with an alkaline solution and the effectiveness of the obtained materials was tested on lettuce plant under greenhouse conditions. Hydrolysed wastes were applied to related pots at 2 mL per kg⁻¹. When the results obtained from this study are examined, wool and feather hydrolysates enhanced the fresh and dry weight and Ca concentration of lettuce plant compared to control. While whole hyrolysates increase the K and Zn concentrations of lettuce plant, the highest P and Fe concentrations were determined with feather and hair hydrolysates, respectively. While feather and hair hydrolysates enhance the S concentrations, Mn concentration increased with both wool and feather hydrolysates. The effect of hydrolysates on N, Mg and Cu concentrations of lettuce plant was found insignificant. Soil organic matter content of our agricultural lands extremely low. Therefore, applying these types of wastes to our soils after appropriate processing will both reduce the risk of environmental pollution and increase the organic matter content of our soils, and also increasing the effectiveness of chemical fertilizers. For this reason, it is extremely important to carry out studies on such wastes and application methods in different plants and climatic conditions.

Key words: Waste management, Protein hydrolysate, lettuce.

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The effect of lime application on soil reaction and available heavy metals

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ABSTRACT

The material of this thesis study consists of naturally low pH soil formed on mica schists in İzmir Ödemiş. In this study, carried out under pot conditions, Vega F1 sweet corn variety (*Zea mays saccharata* Sturt.) was used as plant material. Under laboratory conditions, the amount of lime required to increase the soil reaction from 4.85 to 6.69 was determined and this amount was accepted as the optimal dose. Application treatments were determined as control, $\frac{1}{4} \times$ optimal dose, $\frac{1}{2} \times$ optimal dose, optimal dose and $2 \times$ optimal dose. At the end of the experiment, the highest soil reaction was determined as 6.46 at $2 \times$ optimal dose application. When the availability of heavy metals in the soil was examined, Cu, Pb and Ni were statistically affected by lime application. While the availability of lead increased, the availability of the other two elements decreased. The availability of other heavy metals was not found to be statistically significant. Lime applications had a negative impact on plant fresh and dry biomass amounts. However, no statistical difference was found. Lime applications did not cause a statistical difference in the heavy metal contents of the plant except Pb, Cd and Co.

Key words: Lime, Heavy Metals, pH, Soil, Sweetcorn.

This article was based on a Master thesis



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Soil fertility of tomato greenhouses in the Kaş Region of Antalya

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ABSTRACT

The material of this study, conducted in 2022, consists of 15 topsoil (0–30 cm) soil samples taken from greenhouses cultivating tomatoes in the Kaş district of Antalya province. In the soil samples, pH, electrical conductivity (salinity), organic matter, lime, texture, total nitrogen, and available phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sodium (Na), iron (Fe), copper (Cu), zinc (Zn), and manganese (Mn) contents were analyzed. According to the coefficients of variation, the least variability was observed in soil pH (CV=1.99%), while the highest variability was found in the available sodium (Na) content (CV=154.02%). The highest salinity level (6.84 dS/m) was recorded in the sample with the highest available Na content (3029 mg/kg). All soil samples exhibited slightly to moderately alkaline characteristics. The available Cu content ranged between 3.79 and 22.14 mg/kg, and this high level of Cu is thought to originate from copper-based pesticides. It was determined that the available Mn and Zn contents were generally sufficient in the soil samples, while available Fe content was found to be insufficient. Furthermore, available phosphorus content was found to be very low in some soil samples, while lime content was found to be high.

Key words: Greenhouse, Soil Fertility, Soil Properties, Tomato.

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Effect of Triacntanol (TRIA) applications on seed germination under salt stress conditions

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ABSTRACT

Seed, the starting material of plant production, is also our basic food source. Increasing productivity and ensuring quality depends on the healthy germination of quality seeds. The ability of seeds to form seedlings while maintaining their viability under stress conditions is of great importance. Abiotic and biotic stress factors and seed-specific factors negatively affect yield by reducing germination and emergence rates. In particular abiotic stresses, restrict plant growth leads to serious crop losses on a global scale. Triacntanol (TRIA) acts as a signaling molecule during growth, increases seed metabolism and germination distribution, as well as ensuring plant development under stress conditions. It also has positive effects on development, productivity and quality. However, the germination effects of TRIA, especially under salt stress, have been investigated limitedly. While it increases germination in some plants, it has been reported that it may cause negative impacts in some species. Applications of TRIA in saline environments is important research topic, current studies demonstrate the potential of this substance to alleviate stress effects. In this review, the effects of TRIA on seed germination under salt stress were investigated. Studies have shown varying results on the germination rates of TRIA application. Future research will further elucidate the stress tolerance-enhancing effects of TRIA. The use of TRIA can offer a sustainable approach to increasing agricultural yield and quality.

Key words: Plant Growth Regulator, Salinity, Seed, Seed Germination, Triacntanol (TRIA)

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Boosting soil quality with fermented plant extracts

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ABSTRACT

This research evaluated the impact of three plant-based extracts Aloe vera, Nettle (*Urtica dioica*), and Purslane (*Portulaca oleracea*)—applied at varying concentrations (0%, 0.5%, 1.0%, 1.5%, and 2.0%) on soil quality dynamics. The experiment was conducted under greenhouse conditions using a completely randomized design (CRD) to evaluate different indicators such as soil pH, electrical conductivity (EC), organic matter (OM), basal soil respiration (BSR), microbial biomass carbon (MBC), nitrogen, and available phosphorus. All treatments led to notable improvements in microbial function, organic matter, nutrient levels. Regarding Purslane extract, demonstrated at (1.0% – 2.0%) was the most effective, improving soil pH, E.C, and phosphorus levels. Nettle extract also showed improvements in MBC, especially at 1.5–2.0%. On the other hand, Aloe vera extract (1.0–1.5%) enhanced positively BSR and total nitrogen. In conclusion, the strategic application of plant-based extracts especially Purslane and Nettle at 1.0–2.0% serves as a sustainable method to improve soil parameters. These findings advocate for the use of plant-based biostimulants as part of eco-friendly fertilization strategies that minimize reliance on chemical inputs.

Key words: Fermented plant extracts, Sustainable agriculture, Soil quality, Soil biological health, Organic Fertilization

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Arbuscular mycorrhizal fungi inoculation modulates phosphorus uptake, nodulation activities and enhances the productivity of tropical soybean (*Glycine max* L.) in a derived Savannah

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ABSTRACT

In tropical regions, addressing phosphorus (P) deficiency in soils to enhance legume productivity is crucial for sustainable agriculture. Arbuscular mycorrhizal fungi (AMF) play a pivotal role in nutrient acquisition and growth promotion in plants. This two-year field study conducted in a derived Savannah explored the effects of AMF inoculation, involving three isolates (*Funneliformis mosseae*, *Rhizophagus intraradices*, and *Claroideoglomus etunicatum*), on two tropical soybean cultivars (TGx 1448-2E and TGX 1440-1E) across three P application rates (0, 20, and 40 kg P₂O₅ ha⁻¹). Results revealed that AMF inoculation, particularly with a 20 kg ha⁻¹ P application, significantly increased root length colonization, nodulation, P uptake, P use efficiency, plant biomass, and grain yield compared to the control. Notably, AMF inoculation enhanced nitrogen (N) fixation, as evidenced by increased relative ureide abundance (RUA), nitrogen derived from the atmosphere (Nd_{fa}), and total N fixed. Among the isolates, *Rhizophagus intraradices* and *Funneliformis mosseae* consistently exhibited superior mycorrhizal responses compared to *Claroideoglomus etunicatum*. However, inoculated plants' high P application rates (40 kg ha⁻¹) adversely affected root colonization, mycorrhizal growth, and P responses. Conversely, P uptake and nitrogen fixation activities increased with higher P application rates, albeit at the expense of reduced AMF root colonization. Notably, *Rhizophagus intraradices* inoculation with a 20 kg P₂O₅ ha⁻¹ application yielded the highest RUA, Nd_{fa}, N fixed, and grain yield. Overall, these findings underscore the significance of optimal AMF inoculation coupled with appropriate P application rates in enhancing the productivity of tropical soybean cultivars in derived Savannah environments.

Key words: Legumes, nitrogen fixation, plant nutrition, soil microbes, yield

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Insights into the alleviation of cadmium toxicity in rice by nano-zinc and *Serendipita indica*: Modulation of stress-responsive gene expression and antioxidant defense system activation

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ABSTRACT

The adversities of cadmium (Cd) contamination are quite distinguished among other heavy metals (HMs), and so is the efficacy of zinc (Zn) nutrition in mitigating Cd toxicity. Rice (*Oryza sativa* L.) crop, known for its ability to absorb HMs, inadvertently facilitates the bioaccumulation of Cd, posing a significant risk to both the plant itself and to humans consuming its edible parts, and damaging the environment as well. The use of nanoparticles, such as nano-zinc oxide (nZnO), to improve the nutritional quality of crops and combat the harmful effects of HMs, have gained substantial attention among scientists and farmers. While previous studies have explored the individual effects of nZnO or *Serendipita indica* on Cd toxicity, the synergistic action of these two agents has not been thoroughly investigated. Therefore, the gift of nature, i.e., *S. indica*, was incorporated alongside nZnO (50 mg L⁻¹) against Cd stress (15 µM L⁻¹) and their alliance manifested as phenotypic level modifications in two rice genotypes (Heizhan43 and Yinni801). Antioxidant activities were enhanced, specifically peroxidase, leading to a significant decrease in oxidative burst. Microstructural study showed a decrease in number of vacuoles and starch granules with ameliorative treatments. Overall, plants treated with nZnO displayed gene expression pattern (particularly of ZIP genes), different from the ones with alone or combined S.i and Cd. Inferentially, the integration of nZnO and *S. indica* holds great promise as an effective strategy for alleviating Cd toxicity in rice plants. By immobilizing Cd ions in the soil and promoting their detoxification, this novel approach contributes to environmental restoration and ensures food safety worldwide.

Key words: Heavy-metal stress, Myco-adsorption, Nano-remediation, Nutrient acquisition, Oxidative stress, *Oryza sativa* L.

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Characterizing aeolian erosion risk of salt-affected soils from a degraded wetland area

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ABSTRACT

Global warming and poor management of water resources have led to the drying up of many inland water bodies in Türkiye, thereby increasing the rate of salinization and increasing vulnerability to erosion by wind on the surfaces of dried lakes. This study aims to assess the aeolian erosion susceptibility of surface soils that were collected in the dried basin of Sultan Marshes, which is located in the district of Incesu, in Kayseri Province. Samples of soil were examined according to important physical and chemical indicators, such as electrical conductivity (EC), pH, percentage of exchangeable sodium (ESP), the organic matter content, and soil texture. Also in a wind tunnel, a series of experiments was carried out at three (8, 10, and 12 m s⁻¹) wind velocities to ascertain the threshold wind speed at which particles move and to measure rates of transport of sediments. The findings show that increased salt composition and significantly lowered organic matter in the columns of the soil created a significant reduction in the aggregate stability that made the top horizons very susceptible to detachment and transportation by the wind. Such conditions, especially in the dry summer months, increase the possibility of dust emissions and thereby impose environmental and health hazards on neighboring farming and residential areas. To sum up, the results help understand the dynamics of the wind erosion on salt-impregnated soils composed of senescent lakebeds and highlight the necessity of mitigation strategy implementation in such fragile ecosystems.

