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WEFE2023

BOOK OF ABSTRACTS

SmaCuMed International Conference on
Water-Energy-Food-Ecosystem Nexus in
the Mediterranean Region

November 15-17, 2023
Marrakesh (Morocco)

SmaCuMed

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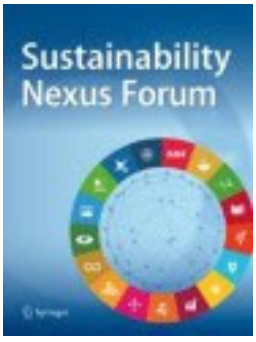

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Introduction

Welcome to the SmaCuMed International Conference on Water-Energy-Food-Ecosystem Nexus in the Mediterranean Region (WEFE2023) took place from 15th to 17th November 2023 in the Mohamed VI Museum of Water Civilization in Morocco (Marrakech, Morocco).

The SmaCuMed WEFE Nexus Conference is organized by the Cadi Ayyad University of Marrakech (Morocco) and the Karlsruhe University of Applied Sciences (Germany), under the framework of the PRIMA project SmaCuMed (www.smacumed.eu).

SmaCuMed "Smart irrigation Cube for sustainable agriculture in the Mediterranean region" is a joint research project from the European Union's EU-Prima initiative - A joint program focused on developing and applying solutions for food systems and water resources in the Mediterranean basin.

The Conference focused on the Mediterranean dimension, but it was open to participants from outside the region who share the same interests and wish to learn from the Mediterranean experience. More than 200 participants from 12 countries joined the conference.

« The Water-Energy-Food-Ecosystem Nexus (WEFE Nexus) approach highlights the interdependence of water, energy and food security and ecosystems – water, soil, and land – that underpin that security. The Nexus approach identifies mutually beneficial responses that are based on understanding the synergies of water, energy, and agricultural policies. It also provides an informed and transparent framework for determining the proper trade-offs and synergies that maintain the integrity and sustainability of ecosystems. »

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SMACUMED International Conference on Water-Energy-Food-Ecosystem Nexus in the Mediterranean Region (WEFE 2023)

Wednesday, November 15, 2023 - Friday, November 17, 2023

Marrakesh, Morocco

Report of Abstracts

Ecotoxicology & Environmental Remediation / 116

Heavy Metal Toxicity and the Environment

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Heavy metals are naturally occurring elements that have a high atomic weight and a density at least five times greater than that of water. Their multiple industrial, domestic, agricultural, medical, and technological applications have led to their wide distribution in the environment, raising concerns over their potential effects on human health and the environment. Their toxicity depends on several factors including the dose, route of exposure, and chemical species, as well as the age, gender, genetics, and nutritional status of exposed individuals. Because of their high degree of toxicity, arsenic, cadmium, chromium, lead, and mercury rank among the priority metals that are of public health significance. These metallic elements are considered systemic toxicants that are known to induce multiple organ damage, even at lower levels of exposure. They are also classified as human carcinogens (known or probable) according to the US Environmental Protection Agency and the International Agency for Research on Cancer. This review provides an analysis of their environmental occurrence, production and use, potential for human exposure, and molecular mechanisms of toxicity, genotoxicity, and carcinogenicity.

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Microcystin health risk in irrigation water and agricultural crops

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Health risks associated with the consumption of microcystin-containing agricultural products have been rising worldwide in toxic cyanobacteria-occurring waters. Fate and biohazard related to the consumption of environmentally realistic doses of microcystins (MCs) in fruits and vegetables are poorly tackled. Therefore, this field study assessed their bioaccumulation in fruit crops, which were irrigated with MC-contaminated irrigation water sourced from the Lalla Takerkoust reservoir nearby. MCs accumulated in edible parts were quantified using an enzyme-linked immunosorbent assay in order to calculate the health risk indicators associated with the consumption of these fruits. Pomegranate accumulated the highest concentration of MCs (26.50 μg kg-1), with an estimated daily intake (EDI) being 22 and 53-fold higher than the limit dose (0.04 μg kg-1) for adults and children, respectively, posing a very high-risk level. Most fruit samples showed EDI values above the limit dose, showing moderate- to high-risk levels. These results point out the urgent need for establishing monitoring and depolluting processes for MCs in toxic cyanobacteria-infested agricultural zones, not only in Morocco but far and wide.

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Metallic Trace Elements Accumulation By *Medicago* *sativa* Grown on Reconstituted Soil Irrigated by Wastewater.

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Wastewater irrigation is a common practice in developing countries. It can be exploited in a sustainable development strategy. However, the use of wastewater in agriculture can have a serious impact on the environment. The work presented aims to assess the capacity of Alfalfa to accumulate Cadmium and Copper on a reconstituted soil irrigated by wastewater. *Medicago sativa* plants were grown on a reconstituted soil with peat and earthy materials. The Medicago sativa plants were irrigated by two types of wastewater sampled from an urban effluent and an industrial effluent of the city of Safi (Morocco). The results show that the wastewater used in our studies brings considerable contents of Cd and Cu. the Cd and Cu contents measured in the reconstituted soil show a remarkable enrichment of the reconstituted soil, irrigation by urban and industrial wastewater, by Cd and by Cu. *Medicago sativa* plants accumulated varying concentrations of Cd and Cu. The highest levels were observed in the aerial parts of *Medicago sativa* plants irrigated by industrial wastewater. *Medicago sativa* plants, cultivated on the reconstituted soil and irrigated by urban and industial wastewater, showed remarkable performances of Cd and Cu accumulation. This makes it possible to propose other studies in order to exploit this plant in a system for the dépollution of contaminated soils by metallic trace elemants and/or for réhiabilitation of degraded areas.