Key words: Wind erosion, wind tunnel experiment, arid ecosystem, dust emission, salt-affected soils

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Effect of tomato compost application on some chemical properties of soils

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ABSTRACT

The aim of this study is to determine the effect of tomato compost (TC) on some chemical properties of soils. For this purpose, a pot experiment was established in the greenhouse and TC was applied in 4 different doses (TC1-1%, TC2-2%, TC3-4%, TC4-6%) to pots containing 3.5 kg of soil, these doses were also applied with chemical fertilizer (CF) (CF, TC1+CF, TC+CF, TC3+CF, TC4+CF) and then tomato plants were grown. Each applications was applied as 3 replicants. Soil sample used in the experiment has clay loam texture, mid-alkaline pH, salt-free, low in organic matter, in the medium lime, nitrogen content is sufficient level, high content of phosphorus, potassium-sufficient, sodic-free soil, microelements are sufficient level. During the greenhouse experiment, soil samples were taken at the end of 3 different vegetation periods of the tomato plant (first flowering, first harvest, final harvest). According to the results, when the changes in cations in the soil were examined, it was determined that the potassium content of the soil increased, calcium did not show any change in the first flowering period of the tomato plant, increased depending on the doses of the applications in the first harvest period, but decreased in the last harvest period. Potassium and calcium were highest in the soil during the first flowering period. The soil magnesium content increased depending on the applications and doses applied. The highest magnesium concentration in the soil was found during the final harvest period. It was determined that the highest amount of sodium in the soil occurred during the final harvest. Generally, after applications across all three periods, the amount of sodium in the soil increased, while in some applications it remained unchanged or decreased.

Key words: Compost, soil, soil cations, fertilizer, greenhouse.

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The response of soil biological properties irrigated with boiled potato water and *Saccharomyces Cerevisiae* application

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ABSTRACT

Boiled potato water (BPW) is among the various waste products that is generated as a result of industrial production process, which can be used in agricultural production to improve soil biological properties. *Saccharomyces Cerevisiae* (SC), known as baker's yeast, is a low-cost, fast-growing, non-pathogenic, easily accessible and usable fungus in agricultural production. This study aims to promote microbial activity by adding BPW and SC to soils. For this purpose, 100 g of dry soil was weighed into incubation containers, two different irrigation waters (distilled water as DW and BPW) and three different SC concentrations (0%, 1% and 2%, as SC0, SC1 and SC2) were applied to a clay textured soil. Incubation continued for 58 days at 30°C with the moisture levels maintained at ~60%. At the end of incubation, soil organic matter (SOM), microbial biomass carbon (MBC) and soil respiration (SR) analyses were carried. The results indicated that while there was a general increase in SOM, MBC and SR, only MBC was significantly ($p<0.01$) increased by 32% in contrast to DW. In addition, increasing SC concentration significantly increased both MBC ($p<0.01$; 11%) and SR ($p<0.05$; 6%) and decreased SOM (2%). The results showed that BPW application slightly improved the amount of organic matter in the soil. Furthermore, contributed to the SOM budget, supported the increase in MBC and SR of light organic fractions. The increase in MBC and SR stimulated by BPW was also further boosted by SC applications. However, a decrease in SOM probably occurred as a result of mineralization of fungi. In this study, the combination of BPW and SC applications increased SOM and MBC. Determining the effects of these increases on plant production process will make significant contributions to sustainable food production.

Key words: Boiled potato water, *Saccharomyces Cerevisiae*, soil organic matter, microbial biomass, soil respiration.

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Effects of manure and glyphosate applications on soil organic matter and microbial activities

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ABSTRACT

Manure (M), an important source of soil organic matter (SOM), contains rich substrates for microbial activity. Glyphosate (GLY), one of the total herbicides, is the most widely used active ingredient to combat weeds in agricultural production. Glyphosate can reach the soil, affecting biological processes even if not directly applied to soil. Glyphosate, contains C, N and P, can promote microbial activity or suppress it by inhibiting 5-enolpyruvylshikimate-3-phosphate synthase found in some microorganisms. Both conditions can affect SOM mineralization. The effects of GLY and M applications on SOM (only on the 56th day), microbial biomass carbon (MBC), soil respiration (SR) in a clay textured soil were investigated on the 28th and 56th days. Treatments include, 3 different concentrations of M (0%, 2.5% and 5% w/w) and doses of GLY (0, 100 and 200 mg GLY kg⁻¹) which, was applied to incubation containers containing soil. The soil water level was kept at ~60% of saturation thought the incubation period. In the study, SOM (43-59%), MBC (24-50%) and SR (21-73%) increased significantly ($p<0.05$) with increasing doses of M. Glyphosate caused a decrease in SOM (2%) on the 56th day and an increase in MBC (0-35%) on each sampling day. In addition, GLY induced a decrease SR (6-12%) on the 28th day and an increase (14-25%) on the 56th day. The increase in microbial activity with GLY induced the decrease in SOM on the 56th day. Although there was rapid increase in microbial activity on the 28th day, this range narrowed on the 56th day. Manure increased SOM and GLY increased SOM mineralization. Although much higher GLY doses than the recommended dose (5-15 mg GLY kg⁻¹) was used, regular and continuous application of GLY can potentially affect SOM dynamics. A more comprehensive investigation of this potential effect will be important for SOM management strategies.

Key words: Manure, glyphosate, soil organic matter, microbial biomass, soil respiration.

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The effects of raw phosphate and elemental sulfur applications on phosphorus availability in wheat

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ABSTRACT

In this study, wheat was grown on a calcareous experimental field located within the Eastern Mediterranean Transitional Zone Agricultural Research Station, where increasing doses of apatite mineral and elemental sulfur were applied. During the two-year cultivation period, phosphorus analyses were performed on leaf samples collected before spike formation. Additionally, grain yield, thousand-kernel weight, number of grains per spike, plant height, biological yield, and harvest index were measured in both years. While individual applications of sulfur showed no significant effect, differences were observed in apatite applications, and the highest yield values were recorded in the second year at the highest apatite dose. In the first year, the lowest grain yield was 610 kg/da in the A15S15 treatment, while the highest was 705 kg/da in the A30S30 treatment. In the second year, no significant interaction effects were observed for yield. When examining the effects of treatments on the number of grains per spike, no differences were found in individual applications; however, interactions were significant in both years. The highest grain numbers were determined in the A15S45 treatment, with 46.6 grains in the first year and 49.66 grains in the second year. The treatments had no significant effects on harvest index and plant height, but they were found to significantly affect phosphorus concentrations in the second year. The highest phosphorus concentration, 0.25%, was observed in the S45A60 treatment. Based on the measurements and analyses, it was concluded that individual applications of sulfur and apatite were mostly ineffective, while their combined application had a more significant impact.

Key words: Elemental sulfur, calcareous soil, apatite, phosphorus, wheat.

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The parametric evaluation approach for productivity index

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ABSTRACT

The primary goal of this study was to use a parametric approach known as the productivity index model to ascertain the crop productivity of the soils at the Field Plants Central Research Institute-Ikizce Research Farm, which is situated south of Ankara. Crop productivity is estimated by the soil productivity model, which takes into account the properties of the soil that influence root development. A thorough soil map scaled to 1/5000 was used to determine the texture, structure, depth, pH, coarse fragment, bulk density, and organic matter of the research area. A productivity index (PI) map was created following the analysis and evaluation of soil characteristics using geographic information system techniques. Furthermore, the use of Geography Information System (GIS) methodologies is crucial for mapping the study and estimating the productivity index.

Key words: Productivity Index, Soil Characteristics, GIS



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Effects of conditioners applied to soils with different textures on some properties of soils

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ABSTRACT

In this study, it was aimed to investigate the effects of polyacrylamide (PAM), humic acid (HA), wheat straw (WS) and hazelnut shell (HH) applications on organic matter and nitrogen content in sandy and clayey loam soils at the end of the incubation period under greenhouse conditions. The study was planned according to the experimental design of the randomized plots. Wheat straw and hazelnut husk were applied at 0%, 2% and 4% doses, polyacrylamide at 0 ppm, 30 ppm, 60 ppm and 90 ppm, and humic acid at 0 ppm, 200 ppm and 1000 ppm. The study was completed after five months of incubation period. After the incubation process, it was observed that organic waste and polymer applications significantly affected the organic matter and total nitrogen contents of the soils. The increase in organic matter contents was higher in sandy loam soil than in clay loam soil. The highest increase in both sandy loam and clay loam soil was determined in the second dose of hazelnut husk (FZ2). The amount of organic matter in sandy loam soil, which was 1.30% in the control, increased by 310% with FZ2 application, reaching 5.34%. On the other hand, the amount of organic matter in clay loam soil, which was 3.11% in the control, increased by 64.30% with FZ2 application, reaching 5.11%. There was a higher increase in total nitrogen content in sandy loam soil than in clay loam soil. The highest increase in sandy loam soil occurred in all samples where the second dose of hazelnut husk (FZ2) was applied with polyacrylamide. The total nitrogen amount, which was 0.10% in the control, increased by 80% with FZ2+ PAM1, FZ2+ PAM2, and FZ2+PAM3 applications, reaching 0.18%. The highest increase in clay loam soil was determined in samples where the second dose of hazelnut husk (FZ2) was applied with the second and third doses of polyacrylamide. The total nitrogen amount, which was 0.18% in the control, increased by 33.3% with 4%FZ+PAM2 and 4%FZ+PAM3 applications, reaching 0.24%.

Key words: soil, soil organic matter, nitrogen, greenhouse.

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Evaluation of soil structural parameters with VESS scores

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ABSTRACT

Soil water and air movement, water retention and aeration capacity, plant nutrient availability, plant root development, macro and microorganism activity are related to soil structure. Appropriate soil structure and high aggregate stability are very important in terms of plant production, sustainable soil management and erosion resistance. In this study, the relationships between the visual soil structure evaluation method (Visual Evaluation of Soil Structure-VESS), which can be easily determined in the field, and the erosion susceptibility parameters obtained because of laboratory analysis were revealed. VESS scores of the soil were determined for 50 sampling points representing 0-30 cm depth taken from different fields and land uses. In laboratory conditions, the textural fractions (sand, silt, clay), wet aggregate stability, structure stability index, dispersion ratio, clay ratio, mean weight diameter (MDW) contents of the soils related to structure were determined. A positive statistically significant correlation was determined between VESS scores and clay, aggregate stability. Negative correlations were determined between VESS and MDW, sand. As a result of the study, it was suggested that VESS scores can be easily determined in the field, the physical quality of the soil can be evaluated, and action plans can be created in advance for possible risk situations.

Key words: Visual evaluation, erosion, physical quality.

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Changes in nutrient availability and microbial activity in acidic soil treated with a microbial inoculant and alkaline amendments

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ABSTRACT

Soil acidity limits nutrient availability and microbial activity, directly affecting crop productivity. This study evaluated the effects of microbial inoculation with *Bacillus megaterium* var. *phosphaticum* RK1 and alkaline amendments (KOH and K₂SiO₃) on the chemical and microbial properties of acidic soil cultivated with wheat (*Triticum aestivum* L.). A greenhouse experiment was conducted using a completely randomized design (CRD) with 10 treatment combinations and 3 replications. Key indicators including soil pH, electrical conductivity (EC), total nitrogen (N), organic matter (OM), available phosphorus (P), microbial biomass carbon (MBC), and soil basal respiration (SBR) were measured to assess the treatment effects. Alkaline amendments significantly increased soil pH from 5.7 (control) to 6.63 in the KOH (F) + BM treatment ($p < 0.05$). EC rose from 0.80 to 1.32 dS/m ($p < 0.05$), reflecting improved ionic concentration. Total nitrogen showed a modest increase under combined treatments, while microbial inoculation alone had no significant effect. Organic matter content remained statistically unchanged across all treatments. Available phosphorus improved substantially, with Bray I P increasing from 4.85 ppm in the control to 8.66 ppm in K₂SiO₃ (F) + BM ($p < 0.05$). MBC rose from 13.98 mg/g to 29.52 mg/g, and SBR increased from 0.070 to 0.121 g CO₂/g soil/24h ($p < 0.05$ for both), indicating enhanced microbial abundance and activity. Results demonstrate that the combined application of *Bacillus megaterium* var. *phosphaticum* RK1 and potassium-based alkaline amendments, particularly half-dose K₂SiO₃ + BM, effectively enhances phosphorus availability and microbial activity ($p < 0.05$). The findings support an integrated biochemical approach as a sustainable solution for improving acidic soils.

Key words: Acidic soil, *Bacillus megaterium*, Phosphorus solubilization, Soil fertility restoration, Soil biological activity

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The effect of different soil characteristics on catalase enzyme activities in alluvial lands

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ABSTRACT

This study examined the catalase enzyme activity in soils with varying pedological properties developed on the alluvial deposits of the Kızılırmak River, Türkiye. The aim was to determine the vertical distribution of catalase activity within soil profiles and to assess its relationships with key soil physicochemical properties. Four soil profiles, classified as Typic Ustifluvent, Typic Haplustept, and Vertic Haplustept, were sampled by horizons in the Bafra Plain. Catalase activity was determined volumetrically and ranged from 56.04 to 667.60 $\mu\text{L O}_2 \text{ g}^{-1}$ dry soil. Activity levels were consistently higher in the surface (Ap) horizons compared to subsurface layers, showing a statistically significant decline with increasing depth ($p < 0.01$). Strong positive correlations were found between catalase activity and soil organic matter ($r = 0.893^{**}$), total nitrogen ($r = 0.888^{**}$), available phosphorus ($r = 0.541^*$), and exchangeable potassium ($r = 0.917^{**}$). These results indicate that catalase activity is a sensitive indicator of the biological status and fertility of alluvial soils. Enhancing soil organic matter through appropriate amendments may not only improve soil physicochemical conditions but also stimulate microbial activity, thereby increasing nutrient cycling efficiency in agricultural lands.

Key words: catalase activity, soil enzymes, alluvial soils, soil fertility, microbial indicators.



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Self-similarity in spatial variability of saturated hydraulic conductivity as affected by soil horizonation

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ABSTRACT

Spatial variation of soil saturated hydraulic conductivity (Ks) in layered soils is highly complex. Understanding this complexity is crucial for ecological, hydrological, and natural resource planning studies. This study aimed to characterize self-similarity in spatial structure of Ks in vertical and horizontal directions using fractal dimension (D) on 80-hectare cultivated semi-arid hillslopes of Gypsic Haplustepts and Gypsic Ustorthents in north-central Anatolia, Türkiye. Saturated hydraulic conductivity was measured with a Guelph permeameter at 174 sites in A and C horizons and 138 sites in B horizon. The spatial variation of Ks in the A, B, and C horizons was modeled using semivariograms, and fractal dimension (D) was calculated from slope of regression lines. Differences in means and D of horizon-specific Ks-values were tested using ANOVA and the method of homogeneity of slopes, respectively. Ks-values ranged from 0.01 to 7.11 cm h⁻¹. The mean Ks value in the B horizon (KsB) was significantly lower than those in the A horizon (KsA) and the C horizon (KsC) at the 0.01 significance level. Semivariograms were highly different between the soil horizons in nugget, sill, and range. KsA and KsC were described with exponential models and KsB with a Gaussian model. The calculated D-values ranged from 2.641 in the B to 2.96 in the A horizon. D-value for KsB was significantly lower than those for KsA and KsC, whereas KsA and KsC showed homogeneity at the 0.01 significance level. All three horizons exhibited D-values greater than 2.50, indicating that the spatial structure of Ks was self-similar to some extent. These findings suggest that soil horizonation can lead to significantly different self-similar spatial patterns of Ks, and that fractal geometry is useful for statistically distinguishing this aspect of Ks spatial data.

Key words: Fractal dimension, persistence, self-similarity, soil horizonation, spatial structure

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How does biochar affect soil fertility in clay soil?

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ABSTRACT

In recent years, biochar has attracted increasing attention because it is a highly stable material that can be used to increase carbon sequestration in soil and improve its fertility. The aim of this study was to demonstrate the effect of biochar after three years. Biochar obtained by the gasification process was applied to the study area on 10 January 2022, after which wheat plants were grown for three years. The application dose was 25 t ha⁻¹. Soil samples were taken on 05 May 2025 at a depth of 0–20 cm. Compared to the beginning of the experiment, the pH and cation exchange capacity increased in both the control and biochar treatments, while the electrical conductivity and organic carbon decreased. Examining the nutrient element contents revealed that only the Ca and Mg concentrations increased in the biochar treatment, while the contents of the other nutrient elements decreased in both treatments. Statistically significant decreases in phosphorus, copper and zinc content were detected compared to the control. Consequently, when soil was amended with biochar rich in basic cations such as Ca²⁺ and Mg²⁺, the concentrations of these elements increased over time, while the concentrations of phosphorus and micronutrients decreased markedly. Evaluating the long-term effects of biochar is crucial for assessing the effectiveness of such applications.

Key words: Biochar, Long term, Nutrients availability, Clay soil

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Organization of effective soil management in the Gusar-Gonagkend cadastral district of Azerbaijan

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ABSTRACT

The study of the soils in the Gusar-Gonagkend cadastral district, which are intensively used in the agricultural sector of the Republic of Azerbaijan, revealed significant problems related to the improper and inefficient use of land resources. The research examined various anthropogenic impacts that significantly affect the environmental situation during land use in the cadastral region. Field and soil surveys of the cadastral district were conducted, and selected samples were analyzed using generally accepted methods, providing qualitative and environmental assessments. It was established that within the cadastral district, non-eroded areas make up 43.9%, while eroded areas account for 56.1%. Of these, severely eroded areas comprise 40.1% (33,029 ha), slightly eroded – 26.8% (22,075 ha), and moderately eroded – 33.1% (27,264 ha). Unsustainable logging in many sections of forested areas within the cadastral district, combined with the lack of reforestation efforts, has led to a reduction in forest-covered areas; forests occupied only a small portion—49,111 ha, which is merely 10.81% of the total area. It was found that soil fertility in the study area has declined due to intensive agricultural use: 16.92% of soils belong to the first quality group, 51.88% to the second group, 27.69% to medium-quality soil, and 3.51% to low-quality soil. Salinization was noted only in mountain-gray-brown soils—24.6%. To ensure environmental safety and ecosystem sustainability in the Gusar-Gonagkend cadastral district, key directions for sustainable land resource management have been identified. A conceptual framework has been developed to ensure the efficient use and protection of soils based on defining proper and effective land-use ratios for areas involved in intensive economic activities, along with an appropriate system of agrotechnical regulations. These include erosion control measures, forest protection and expansion, improvement of agricultural land use, creation of protective forest belts, prevention of soil salinization, expansion of perennial plantations, and others.

Key words: Soil management, soil erosion, deforestation, salinization, agrotechnical measures.

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Identifying limitations and enhancement pathways for the WEPP Model in simulating rill erosion: A focus on parameter uncertainty and hydraulic drivers

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ABSTRACT

The Water Erosion Prediction Project (WEPP) model, developed and refined over the past four decades, is a cornerstone physically based tool for simulating soil erosion at hillslope and watershed scales. The model's development has been strongly informed by pioneering research in soil erosion processes and hydraulics. Despite its extensive use, limitations in parameter estimation and hydraulic representation still affect accuracy and applicability, especially in complex terrains and heterogeneous soils without site-specific calibration. This study aims to evaluate key limitations of the WEPP model in rill erosion simulation, emphasizing that these assessments are grounded in decades of foundational research. It also proposes potential enhancements to improve parameterization and hydraulic modeling. The conceptual analysis focuses on WEPP's empirical estimation of hydraulic parameters such as rill erodibility and critical shear stress, which rely on intrinsic soil properties including clay content, organic matter, bulk density, and permeability. The model's dependence on shear stress as the primary soil detachment driver is examined in light of extensive experimental validation and historical developments in erosion modeling. Parameter estimation methods derived from intrinsic soil properties introduce notable uncertainty, especially in steep or structured soils. Refinements incorporating additional soil fractions and slope effects have improved accuracy but are still limited in scope. Empirical evidence consistently supports shear stress as the dominant hydraulic driver, aligning with WEPP's foundational assumptions. Operational challenges remain, including limited regional calibration data, lack of flexibility for diverse soils, and usability constraints. Enhancing WEPP's predictive reliability requires further development of flexible, regionally adapted parameter estimation methods, improved calibration workflows, and more user-friendly interfaces. Maintaining emphasis on shear stress as the key hydraulic driver, supported by decades of experimental and theoretical research, will strengthen the model's applicability across diverse landscapes.

Key words: WEPP model, rill erosion, shear stress, parameter uncertainty, hydraulic modeling, soil erosion simulation, model enhancement

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The effect of foliar zinc application on yield component of corn plant

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ABSTRACT

The aim of this study was to determine the effect of foliar Zn application on Zn content and uptake of corn (*Zea mays* L.) plant. In the study, zinc sulfate fertilizer was applied to the corn plant at the 5-leaf stage at rates of 0, 0.1%, 0.2%, and 0.4% Zn doses in foliar application. The experiments were under randomized complete block designs with 3 replications. At the end of the study, the corn yield, stalk and grain Zn content and grain Zn uptake of corn plants were increased significantly ($p<0.01$) by foliar Zn applications compared to the control. The stalk Zn contents of corn plants were higher than the grain Zn contents in all applications. The highest increases of corn grain yield and stalk Zn content were obtained at 0.1% Zn dose as 28.98% and 272.94%, respectively; stalk Zn content was found at 0.2% Zn dose as 59.60%, and grain Zn uptake was found at 0.4% Zn dose as 87.37%. Consequently, statistically evaluated all the data, it was recommended that were at 0.1% foliar application for grain yield and Zn uptake, and 0.2% dose for stalk production for corn plants.