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Memory, Attention and Intelligence skills of School Children living in a Lead-contaminated Environment

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Introduction : Lead, which though its levels is not highly increased in the environment, still constitutes a real danger for children, particularly those living in mining site. Indeed, Lead is an intrusive toxic matter which harms the neuro-cognitive and behavioral development of children even with doses considered normal.

Purpose : The present paper aims at evaluating the memory, attention and intelligence skills among 130 schoolchildren living in a mining area (cases) in comparison to 197 living in the Chouiter area (control group) in Marrakech.
Materiel and methods : We used the Digit Span Test (DST), Bell Dam Test (BDT) and Color Progressive Matrix of Raven (CPMR) for the assessment of their memory, attentional and intelligence skills respectively. Interviews with parents were conducted to identify co-variables related to Pb exposure. Agricultural soil, drinking, and groundwater were collected from the surrounding area of the children's school. The determination of Pb content in the environment was performed by ICP-MS.
Results : The results demonstrated that soil Pb level was higher (67.14±10.13 g/g) in mining site than in controls (41.73±13.6 g/g). Pb levels in groundwater and drinking water were low with a significant difference between the two areas in groundwater. The cognitive scores of children from the mining area don't present any significant difference when compared to that of control group in measures of attentional skills and scanning methods. Working memory capacity was normal in both groups of children. Children from mining area exhibited poor 50 percentiles on the intelligence test compared to the control groupe. The mean scores of attention were significantly lower in children exposed to environmental Pb contamination compared to those who are not exposed (p = 0.008).
Conclusion : We have not recorded any cases of lead poisoning. Nevertheless, the risk of contamination still exists given the low lead contamination of soil.

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Assessment and Evaluation of Oxidative Stress and Genotoxicity Related to acute Exposure to antibiotic in Vica faba

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Extensive use of antibiotics led to significant pollution of agricultural fields through wastewater irrigation and manure application. they provoke damage to non-target organisms such as animals and plants. The main objective of this study was to gain insight into the correlation between the phytotoxic-genotoxic effects of four antibiotics(ciprofloxacin, enrofloxacin, sulphapyridine, and roxithromycin) and oxidative stress in *Vicia faba*.
Each antibiotic was assessed at three concentrations (1, 0.1, and 0.01 mg/ml). The findings reveal that these compounds impeded root elongation and seed germination for lettuce and alfalfa, resulting in germination indices below 80%. They also hindered bean development. Ciprofloxacin exhibited the highest level of phytotoxicity, followed by roxithromycin. Among the crop species, lettuce displayed heightened sensitivity to all the antibiotics tested. Regarding genotoxic effects at a concentration of 0.01 mg/ml, ciprofloxacin demonstrated a substantial impact, indicated by the induction of micronuclei. The descending order of genotoxicity was observed as follows: ciprofloxacin (8.4‰), enrofloxacin (6.9‰), roxithromycin (3.5‰), and sulphapyridine (1.8‰)potential impacts of four antibiotics on plant physiological growth

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The environmental impacts of landfills and the available alternatives for governments and local communities

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Assessing the impact of a landfill on soil involves using phytotoxicity and genotoxicity techniques. Depending on our study in Morocco, it is worth noting that the germination rate of seeds can vary significantly based on the plant species and samples. For example, the germination rate for seeds in control soil is quite high, at 99.2%. However, the germination rate for seeds in soil obtained from landfills can be much lower, ranging from 5% to 79.2%. Among the different types of seeds tested, lettuce seeds exhibited the lowest germination rate, ranging between 5% and 20%. The germination index (GI) also varied greatly depending on the species, ranging from 0.5% to 169.8%. Additionally, soils from landfills had a lower GI compared to control soil. The mitotic index (MI) was found to be lower in landfill soils, ranging between 3.3% and 8.3%, compared to control soil, which ranged from 8.9% to 9.5%. Finally, the micronucleus (MN) was found to be very low in the control soil, hardly exceeding 0.3‰, while it increased in other soils obtained from landfills, ranging from 1‰ to 6.2‰. We believe that closing landfills is necessary to stop the ecological impact. Recycling and sorting waste are reasonable solutions.

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Hydrothermal synthesis of zeolites from combustion waste: toward an electrochemical application

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This research reviews the application of nanoscale materials in the field of heavy metal sensing and detection. These materials, including zeolites, have unique and tunable properties with high microporosity, thermal stability, and ion exchange capacity. Specifically, we highlight the unique properties of the zeolite Na-P materials that enable their modification with graphite carbone to increase the sensibility of sorption and preconcentration of cadmium and lead ions from fertilizer samples prior to detection by electrochemical techniques such as cyclic voltammetry (CV), square wave voltammetry (SWV), and electrochemical impedance spectroscopy (EIS). The fabrication and modification of these nanomaterials is discussed, critically reviewed and highlighted.

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Investigation of the efficacy of two triazole derivatives as inhibitors of copper corrosion in NaCl solution: A Combined Quantitative Chemistry and Dynamic Molecular Simulation Approach

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Corrosion of pure copper in a corrosive solution 3.5 wt% NaCl was tested using a novel inhibitor based on 2-hydroxy-5-((4-(hydroxymethyl)-1H-1,2,3-triazol-1-yl)methyl) Benzaldehyde [STR] in comparison with Benzotriazole [BTA]. In the experimental study, electrochemical impedance and potentiodynamic polarization tests were performed on both inhibitor studies. The Increasing of inhibitor concentration causes a significant shift in the oxidation rate of copper in an aggressive media containing chloride ions. At 10-4M of STR and BTA, the inhibition effectiveness is 92.37% and 97.76% respectively. The Tafel curves revealed that STR and BTA were mixed-type inhibitors. According to the Nyquist curve plot, raising the inhibitor concentration led in a rise in polarization resistance, reflecting an increase in inhibition efficiency and a drop in double-layer capacity. The influence of temperature at 10-4M concentration of STR and BTA in the range of 298-323 K revealed that the inhibitory efficiency decreased somewhat with temperature in STR more than BTA. The activation energy, as well as thermodynamic data like enthalpy, entropy, and free energy, were calculated and explained. The experimental results were confirmed by the theoretical calculations which could also provide additional insight into the mechanism of adsorption of our inhibitor molecules on the copper surface.

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Adsorption of Orange G dye on hydrophobic activated bentonite in aqueous solution

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This report deals with the modification of the physical structure and chemical properties of a bentonite clay from the Hammam Boughrara region, in the Maghnia district of western Algeria, to maximize its adsorption capacity. Purified bentonite clay (called B) was modified either by acid activation with sulfuric acid (1M) (B-Act) or by intercalation with the cationic surfactant cetyltrimethylammonium bromide (CTAB), applying a cation exchange capacity (CEC) of 100% (called B-CTAB). The modification of B was also achieved by combining these two steps consecutively, i.e. first acid activation of B followed by intercalation with CTAB (B-Act-CTAB). B-Act-CTAB was obtained by acid activation using H2SO4 (1M), followed by co-adsorption of CTAB with 100% and 300% of the CEC of B-Act as a precursor. In particular, a strong increase in specific surface area and pore volume of modified bentonites was observed for B-Act (469.83 m2/g and 0.401 cm3/g), B-Act-CTAB100(267.72

m2/g and 0.316 cm3/g) and B-Act-CTAB 300 (111.15 m2/g and 0.171 cm3/g), compared with B (31.79 m2/g and 0.074 cm3/g) and B-CTAB (3.79 m2/g and 0.034 cm3/g), respectively.
Bentonite-based adsorbents were then used to evaluate the removal efficiency of an organic molecule, the azo dye Orange G (OG), as a model for persistent organic pollutants. Freundlich, Langmuir, and Sips models (Langmuir-Freundlich model) were applied to analyze equilibrium isotherms, showing a good correlation between experimental data and the Freundlich model. Good agreement was obtained between experimental adsorption kinetics data and the pseudo-second-order model, enabling rate constants to be evaluated. B-Act-CTAB300 can be used as a low-cost material for azo dye removal, as its adsorption capacity towards OG (102.80 mg/g) far exceeds that of B-CTAB (31.49 mg/g) and B-Act-CTAB100 (12.77 mg/g).

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Room Temperature Crosslinked Self-Blowing Biobased poly(hydroxyurethane-co-hydroxythioether) Foam by Simultaneous Aminolysis and Decarboxylation Reaction

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Polyurethane foams are certainly one of the most important materials used in a variety and daily applications, including comfort (matrasses) or energy savings (thermal insulation). Currently, intensive studies are in progress to develop more sustainable ways to produce these products to eliminate the use of toxic isocyanates. A few studies reported the preparation of non-isocyanate polyurethane foams, however, most of them were synthesized using various petroleum-based chemicals with external blowing agents or high temperatures. Due to the increasing concern about the depletion of fossil reserves and greenhouse gas emissions, biobased polymers attract the attention of scientists in recent times. In our work, we report a new approach for the synthesis of novel room temperature crosslinked and self-blown biobased non-isocyanate polyurethane foams, via simultaneous aminolysis and decarboxylation reaction. The polymer network is formed based on the amine's reaction with cyclic carbonate, and an in-situ blowing agent (CO2) is generated from thiol's reaction with Cyclic carbonate. This novel and solvent-free approach offer a practical alternative to the conventional isocyanate pathway, with its amazing diversity and accessibility of the formulation's essential ingredients. It may also pave the way for the development of more environmentally friendly PU foams.