Key words: Foliar application, Corn, Grain yield, Zinc, Content, Uptake

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Effect of alkaline hydrolyzed sheep wool on growth and element concentrations of spinach plant (*Spinacia oleracea* L. cv)

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ABSTRACT

Waste sheep wool (SW) which cannot be utilized in the textile industry, is a highly valuable organic matter source containing keratin. Nevertheless, the complex structure of keratin in SW is highly resistant to degradation in nature. In this study, the solubility of keratin was increased through alkaline hydrolysis. The SW hydrolysate (SWH) was applied to spinach plant at levels of 0, 1, 1.5, and 2 mL kg⁻¹, and the growth and mineral nutrition of spinach was evaluated. Although SWH applied at increasing levels increased the weight of the spinach plant. This increase was not statistically significant. However, SWH treatments increased the nitrogen (N) concentrations of plants from 333.97 g kg⁻¹ to 40.74 g kg⁻¹, potassium (K) concentration from 72.80 g kg⁻¹ to 83.77 g kg⁻¹, magnesium (Mg) concentration from 5.13 g kg⁻¹ to 6.20 g kg⁻¹, and sulfur (S) concentration from 3.18 g kg⁻¹ to 3.78 g kg⁻¹. SWH applications also had a positive effect on the iron (Fe) and manganese (Mn) concentrations. Based on these results, it can be said that the use of SW, which is a waste product, in plant production is significant in terms of productivity, and this approach can support a circular bioeconomy.

Key words: Amino acid, hydrolysate, leafy vegetable, plant nutrition, waste sheep wool

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Comparative study of multifunctional soil sensor with laboratory analysis

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ABSTRACT

The aim of this study was to evaluate the reliability of a multifunctional soil sensor across different soil types and moisture conditions. To this end, the effect of increased moisture levels over different waiting periods was investigated. A total of 25 soil samples were analyzed using standard laboratory methods to determine their pH, electrical conductivity (EC), total nitrogen (N), phosphorus (P), potassium (K), and moisture content. The same samples were also assessed using a multifunctional soil sensor. The sensor data were then compared with laboratory results to evaluate its reliability, accuracy, and applicability for agricultural use. The sensor provided the most consistent and accurate readings for soil moisture, while its measurements for other parameters, including pH, EC, and nutrient levels, showed limited reliability when compared with standard laboratory results.

Key words: Nitrogen, pH, Phosphorus, Potassium, Soil Salinity, Soil Sensor

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Mapping of soil nutrients using GIS for nutrient management in hazelnut

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ABSTRACT

The objective of this study was to determine soil reaction and macronutrient content in Hazelnut soils located in Akçatepe district, Ordu. For this purpose, soil samples were collected from the study area to evaluate the soil fertility parameters. The soil samples were analyzed for the following soil properties: soil pH and macronutrients as total N, available P and available K, Ca, Mg. Afterward, soil nutrient maps were prepared by IDW method with the obtained data results. The maps showed the pH of the soils were between 5.30-7.51 indicating slightly acid to neutral and most of the nutrients were at sufficient levels. In this study, obtained maps of the soil macronutrients indicated that total N, available Ca, Mg and K were at sufficient level whereas available P was insufficient. In addition to, soil nutrients in the study area were positively correlated with each other. Soil pH and total N; available P, available K; available Ca are positively correlated. Results showed that, soil nutrients may be mapped to compare nutritional level and make it easy fertilizer application for nutrient management.

Key words: Macronutrient, pH, soil, IDW, map

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Pan-transcriptomic profiling demarcates *Serendipita indica*-Phosphorus mediated tolerance mechanisms in rice exposed to arsenic toxicity

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ABSTRACT

Inadvertent accumulation of arsenic (As) in rice (*Oryza sativa* L.) is a concern for people depending on it for their subsistence, as it verily causes epigenetic alterations across the genome as well as in specific cells. To ensure food safety, certain attempts have been made to nullify this highest health hazard encompassing physiological, chemical and biological methods. Albeit, the use of mycorrhizal association along with nutrient reinforcement strategy has not been explored yet. Mechanisms of response and resistance of two rice genotypes to As with or without phosphorus (P) nutrition and *Serendipita indica* (*S. indica*; S.i) colonization were explored by root transcriptome profiling in the present study. Results revealed that the resistant genotype had higher auxin content and root plasticity, which helped in keeping the As accumulation and P starvation response to a minimum under alone As stress. However, sufficient P supply and symbiotic relationship switched the energy resources towards plant's developmental aspects rather than excessive root proliferation. Higher As accumulating genotype (GD-6) displayed upregulation of ethylene signaling/biosynthesis, root stunting and senescence related genes under As toxicity. Antioxidant defense system and cytokinin biosynthesis/signaling of both genotypes were strengthened under As + S.i + P, while the upregulation of potassium and zinc transporters depicted underlying cross-talk with iron and P. Differential expression of phosphate transporters, peroxidases and GSTs, metal detoxification/transport proteins, as well as phytohormonal metabolism were responsible for As detoxification. Taken together, *S. indica* symbiosis fortified with adequate P-fertilizer can prove to be effective in minimizing As acquisition and accumulation in rice plants.

Key words: Arsenic accumulation, Endophytic fungus, *Oryza sativa* L., Phytohormone, Transcriptome profiling

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Assessment of composed and non-composted rice straw incorporation on wheat (*Triticum Aestivum*) productivity and soil health

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ABSTRACT

Rice straw (RS) is a valuable organic resource for enhancing soil fertility; however, its direct incorporation poses challenges due to high bulk volume, slow decomposition, and potential allelopathic effects. Although numerous studies have examined both raw and composted RS applications, direct comparisons regarding their impact on wheat growth remain limited. This study investigated the effects of five application rates (S0, S1, S2, S3, S4) of composted RS (CR) and non-composted RS (NCR) on wheat growth components, yield, and soil properties. Wheat was grown in a pot experiment under greenhouse conditions following completely randomized design (CRD). The results revealed that CR significantly improved plant growth parameters including plant height, stem diameter and tiller number, whereas NCR exhibited a suppressive effect. Both fresh and dry biomass were markedly higher in CR treatments than in NCR ($p < 0.001$). Specifically, wheat yield increased by 85% under CR (S1) but decreased by 63% under non-composted RS (S1) relative to the control (S0). Regardless of straw type, RS application significantly enhanced soil pH, EC and organic carbon (SOC) following the treatment ($p < 0.01$). However, N nitrogen (N) and phosphorus (P) contents were significantly higher in composted RS treatments than in non-composted RS. At the S4 level, CR increased N and P by 25% and 49% compared to control, and by 21% and 6% relative to NCR (S4), respectively. Moreover, RS application significantly improved soil potassium (K) and sodium (Na) contents ($p < 0.01$) irrespective of the straw type. Overall, composted RS considerably enhanced wheat's growth parameters, yield and soil nutrient availability, highlighting the promising role of RS composting in boosting crop productivity and improving soil health. The findings underscore composting as an effective strategy for sustainable RS management in wheat cultivation.

Key words: Composting, Nutrients availability, Rice straw, Soil Properties, Wheat growth, Yield

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Remote sensing-based assessment of coastal erosion and geomorphological changes in a Caspian Delta

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ABSTRACT

The Kura River Delta is a dynamic coastal system affected by both marine and fluvial processes. Understanding the geomorphological changes in this region is crucial for sustainable coastal management. This study aims to analyze the geomorphological dynamics of coastal erosion in the Kura River Delta over the past 35 years (1985–2020), identify transformation processes, and evaluate the main drivers using satellite data. High-resolution Landsat 5, Landsat 8, and Sentinel-2 imagery were used. Atmospheric and geometric corrections were applied using ENVI and ArcGIS. The Digital Shoreline Analysis System (DSAS) was employed for shoreline displacement analysis. NDVI, MNDWI, and Tasseled Cap Transformation indices were calculated for land-water classification and landscape dynamics. The results indicate that Caspian Sea level fluctuations and Kura River discharge variability have caused both seaward and landward shoreline shifts. Significant geomorphological changes include erosion-accumulation shifts, coastal terrace reformation, and fragmentation of land cover. The total area affected by transformation was estimated at 48.1 km². Remote sensing and GIS technologies prove to be essential for monitoring coastal erosion and supporting sustainable management practices in vulnerable deltaic systems.

Key words: Coastal erosion; shoreline change; remote sensing; DSAS; Caspian Sea level; landscape transformation; climate action

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Comparison of different boron extraction methods

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ABSTRACT

The aim of this study was to compare different boron extraction methods. To this end, five extraction methods were evaluated against the hot water extraction method in terms of energy consumption. For this purpose, soil samples with hot water-soluble boron contents ranging from 0.7 to 22.5 mg/kg were selected. The boron content of the selected samples was first determined using the hot water extraction method. Among the five selected extraction methods, the highest correlation coefficient ($r = 0.93$) was obtained with the method involving shaking with 0.01 M mannitol + 0.01 M CaCl_2 solution for 16 hours. In the hot water extraction method, the energy consumption per sample was determined to be 0.065 kWh, whereas the method involving shaking with 0.01 M mannitol + 0.01 M CaCl_2 solution for 16 hours resulted in an energy consumption of 0.72 kWh per sample.

Key words: Boron extraction, Comparison of extraction methods, Energy consumption, Hot water method, Soil analysis.

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Digital disaggregation of soil subgroups using DSMART in a Mediterranean landscape

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ABSTRACT

Accurate digital mapping of soil classes remains essential for sustainable land management. DSMART, a disaggregation algorithm based on decision trees, offers probabilistic soil subgroup mapping by combining environmental covariates with legacy soil data. This study aims to disaggregate soil subgroups from existing 1:25,000 scale soil maps using DSMART in a topographically diverse region of Adana, Türkiye. A total of 231 legacy map units were harmonized and resampled to 20 m resolution. Forty soil profiles were collected using a conditioned Latin Hypercube Sampling (c-LHS) design. Predictors were derived from a 5 m digital elevation model (DEM), NDVI was derived from 20 m Sentinel-2 images, and legacy soil information. The DSMART algorithm was implemented in R using the "C5.0" decision tree model, producing multiple realizations and subgroup probability surfaces. Model accuracy was evaluated using Kappa statistics and Shannon entropy. The most dominant subgroups—Typic Xerofluvent (Tx), Typic Calcixerept (Tc), and Typic Xerorthent (To)—were reliably predicted, particularly in heterogeneous landscapes. Subgroups such as Fluventic Haploxerept (Fh) and Oxyaquic Xerofluvent (Ox) showed higher uncertainty due to limited data representation. Elevation and curvature-based topographic indices were the most influential predictors. Overall model accuracy reached 85.2%, and probability surfaces showed smoother transitions than traditional polygon-based soil maps. DSMART enables detailed, probabilistic soil mapping that surpasses classical survey precision by accounting for uncertainty and spatial heterogeneity. The findings contribute to soil management strategies for Mediterranean agricultural regions.

Key words: DSMART, Digital Soil Mapping, Soil Subgroup, Mediterranean Region, Entropy, Legacy Data, Probability Mapping, Topographic Predictors.

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The effect of cover crops on wet aggregate stability, dispersion ratio and organic matter of soil in *Nigella Sativa* L.