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Synthesis of CuS nanomaterials by hydrothermal route: Examining physical properties and photocatalytic activity

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CuS photocatalyst was elaborated by the facile hydrothermal route at 140 ℃ for various durations, from copper chloride (CuCl2) and thiourea (SC(NH2)2) aqueous solutions. Characterization techniques such as X-ray diffraction (XRD), Raman spectroscopy, Fourier transform infrared (FTIR) and scanning electron microscopy (SEM) coupled with energy-dispersive of X-ray system (EDX) analysis, showed the formation of pure CuS nanomaterial. Electrochemical impedance spectroscopy (EIS) revealed that synthesized CuS exhibited a quick charge transfer at high frequencies and a diffusion or transport of ions from the electrolyte to the electrode surface at medium and low frequencies. Hall effect measurement indicated that all prepared CuS are a p-type semiconductors with a hole concentration on the order of 1020 cm−3. A decrease in the hole concentration with increasing heat treatment duration was observed and related to the healing of Cu vacancies. Transmittance and absorbance measurements showed that all samples interacted with light, exhibiting a prominent peak around 600 nm. Tauc method revealed an increase of the optical band gap values from 1.56 to 1.75 eV with the increment of heat treatment duration. Photocatalytic activity of CuS prepared at 140 ℃ for 16 h was determined by measuring the degradation rate of methylene blue (MB) dye under UV light in the absence and presence of hydrogen peroxide (H2O2).

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Low-cost modified adsorbents derived from the solid residue of Rosmarinus officinalis L. for heavy metal uptake

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The current study investigates for the first time the potential of using solid residues collected from the hydrodistillation of R. officinalis, after their modification with Fe, as low-cost adsorbents to alleviate the heavy metals in aqueous solutions. Physicochemical properties and adsorptive performances of R. officinalis solid residue (RO-SR) and Fe-modified R. officinalis solid residue (Fe-RO-SR) were investigated. The Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), and scanning electron microscopy (SEM) coupled with energy-dispersive X-ray spectroscopy (EDS) revealed that the iron was successfully fixed to the surface of RO-SR. Furthermore, after iron modification, the specific surface area of ROSR was increased from 36.2 to 50.4 m2/g. Kinetics and isotherms of adsorption of Co onto RO-SR and Fe-RO-SR were fitted by applying different models, though the pseudo-second-order (Adj. R2 > 0.9985) and Langmuir (Adj. R2 > 0.9532) models fitted the experimental results better, respectively. The adsorption performances of RO-SR and Fe-RO-SR for Co were 37.31 and 50.25 mg.g-1, respectively. The equilibrium adsorption capacity was reduced from 22.56 g/L to 10.67 g/L when the temperature was raised from 25℃ to 45℃.

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Enhancement of Magnetic Refrigeration Properties in Doped Perovskite Material

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In the context of this research endeavor, our primary objective is to assess the magnetic and magnetocaloric properties (referred to as MCE) of a perovskite material that has been enriched with lead (Pb), contrasting these properties with those of the pristine, undoped perovskite variant. Our inquiry is driven by the aim of exploring the viability of utilizing this material in the field of magnetic refrigeration technology, which is a greener alternative to traditional Gas-compression refrigeration systems. The materials were prepared by flash combustion, a technique known for its rapid and controlled synthesis. The samples were then subjected to X-ray diffraction (XRD) and magnetic analysis. Important information about the crystal structure, the phase composition, and the lattice parameters of the material was provided by the XRD analysis. As a result of Pb doping, we observed a slight change in the lattice properties in our experiment, which reduced the volume of the unit cell. However, neither the existence of secondary phases nor changes in the crystal structure were found. The magnetic properties of the material were analyzed using a superconducting quantum interference device (SQUID) magnetometer. Several aspects are discussed, including Curie temperatures, the nature of phase transitions and their orders, changes in magnetic entropy, and magnetocaloric properties.

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Simulations of Ozone Concentrations in the City of Marrakech using an Eulerian Chemistry Transport Model

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Systematic ambient air pollution data is essential to conduct epidemiological studies aimed at mitigating the impact of air pollution on human health in the dust belt region. However, a lack of data plagues the regions most affected by low air quality, owing to daunting challenges in monitoring air quality. These challenges include the need for reference-grade air quality monitoring stations that require a stable alternating-current electric power supply, expensive reference-grade analyzers, and frequent calibration and maintenance. Meeting these standards is a significant challenge in Africa.

Numerical models play a crucial role in understanding the behavior and estimating the concentrations of various pollutants in the atmosphere. In this conference, we present maximum 8-hour daily average ozone concentrations for the city of Marrakech during Winter 2009 and Summer 2015. These concentrations result from simulations using CHIMERE-WRFv2021, utilizing a detailed spatialized inventory.

Our results, compared to observations from two local monitoring stations, indicate that the model accurately simulates MDA8 (maximum daily average) ozone concentrations at the JEF Station, albeit with a slight overestimation of 16% in Summer (average: 45 ppb) and 37% in Winter (average: 33 ppb).

However, at MHD Station, which is less affected by significant changes in anthropogenic activity, the model overestimates ozone concentrations by 91% in Summer (average: 49 ppb) and by 50% in Winter (average: 38 ppb).

Looking at the diurnal average concentrations of ozone, the CHIMERE model system overestimates both daytime and nighttime surface ozone concentrations by up to 91% (NMB) in Summer. Pearson's correlation coefficient (r) based on MDA8 ozone concentrations was found to be less than 0.5 (S: 0.46, W: -0.07) for LOCAL/ON (S: 0.33, W: 0.21) with the MEMSD inventory and (S: 0.36, W: 0.29) with the CAMS inventory. This indicates that the model does not accurately reproduce temporal variability in Marrakech.

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Remote sensing and GIS-based WetSpass model for estimating actual evapotranspiration in Grombalia region, Northeast Tunisia: Comparison with FAO published data

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The assessment of actual evapotranspiration and other components of the water balance is an important step for surface and groundwater resources sustainable management. This work aims to estimate and map the spatio-temporal distribution of the actual evapotranspiration in Grombalia phreatic aquifer for the 2020/2021 agricultural season using Sentinel 2 images and the WetSpass model and compare the obtained data with the FAO's.
Seven Sentinel images from October 2020 to May 2021 were downloaded and atmospherically corrected. Multi-date supervised classifications were applied to map the LULC within the limits of Grombalia's shallow aquifer. The LULC classes considered are orchards, agriculture, built-up land, shrubland, and water surfaces. They are defined according to the requirements of the WetSpass model. Two combinations were tested using four images each. The dates of the images for the first combination (C1) are: October 02nd, 2020; December 16th, 2020; March 06th 2021 and May 10th 2021 and for the second combination (C2) are: November 01st, 2020; January 20th, 2021; March 26th, 2021; May 10th, 2021. The best resulting LULC map used to run WetSpass model is the one with the highest kappa index (ki). This combination is C2, with ki equal to 0.68.
The LULC map was integrated with seven other raster datasets in the WetSpass model, including hydro-meteorological datasets (rainfall, temperature, and wind speed) and biophysical datasets (soil texture, topography, slope, and groundwater depth). The resulting WetSpass simulated parameters are evapotranspiration, surface runoff and diffuse recharge, provided seasonally and yearly. The yearly means of these simulated parameters are respectively 350, 28 and 36 mm, stating that the water balance is driven mainly by actual evapotranspiration, with 85% of the received precipitation (412 mm). The annual evapotranspiration varies between 141 and 791 mm. The lowest are located in the building area and the highest in free surface water, especially the Sebkha of Soliman.
The WetSpass simulated evapotranspiration were compared with FAO published data (based on ETlook model). WetSpass gives higher values than FAO under free surface water and building areas and lower values under irrigated agricultural areas, where the highest difference (more than1000 mm) is observed. The main reason of this difference is that WetSpass model does not consider water irrigation amount as input. This underscores the need of a careful consideration of the input datasets used and a wise interpretation of the results obtained for an appropriate surface and groundwater management and hydrological and hydrogeological assessment

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Modeling of soil salinity in Rheris Oases (Southeastern of Morocco) using satellite spectral indices.

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The Rheris oases in Southeastern Morocco is a very important ecosystem. It present enormous ecological and natural values. Water scarcity coupled with agricultural intensification results soil salinization and its degradation. This work aims to propose a spatiotemporal monitoring method of soil salinization in the Rheris oasis using spectral indices derived from Thematic Mapper (TM) and Operational Land Imager (OLI) data.
The most used indices in the literature were (14 indices) tested and correlated with the results obtained from 50 samples taken from the first soil horizon at a constant depth of 0.20 m from the Novembre 2022 campaign. Based on the results, we can conclude that this approach is an effective and valid methodology for modeling and spatial mapping soil salinity in this area.
The drought cyclicity has increased soil degradation by intensifying the soil salinization process. Soil salinity is strongly associated with The standardized precipitation anomaly index (SPAI). The state of the hydroclimate is another aspect that influences this phenomenon. An increase in salinized surfaces is observed during the periods of 1990–1996, 2000–2005 and 2017-2022. The spatio-temporal distribution of saline soils in Rheris oasis is very variable. The monthly variations are more important than the annual ones.

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Modeling the Influence of Wastewater Treatment Plant Implementation on Enhancing Surface Water Quality

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River pollution is a major concern worldwide and in urban areas, untreated wastewater is one of the main contributors to this problem. This study aims to highlight the modeling of the impact of the installation of wastewater treatment plants (WWTPs) on improving the quality of surface waters. The physicochemical parameters of rivers in the ZAT watershed were evaluated through experimental monitoring and surface water quality modeling. The study also evaluated the effectiveness of co-treatment scenarios involving different types of wastewater, including urban wastewater, slaughterhouse wastewater, leachate, and olive mill wastewater. The researchers used a combination of field measurements and computer simulations using the PEGASE model to assess water quality depending on treatment efficiency.
A significant correlation was obtained between measured and simulated values, after the calibration of some model parameters. The model performance showed good statistical agreement for all parameters studied. The outcomes demonstrated a 66.89% improvement in river quality thanks to wastewater treatment before release. River quality was improved by 85.24% by co-treatment when the olive oil manufacturing effluent was diluted by 0.5% (v/v). The study showed that co-treatment of several types of wastewater could significantly improve surface water quality, but careful control of the dilution level of the oil mill wastewater to 0.5% (v/v) was necessary to maintain better treatment capacity. These results have important implications for the planning and implementation of

wastewater treatment systems in areas with a variety of discharge types and provide valuable data for decision-makers and stakeholders involved in water resource management.