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ABSTRACT

Cover crops play an important role in improving soil structure and organic matter and contribute to sustainable agricultural practices. They also increase organic matter through decomposition of plant residues, contribute to humus formation and support microbial activity, thus promoting overall soil health. In this study, the effects of different cover crops on wet aggregate stability (WAS), dispersion ratio (DR) and organic matter (SOM) of soil were investigated in the field where *Nigella Sativa* L. seed was grown at Erciyes University Agricultural Research and Application Centre in Kayseri, Türkiye. *Vicia sativa* L. (VS), *V. sativa* L. + *Hordeum vulgare* L. (VS+HV), *V. villosa* Roth. (VV), *V. villosa* Roth. + *H. vulgare* L. (VV+HV), *Secale cereale* (SC), *Hordeum vulgare* L. (HV) were used as cover crops. The experiment also included control (C) where no cover crop was used. The experiment was established according to the randomised block design with four replications. The experiment was conducted for two years (2022-2023 and 2023-2024). In both years, the mown cover crops were thoroughly shredded and mixed homogeneously with the soil. Soil samples were taken from 0-20 cm soil depth from each plot 90 days after mowing. The cover crops increased the WAS of the soils and decreased the DR. The WAS of the cover crops were ranked as C < SC < HV < VS+HV < VV+HV < VS < VV. The highest WAS (21.42 %) and lowest DR (52.87 %) were found in VV. The highest increase in SOM was found in VV and VS, while the lowest was found in the control. Significant negative correlations were obtained between WAS and DR (-0.952**) and SOM and DR (-0.938**), while significant positive correlations were determined between WAS and SOM (0.902**). VV and VS applications of annual legumes are recommended to improve wet aggregate stability and organic matter of soils.

Key words: Cover crops, *Nigella Sativa* L., wet aggregate stability, dispersion ratio, organic matter, *V. villosa* Roth., *Vicia sativa* L.

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The effect of different diatomite doses on the leaching of phosphorus (P) and ammonium (NH_4^+) from soil

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ABSTRACT

The aim of this study is to evaluate the effect of different doses of diatomite application on the leaching of phosphorus (P) and ammonium (NH_4^+) under laboratory conditions. In the experiment, diatomite ground to a particle size of 250 μm was mixed with soil at rates of 1%, 2%, and 4% (w/w), and placed into leaching columns with an internal diameter of 5 cm. After saturating the soil columns with distilled water, 180 mL of distilled water was applied to each column, and the leachates were collected for analysis. Two different soil column heights (20 cm and 40 cm) were used in the experiment; in the 40 cm columns, diatomite was applied only to the upper 20 cm layer. Phosphorus and ammonium concentrations in the collected leachates were subsequently analyzed. According to the results, the greatest reduction in phosphorus leaching was observed in the 20 cm soil height with 4% diatomite application, with a decrease of 36,73%. Similarly, the highest reduction in ammonium leaching was also recorded in the same treatment, with a 40.74% decrease. These findings indicate that diatomite, when applied at appropriate doses and depths, has significant potential to reduce phosphorus and ammonium losses from the soil.

Key words: Ammonium (NH_4^+), Column leaching experiment, Diatomite, Nutrient leaching, Phosphorus (P)

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Development and pilot application of a plant test system for ecotoxicity assessment of metal-contaminated soils

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ABSTRACT

Plant bioassays are widely recommended for assessing the ecotoxicity of metal-contaminated soils. While germination rate and plant biomass are commonly used endpoints, parameters such as photosynthetic performance, enzyme activity, and other physiological indicators are rarely incorporated. This study aimed to develop a plant-based test system for ecotoxicity assessment of metal-contaminated soils, incorporating physiological endpoints to enhance sensitivity and accuracy. The study was conducted under controlled environmental conditions and included the following phases: (1) Evaluation of plant species sensitivity to elevated levels of Cd, Cu, and Zn in the root medium; (2) Selection of a suitable plant species and characterization of its response to metal contamination; (3) Identification of optimal endpoints for phytotoxicity assessment and determination of their threshold values for light, moderate, and strong chronic toxicity, (3) Comparative assessment of the new system's sensitivity against existing plant test systems; (4) Pilot application of the newly developed test system to characterize metal-contaminated soils in Bulgaria. (1) Cucumber (*Cucumis sativus* L.) was selected as the most suitable test species; (2) The proposed test system includes the following endpoints: fresh biomass, photosynthetic CO₂ assimilation rate, apparent electron transport rate of PSII, and root peroxidase activity; (3) Based on these criteria, metal-contaminated media can be classified as non-toxic, chronically toxic (light, moderate, or strong), or lethally toxic; (4) The new test system demonstrated sensitivity to heavy metals comparable to that of established plant bioassays. (5) The system was successfully applied to assess the toxicity of soils contaminated with metals in the Plovdiv region. The developed plant test system represents a reliable and sensitive complementary tool for the ecotoxicological assessment of metal-contaminated soils.

Key words: Plant test system, heavy metals, cucumber, *Cucumis sativus*, fresh biomass, photosynthesis.

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Ecological problems and the impact of climate change in Shusha

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ABSTRACT

The article investigates the current state of water and soil cover in the Shusha administrative district. The study examines the physical and chemical properties of the area's soil cover and includes analyses of its springs and rivers. Considering global climate change and the city's future development, research has been conducted to establish a more sustainable water and soil supply system. Overall, groundwater resources in the area are highly limited. Therefore, preference has been given to utilizing water from the Khafalichay River for irrigation. To assess the quality of spring water, monitoring activities have been carried out, water samples have been collected from springs, and relevant physicochemical analyses have been conducted. These monitoring activities were initiated in May 2023.

Key words: Heavy metals, cobalt, soil, pollution, physicochemical parameters, spring.

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Optimizing foliar micronutrient application to improve sugar beet yield and quality in Southeastern Kazakhstan

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ABSTRACT

This study investigates the impact of boron and zinc foliar fertilizers on the productivity of sugar beet hybrids Bolashak and Abulkhair in southeastern Kazakhstan. Foliar applications of YaraVita Bortrac150 (B) and Zintrac700 (Zn) were tested individually and in combination on two domestic hybrids using a randomized complete block design. Results indicated that combined micronutrient treatments significantly improved root yield (up to 82.0 t ha⁻¹), sugar content (up to 18.1%), and sugar yield (up to 14.8 t ha⁻¹), especially under NPK background fertilization. The study demonstrates that foliar application of B and Zn is an effective agronomic approach to enhance sugar beet productivity under semi-arid conditions.

Key words: Sugar beet, boron, zinc, foliar application, yield, sugar content.

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Response of soil organic carbon and nutrient stocks to future climate change under different land uses across Europe

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ABSTRACT

Soil organic carbon (SOC) and nutrient stocks are critical for climate change mitigation as they regulate plant productivity, biogeochemical cycles, and greenhouse gas fluxes. However, their responses to future warming scenarios remain uncertain. This study quantified SOC and nutrient (N, P, K) stocks across different land uses in the European Union (EU) and United Kingdom (UK) in 2018 and projected their dynamics under three Representative Concentration Pathways (RCP2.6, RCP4.5, and RCP8.5) for 2050 and 2070. Soil bulk density was predicted using a random forest model with the R^2 of 0.66 b using the following variables - mean annual temperature (MAT), total precipitation (TP), soil texture, and land use. Later, the stocks for 2050 and 2070 were predicted for the RCPs using land uses, sand content, MAT and TP. Results showed SOC and N stocks increased slightly under mild warming but declined significantly under RCP8.5, particularly in croplands. In contrast, P and K stocks increased with rising temperature across all land uses. Grasslands and shrublands exhibited resilience, showing minimal changes in SOC and N, while woodland responses varied: pine-dominated woodlands gained SOC and N, whereas spruce-dominated stands declined markedly. These findings highlight land-use types that enhance SOC and nutrient stability under climate change, offering guidance for adaptive land management and policy aimed at sustaining soil health and carbon storage in a warming future.

Key words: Climate change; land use; nutrient stock; soil organic carbon stock.

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Guaiacol peroxidase activity as a biochemical indicator of cold stress tolerance in Radish (*Raphanus sativus* L.) genotypes

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ABSTRACT

Low-temperature stress represents a significant abiotic constraint to crop development and productivity, particularly in temperate agroecological zones. The present study aimed to elucidate the cold stress responses of eleven distinct *Raphanus sativus* L. genotypes by integrating phenotypic evaluations with biochemical analyses, specifically focusing on guaiacol peroxidase (GPX) activity—an enzymatic antioxidant implicated in reactive oxygen species (ROS) detoxification. Plants were grown in homogeneous greenhouse conditions as a control group and were also subjected to cold treatment (4°C) in a climate-controlled environment as a stress group. GPX activity was quantified under both control and stress conditions, and data were subjected to repeated measures ANOVA and Fisher's Least Significant Difference (LSD) post hoc testing to determine statistically significant differences among genotype-treatment interactions. The analysis revealed a significant overall effect of cold stress on GPX activity across genotypes ($p < 0.05$). Genotypes classified as cold-tolerant based on the results of classical phenotypic assessment—namely BT11, KT2, and KT1—exhibited markedly elevated GPX activity under cold conditions, whereas cold-sensitive genotypes such as KT3, FT3, and ST2 demonstrated limited enzymatic induction. The moderately tolerant genotype BT1 displayed an intermediate GPX response. Pairwise comparisons via LSD testing confirmed significant differences between tolerant and susceptible genotypes under stress conditions, substantiating the discriminatory power of GPX as a biochemical marker. These findings underscore the utility of GPX activity as a reliable physiological indicator for cold tolerance in radish. The integration of enzymatic antioxidant profiling with classical phenotypic assessment enhances the resolution of genotype classification under abiotic stress and offers a robust framework for selection within breeding programs aimed at improving cold resilience.

Key words: Cold stress, Guaiacol peroxidase, Antioxidant enzymes, Radish, Oxidative stress, Genotypic variation.



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Management of pesticide-laden tomato residues in vermicomposting: Implications, limits, and safe application approaches

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ABSTRACT

This study highlights vermicomposting's critical role in detoxifying toxic residues from chemical applications in agricultural waste. Plant and animal residues are a significant source of organic matter for soil, but intensive chemical use often leads to persistent toxic residues within this material. Applying these wastes requires adherence to proper composting principles, as incomplete composting introduces problems like salinity, toxic compounds, pathogens, and weed seeds, compromising soil health. Earthworms rapidly decompose and humify organic materials. Studies show their metabolic activities can detoxify organic pollutants, sanitize substrates by digesting pathogens, and bioaccumulate heavy metals. Tomato cultivation, a leading agricultural practice in greenhouses, generates significant waste from pruning and post-harvest residues (the more lignocellulosic materials of plants). The intensive pesticide regimen makes direct land application of these residues risky, especially for organic farming. In this study, tomato plant residues (TR) were added to pre-composted manure at rates of 10%, 20%, 30%, 40%, 50%, and 60%. The effects of TR application on the vermicompost's chemical and biological properties, parameters like pH, EC, and C/N ratio, basal respiration, microbial biomass C and plant nutrients were investigated over 45 days. By day one, earthworms in the 50% and 60% TR mixtures perished, followed by those in the 40% mixture by day five. This high mortality was attributed to toxic compounds from intensive pesticide applications on the source tomato plants. The data confirmed that both the application rate of pesticide-laden TR and vermicomposting duration significantly impact the final product's quality and safety. We conclude that further research is essential, focusing on lower application doses, longer incubation periods, and pre-composting of tomato residues to develop safe and effective waste management protocols for sustainable agriculture.