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Investigating the Impact of Human-Induced Pollution and Seasonal Variations on the Water Quality of ZAT River in Morocco: A Comprehensive Analysis

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The quality of water resources in the Tensift basin, specifically in the ZAT sub-basin, is under increasing pressure due to population growth, urbanization, industrial, and agricultural development. For most urban and rural centers and industrial units, wastewater is discharged into the receiving environment (surface water) without prior treatment, this state exacerbates the eutrophication processes, due to the contributions of point and diffuse pollution. These combined processes lead to considerable degradation of the physicochemical quality of water resources, especially surface waters. In this study, we assess the surface water quality of the ZAT river in different spatial and temporal contexts by a monitoring network consisting of 9 sampling stations. The location of these stations was chosen to monitor the respective natural and anthropic contributive loads entering the main river. The monitoring campaigns were conducted on a bi-monthly basis during the summer, winter, and spring 2021periods. They included sampling, on-site measurements, and laboratory analyses and ultimately leaded to the use of the Weighted Index (WI) and the Biotic Index of the Iberian Working Group on Biological Monitoring (IBMWP). The results showed that in terms of quality and using both indices, the upstream river ranges from good (WI) to medium (IBMWP) quality, while it varies from medium (WI) to poor (IBMWP) quality in the downstream river. As for the temporal variation, the (WI) index exhibited a good quality during spring and from good to medium quality during winter and summer. On the other hand, the (IBMWP) displayed a medium-poor quality during winter and summer. The findings also indicated that Anthropogenic contamination and the decline in slope with temperature increase are variables impacting the worsening of water quality in the summer. Downstream stations in summer, which were substantially lower than the stations upstream, served as evidence of this. The outcomes also demonstrated that urban pollution has a significant impact on water quality degradation and low quality. The results of the current study indicate thus that it is essential to review the management policy and change the vision towards a more descriptive, holistic, and sustainable management of water quality.
Keywords: Anthropogenic, Pollution, Seasonal variation, River, Quality indices, Morocco.

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Valorization of Mediterranean Almond orchards through the use of intercropping integrated strategies

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The Mediterranean region has strong agricultural traditions associated with conventional agronomic practices. In various countries, such practices are not efficient under a climate change scenario, leading to reduced crops yield and productivity and thus resulting in reduced economic returns for local farmers. VALMEDALM project objective is to use intercrops within almond orchards as an integrated strategy, aligned with economic, social, and environmental aspects, and implemented across the Mediterranean basin, assisting in adapting the small-scale farming systems to climate change and to increase farmers'
incomes, especially in those countries with lower reported productivity and valorization outputs. To achieve these goals seven demo sites are implemented in different Mediterranean countries (Portugal, Croatia, Egypt, Morocco, Israel, Italy), to assess the effect of intercropping in almonds orchards and the role in pests and weed management.
VALMEDALM will (i) provide an inventory of the intercropping practices and main pests from Mediterranean basin; (ii) produce guidelines for the best intercropping practices and pests and weeds management practices adapted to each local and Mediterranean region; (iii) provide a complete nutritional and functional portfolio of almonds and crops used as intercrop; (iv) establish training and demonstration sessions, networking platforms and dissemination strategies to enhance awareness among Mediterranean population (consumers, farmers, producers, industry). This project will contribute to the adoption of sustainable and productive agricultural systems based on plants diversity, to increase farmers income and competitiveness of small producers in the Mediterranean markets.

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Biological Characteristics of the Rhizospheric Soil of Alfalfa Grown on Natural Soil and Anthropized Soil

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In urban areas, the soil is dramatically disturbed. These modifications have a great effect on its behavior and its functioning as a support for the vegetation. Rhizophiric soil is generally influenced

by soil quality and plant behavior under anthropized soil conditions. The objective of our work is to evaluate the biological characteristics of the rhizospheric soil of Alfalfa grown on natural soil and another anthropized soil according to the contamination by metallic trace elements. The results show that the mesofauna of the different rhizospheric soils of the different Alfalfa plants varies from one area to another. The rhizospheric soil of Alfalfa, grown on soils irrigated by wastewater, presents the most abundant mesofauna. This mesofauna is dominated by Insects and Arachnids. The contents of metallic trace elements, measured in the rhizospheric soils of different studied plants of Alfalfa, show that soils irrigated by wastewater exhibit the most remarkable concentrations of metallic trace elements. Therefore, the biological characteristics of the rhizospheric soil can vary according to land use and they are influenced by metallic contamination.

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Understanding environmental and climatic drivers of microbiome diversity in Soybean rhizosphere in Nigeria

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Soil microbiomes are among the most vital soil natural resources that play an important role in soil health, ensuring plant health and growth, and access to vital nutrients for better yield. However, their survival and optimum contributions to soil and plant health are consistently threatened due to the continued application of hazardous chemicals. Soybean (Glycine max, L), is an important soil-enhancing legume that positively interacts with a wide array of nitrogen-fixing bacteria. However, very little research exists to fully unravel the microbial communities inhabiting soybean-growing soils and the different environmental and climatic parameters driving their distributions in Nigeria. To fully understand the microbial composition within soybean farms, we sequenced the 16S rRNA gene from rhizosphere soil to analyze the diversity of the soil microbiome in broadly, two major agroecological zones in Nigeria, viz: Sudan (SS) and Guinea (GS) savannas. Integrating the analyzed soil properties and site-specific climatic variables, we determined the main drivers shaping the native microbiome composition across the different soybean growing fields in Nigeria. Our preliminary results showed the presence of a wide range of qualitative microbes, widely distributed across the different soybean growing fields, including the important Actinobacteria and Proteobacteria groups. We also found the most important environmental factors shaping the microbial community structure across the Soybean growing areas to be temperature, altitude, and Zinc. This study highlights the rich diversity of the soybean-growing soils in Nigeria and validates the potential of the soil as a reservoir to isolate beneficial rhizobia capable of enhancing soybean yield for the ever-increasing soybean farmers in Nigeria and sub-Saharan Africa in general.

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Exogenous proline supply improves growth, antioxidant defence system, and nutrient homeostasis in salt-stressed alfalfa (Medicago sativa L.)

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Salinity is a severe environmental stress limiting agricultural production. Exogenous proline has emerged as a promising way to improve plant tolerance to salinity. A pot experiment was conducted using two Moroccan, *Ouad Lmaleh (OL)* and *Demnate 201 (Dm)*, and one European, *NS Mediana ZMS V (NS Med)*, alfalfa (*Medicago sativa L.*) varieties to investigate the effect of exogenous proline on physiological and biochemical responses under salinity stress. Results indicated that salt stress reduced shoot and root dry weight, plant height and leaf number, with NS Med being the most affected with reductions rates of 75%, 85%, 53%, and 65%, respectively. Salinity also reduced photosynthetic pigments, potassium (K+) and increased malondialdehyde (MDA) and sodium (Na+) contents. The injury impact of salinity stress on alfalfa plant growth was alleviated by exogenous proline treatment, as evidenced by increasing plant biomass and plant height and leaf number. Proline-treated salt-stressed plants also showed higher photosynthetic pigments and K+ and reduced Na+ contents. Proline treatment also effectively reduced MDA content under salt stress, particularly in NS Med variety, by 26%. The lower amount of MDA in the proline-treated plants seemed to be related to its capacity to modulate antioxidant enzymes activities such as superoxide dismutase, catalase, ascorbate peroxidase, and glutathione reductase. Furthermore, proline treatment boosted the accumulation of proline content, which positively correlated with improvement in plant growth and photosynthetic pigments. Our findings suggested that exogenous proline treatment could be a promising way to mitigate the effect of salinity on alfalfa plant.

Keywords: *Medicago sativa*; Proline; Salinity; Photosynthetic pigments; Antioxidant enzymes.

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Elaboration and Characterization of Vitreous Fertilizers and Study of Their Impact on the Growth and Yield of maize.

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Four different phosphate glass formulations (F1, F2, F3, and F4) were developed according to maize nutrient requirements to be used as controlled-release fertilizers. These glasses contain macro-elements (P2O5-K2O-CaO-MgO), with the addition of microelements (Fe-Mn-Zn-Cu) in each formulation. The effects of these elements'addition on thermal properties, glass structure, and dissolution behaviors were investigated. Results showed that these glasses are composed essentially of metaphosphate and pyrophosphate chains and that the addition of micronutrients could change the chemical durability of phosphate glasses. A greenhouse experiment was performed using maize to evaluate the efficiency of the four glasses, with or without the application of chemical nitrogen (N) (N + VF and VF, respectively). The different formulas were tested using 1.4 g per plant. In addition to the vitreous fertilizer formulations, two other treatments were applied: control treatment with no amendment and Nitrogen-Phosphorus-Potassium treatment with the application of the conventional fertilizers on the base of optimal rates. After three months of cultivation, the application of vitreous fertilizers significantly improved growth compared to NPK treatment and the control. It has been found that formulas F1, F2, and F3 may constitute a potential alternative to conventional fertilization due to their positive impact on maize production. They can be used in practice as an environmentally controlled-release fertilizer.

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Development of biosourced polymers superabsorbent for irrigation

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Most Mediterranean regions, especially the Maghreb, have experienced several periods of drought during which rainfall has fallen by around 20%. These regions are among the thirty or so most sensitive areas on the planet, and one of the most exposed to drought risk. Added to a global temperature rise of 0.5℃, we are also witnessing the spread of severe drought, which contributes to the deterioration of ecosystems, aggravates soil desertification, and implies the loss of productivity of cultivated land.
The idea behind this project is to improve water resource management for irrigation, soil quality and the economic performance of agriculture through the use of super water absorbents or hydrorenters, combined or not with the use of treated wastewater.
This research aimed to synthesize and study the swelling behavior of a new super-absorbent hydrogel based on a bio-polymer extracted from industrial food waste. Product characterization was carried out by FTIR, TGA, SEM, NMR and XRD analysis. Reaction variables affecting the hydrogel water absorption capacity, as well as the hydrogel sensitivity to salt, pH and temperature, will be studied in detail.
Using super-absorbent polymers in irrigation can help retain water in the soil and increase the water-holding capacity of sandy or organic matter-poor soils. This can improve the soil's ability to supply water to plants and reduce water stress, which in turn can improve crop growth and yield.
Keywords: Agriculture, Biopolymers, hydrogel, Irrigation, Superabsorbents.