Key words: vermicomposting, tomato residue, soil biology, pesticide, waste management, soil organic material

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Study of the soil cover structure of the Gobustan Massif

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ABSTRACT

Gobustan is a region within Azerbaijan's Shirvan province, situated in the eastern and southeastern foothills of the Greater Caucasus, in the eastern part of Azerbaijan. According to modern physical-geographical zoning, Gobustan is classified as a separate area, stretching 80 km from east to west and 100 km from north to south. The district lies east of Shamakhi, 101 km from Baku. The terrain of Gobustan is mountainous and complex, featuring valleys, ravines, and rocks. Geographically, the mountain slopes are categorised into plateaus, hilly terrains, and plains, with the plateau occupying Gobustan's northwest. Clay karst has developed in the Adjidara area, forming widespread karst landscapes. Winds, precipitation, and mud volcanoes have shaped a major part of the region's relief. Geologically, Gobustan is rich in oil and gas. The mud volcanoes are a natural sign of this. Gray-brown saline and various gray-brown soil are prevalent here. Soil profiles were established, and individual types of the structures of the soil cover (SSC) were identified within Gobustan. Using the method of relief plasticity, the SSC of the Gobustan massif were determined and mapped at a scale of 1:100,000. Identified types include the dendritic in the foothill area, the radial-circular, and the dendritic of volcanic origin. It was determined that the formation of SSC and the soil properties are influenced by the exposure of slopes — specifically, the contrasting conditions of the northwestern shaded and southeastern sunlit parts of the relief. Mountain gray-brown and saline soils of the southeastern sunlit slopes display reduced humus-accumulative horizons (AY = 15–20 cm), humus content (1.0–1.5%), and absorbed bases (15–18 mmol-eq), alongside increased salinity (1.35–2.67%), pH (8.5–9.0), weakened granulometric structure (<0.01 mm = 38–45%; <0.001 mm = 35–41%), and accelerated erosion.

Key words: Gobustan, structures of soil cover, relief, exposure of slopes, soil properties

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Changes in the lands of landscape complexes on the southern slope of the greater Caucasus in terms of ecotourism

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ABSTRACT

The development of tourism in the landscape complexes of the natural-geographic region of the Greater Caucasus has led to certain changes occurring in the lands.. The area's complex relief, climate, vegetation, soil cover and the natural forest, alpine and subalpine steppe and steppe biogenoses created by these natural components depending on the altitude have changed their areas and natural-historical structure and undergone transformation due to the influence of human economic activity from time to time. The ecosystems of Gabala region, located on the southern slope of the Greater Caucasus, which naturally consists of forest cover in partially high, medium and low mountainous zones, have undergone certain changes. Thus, a part of the important natural resource such as forest has been lost and replaced by steppe areas or agro-landscapes - crops, fields, fields, etc. The reduction of forest cover in the area occurred both in the lower part of the forest belt and in the upper part of the belt. Protection of forests and river basins is an important issue in mountainous areas, as prevention of soil erosion is more important than in other lowland areas. The ecological processes occurring in the forest ecosystems in the mountainous zone naturally change both as a result of natural events and anthropogenic influences. In the modern era, global climate change, pollution of the atmosphere and water bodies, desertification and aridification, loss of biodiversity and other ecological problems cause concern and are relevant. The accession of our republic to a number of international conventions related to environmental protection, the adoption of laws, regulations and other legal documents within the country, and finally the implementation of specific measures in the field of environmental protection began to give effective results in solving this problem.

Key words: Landscape complexes, climate, vegetation, soil, forest, river, desertification, aridification.

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Effect of foliar phosphorus fertilizers on wheat development

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ABSTRACT

Phosphorus (P) is an extremely important nutrient found in energy transport reactions, photosynthesis and protein synthesis in plants. Phosphorus deficiency is intense in our country's soil due to high pH and lime, low organic matter and rainfall. Since phosphorus fertilizers are easily fixed in the soil, they are generally applied to the seedbed and band at the time of sowing/planting by fertilizing. However, some studies conducted in recent years report that P given at once with basal fertilization is not sufficient and that plants experience P starvation towards the end of plant development. Based on this information, in the study, 2 different P sources (H_3PO_4 and nano-P) were applied to wheat plants grown under field conditions via leaves at 0.2% P in 2 different periods (beginning of heading and end of heading) and the effects of the applications on some yield components and grain N, P, Fe, Zn, Cu and Mn concentrations were investigated for 2 years. When the results obtained from the study were examined; grain yield, 1000 grain weight and grain Fe and Cu concentrations were not affected by foliar applications in 2 years. While the grain N concentrations increased with nano-P application compared to the control in both years, the increase in grain P and Zn concentrations compared to the control was significant only in the second year and with nano-P application. Grain Mn concentration increased with nano-P application compared to H_3PO_4 in both years. The results obtained from the study show that the pressure exerted by conventional P fertilizers especially on microelements is lost with nano-P application and that P and N concentrations in grain can be increased with nano-P. In addition, it is extremely important to conduct similar studies in different regions of our country, especially on different plants grown in dry farming.

Key words: Phosphorus (P), foliar application, nano-P, wheat

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Yield response of wine grapes to fertilizer application and quality of wine

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ABSTRACT

Fertilization of wine grapes is an important management practice for the yield of grapes and the quality of the wine produced. A four-year fertilizer experiment was conducted in the region of Pomorie, East Bulgaria (Black Sea coast). The study examines the effects of fertilization on grape yield and wine quality. The vineyard was planted with the grape variety Cabernet Sauvignon. The experiment included eight treatments: unfertilized control, N, P, K, NP, NK, PK, and NPK. The fertilizer rates were N - 80 kg ha⁻¹, P₂O₅ - 60 kg ha⁻¹, K₂O - 80 kg ha⁻¹. Ammonium nitrate, triple superphosphate, and potassium sulfate were used for fertilization. The use of a single nutrient or a combination of two or three nutrients showed different effects on grape yield during the experiment. The application of the triple combination of NPK provided the highest yield during the four years of the experiment. Sensory evaluation of the wine produced by the experimental variants showed that the highest quality wine was obtained from the variants of NP, K, and PK fertilizers.

Key words: grape yield, NPK fertilization, quality of wine

Acknowledgment: The study was realized thanks to the financial and methodological support of the International Plant Nutrition Institute (IPNI), USA, under the project "Best management practices for sustainable crop nutrition in Bulgaria".



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Heavy metal content in the soils of the dried-up bottom of the Aral Sea

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ABSTRACT

On the territory of Uzbekistan, as a result of the drying up of the Aral Sea, a large area of land has formed, which is about 5 million hectares. This leads to many problems for the environment. To study the content of gross forms of heavy metals, soil samples were taken from the southern part of the dried bed of the Aral Sea - near the city of Muynak from the zero point (0-headquarters), helicopter pad, 22 km, and from the eastern part - in the Kukdash area (coordinates 43°40'52" and 60°02'54"). The content of heavy metals was determined on an atomic emission spectrometer with inductively coupled plasma (ICPE-9820 Shimadzu). The results of the study show that of the most dangerous heavy metals, cadmium is contained in the soil of the dried bed of the Aral Sea in the southern part in the 0-stab 0.031 ppm, at 22 km - 0.129 ppm, on the helicopter pad - 0.049 ppm, in the eastern part - in the 0-10 cm horizon 0.118 ppm, in the 10-30 cm horizon - 0.042 ppm, in 30-50 cm - 0.111 ppm. The highest content of gross forms of cadmium was noted at the 22-kilometer point of the southern part and in the upper 0-10 cm horizon of the eastern part of the dried bottom of the Aral Sea. The highest arsenic content was noted in the southern part of the Aral Sea - 126-184 ppm, and in the eastern part 108-115 ppm. The gross chromium content was higher at 0-shtab and 22 km than at the helicopter pad and was 41.8; 37.6; 17.3 ppm, and in the eastern part - 27.9 - 36.9 ppm. Thus, the soils of the dried-up bottom of the Aral Sea contain heavy metals in sufficient quantities to pollute the environment.

Key words: heavy metals, soil, content, pollution, cadmium, arsenic, chromium

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The influence of soil salinity in the Shoulder irrigation area on autochthonous microorganisms

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ABSTRACT

According to the Agency for Land Management of the Republic of Kazakhstan, the total area of saline soils, solonetz and solonchaks occupies 41% of all soils in Kazakhstan. The aim is to study the autochthonous microbial community of saline soils to assess its condition and degree of degradation. Humus was determined according to the method of Tyurin, Isolation of autochthonous microorganisms from soil was carried out according to the method of E.Z. Tepper, identification by PCR. The paper presents the results of the study of autochthonous microorganisms of saline soils of Shoulder irrigation massif of Turkestan region. It was found that with increasing degree of soil salinity the number of isolated microorganisms decreases. The highest value corresponds to soils with low salinity degree, in soils with medium and very high salinity degree their number decreases approximately in 2 times. There is an inverse dependence between humus content and number of microorganisms, which indicates their participation in the process of mineralization of humic substances. Taxonomic position of dominant species of autochthonous microorganisms in saline soils was determined. 25 morphotypes of autochthonous microorganisms were identified by PCR and their percentage content in the studied soils was determined. It has been established that the number of autochthonous bacteria and their species diversity decrease with increasing soil salinity. Autochthonous bacteria in saline soils are represented by the following phyla: *Actinobacteria*, *Proteobacteria* and *Firmicutes*, whose members are united by a common functional activity – transformation of complex, difficult to decompose organic matter, which include humus compounds. The activity of this group of bacteria can lead to humus losses in the soil.

Key words: saline soils, autochthonous microorganisms, morphotypes, identification

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Integrated indicators of degradation of irrigated agricultural soils in Southeastern Kazakhstan

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ABSTRACT

Intensive agricultural use of irrigated lands in southeastern Kazakhstan has led to soil degradation. Effective diagnosis and monitoring require integrative indicators reflecting both chemical and biological soil properties. The study examined virgin and irrigated arable soils (sierozems and dark chestnut) using standard methods commonly accepted in soil science. Humus content in virgin sierozems and dark chestnut soils was 2.0% and 6.5%, respectively, but declined to 0.7% and 2.5% under long-term cultivation. Virgin soils were characterized by a predominance of humic acids over fulvic acids and a high content of non-hydrolyzable residue. In contrast, cultivated soils showed a decrease in humic acids, an increase in fulvic acids, and reduced non-hydrolyzable residue - indicating a shift in humus type from fulvate-humate (virgin) to humate-fulvate and fulvate (arable). Readily hydrolysable nitrogen was 46.7 mg/kg in virgin sierozems and 92.4 mg/kg in virgin dark chestnut soils. Under agricultural use, these values dropped to 39.2 mg/kg and 48.5 mg/kg, respectively, indicating soil nutrient depletion. Microbiological indicators - including total microbial count, actinomycetes, nitrogen-fixers, and fluorescein diacetate (FDA) activity - were highest in virgin dark chestnut soils and lowest in cultivated sierozems, reflecting significant biological degradation. Differences in humus composition, available nitrogen, and microbial activity between virgin and irrigated soils confirm degradation processes. These indicators are informative for assessing soil condition and justify the application of agrotechnologies aimed at restoring and preserving soil fertility.

Key words: Humus, humic acids, fulvic acids, nitrogen, soil biological activity.

Acknowledgment: The work was carried out within the framework of scientific and technical program BR22885097-OT-24 of the Ministry of Agriculture of the Republic of Kazakhstan.

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The effect of foliar fertilization on the yield of tomato plants in meadow- chernozem soils in Azerbaijan

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ABSTRACT

The aim of this study was to evaluate the effects of foliar fertilization applied at different phenological stages on the yield, yield components, and quality indicators of tomato plants under controlled greenhouse conditions. The experiment was conducted using a randomized block design with four replications. Agrochemical analyses conducted in meadow-chernozem soils determined that the humus content in the upper layer (0-20 cm) of the soil was 2.39%, while in the lower layer (20-40 cm), it decreased to 1.22%. The soil reaction was weakly alkaline (pH = 7.5-7.8). The amount of water-soluble ammonium nitrogen (NH_4) was 12.5-15.5 mg/kg, nitrate nitrogen (NO_3) was 9.6-14.4 mg/kg, and available phosphorus (P_2O_5) was 10.8-16.3 mg/kg. These values sharply decreased with increasing depth. Foliar fertilization treatments were applied three times. A control treatment without foliar fertilization was also included. The foliar fertilizers, containing essential macro and micronutrients, were applied at a 0.5% concentration using a hand sprayer. The results showed that foliar fertilization significantly improved tomato yield and nutrient composition compared to the control. Considering practical and economic aspects, foliar application during the fruit formation period is recommended as the most efficient approach.

Key words: phenological stages, tomato plants, foliar application.

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The productivity potential of the lands of Nehram village in the Nakhchivan Autonomous Republic

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ABSTRACT

This study investigates the complex interrelationship between soil characteristics, productivity issues, and solutions in the landscapes of Nehram village in the Nakhchivan Autonomous Republic (NAR). The aim of this research is to assess the physical and chemical properties of soil samples taken from these fields, with a focus on nutrients. By synthesizing these perspectives, the study enriches the understanding of the complex relationship between soil fertility class and productivity, while offering ideas for sustainable fruit growing. Soil samples were collected from the Nehram village area and analyzed according to various parameters: soil texture, pH, electrical conductivity, organic matter, and nutrient content. The process of sample collection and preparation preserved the integrity of the collected samples, providing a reliable basis for scientific analysis. The results reveal various soil characteristics, with a dominance of sandy and loamy textures. The deficiency of nutrients in the soil creates problems, highlighting the need for their correction. Most of the soils have inappropriate pH levels, indicating that interventions such as soil neutralization are necessary. Low organic matter and nutrient deficiencies suggest the need for targeted interventions. The study emphasizes the importance of adapted strategies in solving specific regional problems and provides valuable information for local practices and the broader global search for sustainable productivity.

Key words: sandy soil, humus, sustainable productivity, stone fruits.



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Comparison of mineral and heavy metal contents in the soils of conventional and organic apple orchards in Erzincan

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ABSTRACT

This study aimed to compare certain physical properties, nutrient elements, and heavy metal contents of soils taken from conventional and organic apple orchards located in Üzümlü district of Erzincan province. In the scope of the study, the soils of conventional and organic apple orchards were also evaluated in terms of soil fertility. For this purpose, soil samples were collected from 0–30 cm and 0–60 cm depths in 5 organic and 5 conventional apple orchards, and the necessary analyses were performed. According to the results obtained from the study, the differences between soil samples from conventional and organic apple orchards were found to be statistically significant ($p < 0.05$) in terms of nutrient elements and heavy metal contents. The findings indicated that chemical fertilization causes physical and chemical degradation in the soil, whereas organic fertilization is more beneficial for both soil and human health. It was also concluded that the soils in organic farming areas have a higher percentage of organic matter.

Key words: Organic farming, conventional farming, heavy metal, plant nutrients, soil fertility, Erzincan.

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Effect of cultivation factors on rice productivity elements in the Lankaran-Astara Region of Azerbaijan

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ABSTRACT

This study investigates the effect of different sowing dates, varying NPK fertilizer application rates, and seed quantities on rice productivity and soil nutrient content in the pseudopodzolic soils of the Lankaran-Astara region under natural climatic conditions. Experiments conducted between 2016-2019, focusing on the "Haşimi" rice variety, were carried out using a randomized complete block design with four replications in the region's unique pseudopodzolic clayey-yellow soils. The results show a significant positive correlation between nitrogen application and rice yield. Specifically, the treatment 1.7-N₁₂₀P₈₀K₆₀ (1.7 million seed rate, 120 kg N/ha, 80 kg P/ha, and 60 kg K/ha) demonstrated the highest average rice yield. Agrochemical analyses conducted under the conditions of Lankaran district show that these soils are not adequately supplied with nutrients. Therefore, proper fertilization is essential for the growth and development of rice plants, achieving high-quality yields, and maintaining soil fertility in these soils.

Key words: rice productivity, nitrogen application, soil analysis.



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Assessment of metal content and soil contamination indices in the vicinity of non-ferrous metal smelter (KCM-Plovdiv), Bulgaria

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ABSTRACT

Mining and smelting of metal ores are widely recognized as significant drivers of environmental pollution, particularly due to the release of toxic metals and metalloids into surrounding ecosystems. The aim of this study is to assess the level and spatial distribution of heavy metal contamination in soils near the vicinity of Non-Ferrous Metal Smelter (KCM-Plovdiv), located in southern Bulgaria. To determine the level of soil contamination, metal concentrations were compared with maximum allowable concentrations (MAC) and intervention concentrations (IC), and by using single and integrated soil contamination indices, such as geoaccumulation index (I_{geo}), enrichment factor (EF), contamination factor (CF), pollution load index (PLI), and Nemerow contamination index (NI). The results shows that the contamination was enclosed in a region of about 500 m around the plant chimney and the contaminated soil depth was about 20 cm, which was due to the low solubility of the Pb species, their affinity with the organic matter and clay minerals of the soil. According to the geoaccumulation index, enrichment factor and contamination factor, the highest soil contamination is lead, zinc and cadmium. Contamination loading index and Nemerow contamination index confirmed that the most contaminated soils were in the untracked proximity to the metallurgical complex as well as locations in the prevailing wind direction.

Key words: soil, non-ferrous metal smelting, pollution, contamination level, metals.

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Investigation of the effects of different doses of ammonium sulfate, diammonium phosphate, urea and 15-15-15 NPK fertilizer applications on pH and nutrient elements in agricultural soils taken from different regions

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ABSTRACT

Plant nutrition is a crucial issue in both our country and global agriculture. Fertilization methods and fertilizer choices within plant nutrition are currently considered highly sensitive issues. Fertilizers are divided into two categories: organic and chemical. In today's agriculture, chemical fertilizers are used indiscriminately. Excessive use of chemical fertilizers affects the uptake of other nutrients in the soil, as well as important soil properties such as soil pH and EC. This effect is thought to vary depending on the type and amount of fertilizer used. In this study, ammonium sulfate, DAP, urea, and 15-15-15 NPK fertilizers were applied at doses of 0, 10, and 20 kg da⁻¹ to soil samples taken from agriculturally used lands in the provinces of Kayseri and Adana. The study aimed to identify the effects of chemical fertilizers, commonly used as base and top dressing fertilizers, on existing soil properties when applied to cultivated lands, and to identify the potential future effects of these effects on cultivated lands.

Key words: Fertilization, Soil, pH, EC, Nutrient Element



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***Tenebrio molitor* Frass: A multifaceted option for plant growth and biotic stress resistance in cucumber**

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ABSTRACT

The insect-based biowastes in crop production form a new method of promoting the growth and stress resistance of the plants. This study examined the impacts of Yellow Mealworm (*Tenebrio molitor*) frass produced on cucumber (*Cucumis sativus*) in normal and *Alternaria alternata*-induced biotic stress in a controlled laboratory configuration. The frass used was rich in nutrients, with a concentration of nitrogen (22,588 mg/kg), phosphorus (22,177 mg/kg), and potassium (18,869 mg/kg). Five treatments were considered: V1 (negative control) consisting of no Frass and no Fertilizer, V2 (positive control) comprising Frass and Fertilizer only, V3 (biotic stress control) +Fertilizer and +Biotic stress (*Alternaria alternata*), V4 (early-stage Frass Application, late-stage biotic stress induction), and V5 (+Fertilizer, early-stage biotic stress induction combining with late-stage application of Frass). The outcome showed strong physiological and biochemical variations between treatments. The tallest plants were produced in V4 (69.60 cm) and V5 (61.37 cm) in comparison to the biotic-stress control group V3 (47.00 cm). V2 showed the greatest dry plant weight (3.30 g), whereas V5 improved chlorophyll and gaseous exchange characteristics, transpiration (2.98 $\mu\text{mol}/\text{m}^2/\text{s}$), stomatal conductance (0.50 $\text{mol}/\text{m}^2/\text{s}$), and photosynthesis (12.03 $\mu\text{mol}/\text{m}^2/\text{s}$). Biotic stress control, V3, showed higher antioxidant responses, i.e., maximum Guaiacol peroxidase activity (1.62 U/g) and polyphenol content (0.81 mg GAE /g Fw), which is a sign of induced stress defense. It is worth noting that the value of DPPH radical scavenging was the most significant in V3 (36.69%) and V5 (31.24%), indicating that frass could be a modulator of oxidative stress even after pathogen infection. These results indicate that *Tenebrio molitor* frass, and especially in terms of a strategic temporal application, could stimulate cucumber performance due to boosting photosynthesis rates as well as growth and defensive reactions. Frass can therefore be considered a feasible, long-term amendment of integrated crop and biotic stress management.

Key words: Sustainable Agriculture, Insect Frass, Organic Fertilizer, *Alternaria Alternata*, *Cucumis sativus*

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Calibration of soil analysis method for fertilization: For example organic matter

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ABSTRACT

In this study, it was examined how chemical analysis methods used to determine soil nutrient levels are calibrated and how much fertilizer should be applied based on soil nutrient levels, using the organic matter (OM) method as an example. Calibration studies allow the chemical methods used in soil analysis to be tested in field experiments for each a plant (or indicator plant) under the climate and soil conditions of each region. They also allow the determination of soil sufficiency levels (low, medium, sufficient, much, very much and excessive etc.) and the calculation of fertilizer amounts to be applied to the soil. In the calibration study, the soils where the experiments will be conducted are firstly grouped in terms of nutrient levels or OM as very low, low, medium, sufficient, or very much. Plants are then grown in field trials by applying fertilizer at increasing rates (1.39-4.26% OM) according to the nutrient content of each soil, ranging from very low to very much. Parabolic multiple regression equations are then developed to relate the relative yield values obtained from the cultivated plants to the soil's nutrient content and fertilizer doses. Using these equations, soils are classified by determining the fertilizer doses required to achieve 95% of their maximum yield. As a result, soils are classified according to their nutrient or OM content; 20 kg N/da is recommended for soils with very low (<1.39% OM), 15 kg/da for soils with low nutrient content (1.39-2.91% OM), 10 kg N/da for soils with medium (2.92-3.61% OM), 5-0 kg N/da for soils with high (3.62-4.32 % OM), and no fertilizer is recommended for soils with very high (4.22%< OM). Consequently, it was recommended that the chemical methods used be calibrated to obtain accurate and reliable results in fertilization based on soil analysis results.

Key words: Calibration, Soil, Nutrition level, Classification, Fertilization

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Impact of anthropogenic pressure on heavy metal pollution in urban park soils: A case study of Solvay Park in Krakow, Poland

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ABSTRACT

Industrial activity and progressive urbanization can cause heavy metals to accumulate in urban soils, which negatively affects the quality of green areas and can potentially pose a threat to the health of residents. In particular, publicly accessible urban parks should be places for safe recreation and relaxation, hence the need to monitor soil pollution. The primary objective of the research was to assess heavy metal contamination in the soil of Solvay Park in Krakow (Poland). This objective was achieved by determining the spatial distribution of Cd, Cr, Cu, Ni, Pb, and Zn, as well as the basic properties of the topsoil and calculating pollution indices using various geochemical backgrounds. An attempt was also made to identify possible sources of soil pollution in Solvay Park with the studied heavy metals. Solvay Park is located in the southern part of Krakow and was established in the immediate vicinity of the former soda factory. Surface soil samples (0–20 cm depth) were collected from 51 sampling sites, selected randomly to be representative of the entire park area. In the soil samples, the total content of the studied heavy metals was determined after prior mineralisation in a mixture of concentrated nitric and perchloric acids using the ICP-OES technique, as well as the soil texture, pH and organic carbon content. The heavy metal content in analysed soils was as follows: Zn > Pb > Cu > Cr > Ni > Cd. Elevated concentrations of almost all heavy metals were found mainly in the central part of the park, which is probably due to the proximity to the parking area and intersections of paths. The organic carbon content had a significant impact on heavy metal binding, especially Cd and Zn. The geoaccumulation index (I_{geo}) and enrichment factor (EF) indicated significant human influence on heavy metal content, among other things from traffic emissions, industrial activities, and household inputs. This study highlighted the urgent need to monitor the state of urban soil pollution.

Key words: Environmental safety, urban areas, soil pollution, potentially toxic elements, pollution indices

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The effect of nitrogen and phosphorus enriched purified wood vinegar on soil enzymes and plant nutrition

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ABSTRACT

Carbon-based materials are prominent in the synthesis of nano products due to their high biocompatibility and are preferred in agricultural fields as they do not exhibit harmful or toxic properties. Based on this, the effects of nanofertilizers obtained by adding nitrogen and phosphorus to carbon quantum dots produced from tar obtained during purification of raw wood vinegar, a pyrolysis product well known to support plant growth, on corn yield and some important soil components were investigated in this controlled pot experiment. This study also aimed to determine the optimum ratio of pure wood vinegar to be used as a natural carrier during nanofertilizer preparation. Nanofertilizers using 1.5%, 3% and 6% diluted doses of purified wood vinegar as carriers were tested alone and in combination with reduced doses of conventional chemical fertilizers. The highest plant height was achieved in pots where 25% of optimal fertilizer was applied using 75% Nano-N made with 3% and 6% purified wood vinegar. Nano-NP fertilizer containing 1.5% purified wood vinegar showed high performance in plant height even when applied at half the optimum fertilization rate. The highest fresh weight was obtained from 75% Nano-N containing 6% purified wood vinegar with a 25% reduction in standard chemical fertilizer. The highest dry weight was recorded in pots with 75% Nano-N containing 3% purified wood vinegar and 25% chemical fertilization. The highest nitrogen content was found in pots where chemical fertilizer was reduced by 25% and 25% Nano-NP with 1.5% and 3% purified wood vinegar was applied. The highest phosphorus content was obtained from 75% Nano-NP applications that reduced chemical fertilization by 75% and contained 3% purified wood vinegar. In soil, urease enzyme activity and biological indices (qCO₂, Cmic/Corg) were high in control soil and single applications, whereas alkaline phosphatase activity was higher in combined applications.

Key words: Nano-fertilizer, Wood vinegar, Carbon quantum dots, Soil enzymes, Plant nutrition

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Predicting soil degradation susceptibility using standard scoring functions and artificial neural networks: A case study in the Yukarı Engiz Basin, Türkiye

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ABSTRACT

Soil degradation is a complex process that adversely affects the productivity, ecological functions, and natural balance of soils, leading to irreversible losses in their physical, chemical, and biological properties. This process accelerates through the combined influence of both natural and anthropogenic factors, such as climate change, improper land use, overgrazing, agricultural intensification, and deforestation. In particular, intensive tillage practices applied in agricultural areas result in a decrease in organic matter content, weakening of soil structure, and an increase in erosion rates. This study was conducted in the Yukarı Engiz basin, located within the provincial borders of Samsun, Türkiye. In the study, standard scoring functions were employed using a novel approach to identify the locations within the study area that are more susceptible to soil degradation, and predictions were made using artificial neural networks (ANN). The results indicated that ANN was able to predict soil degradation calculated with a linear function with an accuracy of $R^2 = 0.98$, and with a non-linear function with an accuracy of $R^2 = 0.92$.

Key words: Soil degradation, Irreversible soil losses, Standard scoring functions, Degradation predictions, Machine learning, Artificial neural networks.

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Effect of gypsum application on chemical and biological properties of a calcareous soil

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ABSTRACT

Calcareous soils, covering over 30% of the earth's terrestrial surface, are particularly prevalent in arid and semi-arid regions. These soils are characterized by high calcium carbonate (CaCO_3) content and high pH values (>7), which significantly restricts the availability of essential nutrients for plant uptake. The incubation study was carried out to investigate the effect of gypsum on some chemical and biological properties of calcareous soil. The study included four gypsum application rates (T0: control, T1: 0.75%, T2: 1.5%, T3: 3%) and two incubation periods (3 weeks and 6 weeks). At the end of both incubation periods following parameters were measured: (1) soil pH, electrical conductivity (EC), and exchangeable cations (Ca, Mg, Na, K) and (2) CO_2 production, microbial biomass carbon (MBC), and dehydrogenase activity (DHA). Increases were observed in the pH value of the soil over time and decreased with the addition of gypsum compared to the control. The lowest soil pH value was 7.55, recorded in the 1.5% gypsum treatment. EC values did not change depending on the dose and time but increased with the addition of gypsum compared to the control. While exchangeable cations Ca, Mg and Na increased with the addition of gypsum, decreases were observed in the K content. In the biological properties of the soil, decreased over time and increased with the addition of gypsum. The highest CO_2 (0.97) and MBC (178.09) values were recorded in the 1.5% gypsum treatment, while the highest dehydrogenase activity (39.19) was obtained in the 0.75% gypsum treatment. As a result, gypsum application significantly improved the chemical and biological properties of calcareous soil, with moderate doses exhibiting more pronounced effects, while incubation time generally did not significantly influence these parameters.

Key words: Soil reaction, gypsum, calcareous soil, dehydrogenase enzyme, exchangeable cations.



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Effects of microplastics on soil properties and plant physiology

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ABSTRACT

Microplastics are generally defined as plastic particles smaller than 5 mm, whereas particles smaller than 0.1 μm or 1 μm are classified as nanoplastics. Recent scientific perspectives propose lowering the minimum size threshold for microplastics to 1 μm . The majority of microplastics originate from the fragmentation of macroplastics via physical, chemical, or biological processes. Once introduced into the soil environment, microplastics can induce a range of alterations in its physical structure. They may reduce soil bulk density, thereby decreasing root penetration resistance, enhancing aeration, and promoting root growth. Conversely, microplastics can modify water dynamics by forming preferential flow channels, increasing evaporation rates, and accelerating soil desiccation. Despite their high carbon content, most of this carbon remains inert, resulting in a very slow biodegradation rate. Furthermore, their wide C:N ratio can suppress microbial activity and lead to microbial immobilization. Through adhesion to root surfaces or translocation into plant tissues via the root system, microplastics can disrupt physiological and biochemical processes, induce phenotypic alterations, and ultimately reduce crop yield. Such toxic effects are of concern not only for their implications in agricultural productivity losses but also for their potential to pose risks to human health through entry into the food chain. Although research on the toxicity mechanisms of microplastics in plants is still in its early stages, the understanding of these mechanisms is steadily advancing.

Key words: Agricultural productivity, Environmental pollution, Microplastics, Plant physiology, Soil contamination.

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Land degradation in agricultural soils in Zile District, Tokat

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ABSTRACT

Land degradation poses a serious threat to environmental sustainability and the livelihoods of millions of people, especially in developing countries. Land degradation generally refers to the deterioration of land quality and productivity caused by human activities such as deforestation, overgrazing, and unsustainable agricultural practices. The aim of this study is to determine the state of land degradation in agricultural lands located in the Tokat Zile Plain, which has a semi-arid terrestrial ecosystem. For this purpose, 175 surface (0-30 cm) soil samples were taken to represent the 1,667-ha research area. To determine soil degradation, the physical and chemical indicators of the soils were analyzed, including crust formation, K Erodibility, bulk density, hydraulic conductivity, sand, silt, clay, pH, EC, and organic matter indicators, totaling 10 indicators.

Key words: land degradation, soil, Tokat.

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Soil erosion risk assessment of Sivas Zara district with Icona model

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ABSTRACT

Erosion is one of the most critical environmental issues in Turkey. In this study, the ICONA model was applied to assess erosion risk in the Zara district watershed of Sivas province. The model incorporated slope, geology, land use, and land cover layers. Using a Digital Elevation Model (DEM), a slope map was generated and analyzed together with geology data to produce a potential erosion risk map. The results revealed that 2.25% of the watershed falls into the low-risk category, 25.09% into moderate, 46.08% into moderate-high, 26.55% into high, and 0.02% into very high risk. Overall, 26.57% of the study area was classified as high and very high risk, while 27.34% was in the low to moderate risk classes. The findings highlight that Geographic Information Systems (GIS) and Remote Sensing (RS) techniques can be effectively used in erosion risk assessments, and that areas with steep slopes and sparse vegetation, such as rangelands and dry farming zones, should be prioritized in sustainable land management strategies.

Key words: Erosion, ICONA model, Geographic Information Systems, Remote Sensing, Zara,

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Eco-ethics Problems of Azerbaijan: Scientific, Legal, Moral Aspects

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ABSTRACT

In the scientific, legal, and moral context of its eco-ethical problems, this study begins by outlining the rich yet vulnerable diversity of Azerbaijan's plant life, including its forests, shrubs, meadows, steppes, semi-deserts, and mountain vegetation. Accelerating industrial, agricultural, and urban development since the second half of the 20th century has heightened air, water, and soil pollution, leading to deforestation and the degradation of pastures. Local issues, compounded by macro-scale environmental challenges like global climate change, sea-level fluctuations, and ozone layer problems, have reached a point where they can no longer be ignored in Azerbaijan. As a state's international prestige is increasingly measured by its stewardship of nature and natural resources, the Azerbaijani society's attitude toward the environment is becoming ever more critical. This work examines the complex relationship between nature and society from an eco-ethical perspective, proposing solutions across three main groups. The first group covers specific ecological problems and their solutions, such as forest protection and rehabilitation, the reclamation of natural grazing lands, soil decontamination from pollution, and the prevention of salinization and alkalization. The second group focuses on establishing scientific and operational mechanisms, including ecological monitoring, the preparation of ecological assessment charts, and the creation of soil improvement passports. The third group points to the need for legal and institutional support systems, such as strengthening criminal legislation on environmental crimes and establishing ecological aid funds and information banks. This holistic approach is based on fundamental eco-ethical principles: ensuring that national development strategies do not alter the core ecological parameters of natural ecosystems, that reconstruction efforts align with the natural structure, that public ecological knowledge is increased, that environmental legislation is brought up to international standards, and that ecological awareness is instilled at all educational levels. The author's conclusions are based on extensive research conducted in Azerbaijan over many years, supplemented by data from international studies.

Key words: Eco-Ethics, Azerbaijan, Environmental Policy, Sustainable Development, Natural Resources.

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