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Synergistic Potential of Biochar Combinations on plants growths parameters

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This study investigates the effects of biochar combinations with different types of manures on plant growth, nutrient uptake, and soil health in fava beans. The length, biomass, and chlorophyll content of the plants were assessed, along with the nitrogen, phosphorus, and potassium uptake. Soil properties such as pH, electrical conductivity, and organic matters were also evaluated. The results demonstrated that the presence of biochar combinations significantly enhanced plant growth and productivity in fava beans, the combination of 3% combination exhibited the highest length and biomass, leading to a substantial increase in productivity compared to the control group. The biochar combinations positively influenced nitrogen, phosphorus, and potassium content in all plants specifically, the 1% combination yielded the highest nitrogen and potassium content in fava beans. As for soil properties, the addition of biochar combinations resulted in an increase in soil pH, suggesting a potential for soil alkalization. Soil organic matter content significantly increased with increasing biochar concentration.
These results highlight the positive impact of biochar combinations on plant growth, nutrient uptake, and soil health in fava beans which emphasizes the potential of these combinations as sustainable strategies to enhance agricultural productivity and improve soil fertility.

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Effect of autochton biostimulants on the phenol compounds of datte palm vitroplants under salt stress

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In arid and semi-arid areas, the date palm (Phoenix dactylifera L.), an indispensable tree, plays an important socio-economic role. However, in recent years, the whole world has experienced serious climate change, which negatively influences plant growth, physiology and production, especially through increased soil and water salinity. The present study was carried out to evaluate the response of date palm vitroplants to salinity and examine the possible roles of a native and exotic arbuscular mycorrhizal fungi (AMF1 and AMF2, respectively), PGPR and compost in improving salt tolerance. Plants were grown under non-saline or saline conditions (0 and 300 mM NaCl) with and without application of the tested biostimulants alone or in dual or in triple combination. Plant growth parameters, including plant dry biomass, were negatively affected by salinity. However, biostimulants -treated plants showed higher growth parameters and a great stimulation of the biosynthesis of bioactive compounds such as total polyphenols and total flavonoids content under saline conditions compared to non-inoculated and non-amended plants. In addition, salt stress caused high lipid peroxidation and increased H2O2 content. However, the application of biostimulants reduced both parameters in salt-affected plants. The best reductions in stress markers (MDA and H2O2) 57% and 55%; 51% and 49% were recorded in plants treated respectively with PGPR+AMF1+Comp and PGPR+AMF2+Comp. Application of biostimulants and especially their combination as an efficient practice to improve growth and development of date palm.

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Reuse of wastewater in irrigation of biochar-amended soils

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Biochar is a carbon-rich material produced mainly from plant and animal biomass by thermochemical conversion. Soil amendment by biochar improves crop productivity mainly by increasing nutrient utilization efficiency and water retention capacity, as well as removing organic and inorganic contaminants from the soil.
The objective of this work is to evaluate the effect of the reuse of treated wastewater in soil irrigation amended by conventional biochar on the growth and yield of a crop of arugula (*Eruca sativa*) grown in vegetative pots. Monitoring is carried out following the analysis of
the substrate and irrigation water (pH, %humidity, electrical conductivity, organic carbon, total limestone, total nitrogen, salinity, Na+, K+, Mg2+, Ca2+, heavy metals, and fecal contamination control germs, pathogenic bacteria (salmonella, Pseudomonas, and staphylococci). Different parameters of plant growth (such as stem height and diameter,
stomatal conductance, photosystem II activity, flowering period, and complete leaf expansion are monitored to assess the impact of biochar and wastewater on plant growth). Organic residues (stems and stubble, leaves, and pods) as well as sensory tests on fruits, primary and secondary metabolites, sugar, and antioxidants will be analyzed to assess the safety and quality of the products obtained).
Our results reported that biochar has a high water retention capacity, which is reflected positively in the growth of rocket seedlings, we observed good growth and a large number of leaves in treatments modified with biochar and irrigated with treated wastewater II.
The combination of biochar and secondary treated wastewater allowed to obtain very important nutrient contents for the rocket, this is what emerges from our results of physicochemical analyses of substrates after irrigation with treated wastewater II, where an increase in the percentage of organic matter, total organic carbon and total phosphorus is noted, especially in tests that contain biochar compared to others without biochar and irrigated with well water.

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Optimizing drying temperature to preserve the quality of two Moroccan sweet cherry varieties (Prunus avium L.)

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Sweet cherries (*Prunus avium* L.), members of the *Rosaceae* family, are a rich source of sugar, proteins, and phenolic compounds, such as anthocyanins and quercetin. Their highly seasonal character and high moisture content make them perishable, necessitating preservation methods to extend shelf life and minimize losses while preserving nutritional and organoleptic quality. Drying is a common preservation method for many fruits and vegetables, including sweet cherries. It involves removing

moisture from the product to reduce microbial growth and enzymatic activity. The drying temperature is a critical factor affecting the quality of the dried product, as it can influence the retention of nutrients, color, and flavor. To investigate the effect of drying temperature on the primary and secondary metabolites of two varieties (Van and Burlat) of Moroccan sweet cherries, we conducted a study using an indirect solar dryer at 50, 60, 70, and 80℃. The cherries were harvested in Marrakech in June 2019 at the mature stage, cleaned, and dried in forced convective mode. After drying, the sugar, protein, and polyphenol content were measured using spectrophotometric methods [1-4]. The rehydration capacity [5] and the color parameters were determined using a Konika Minolta CR400 colorimeter. Our results showed that the drying temperature had a significant effect on the primary and secondary metabolites of both varieties of sweet cherries. For sugars, the highest content was observed at 70℃ (253.61±7.36 and 263.75±22.30 mg/g DM). For proteins, the highest content was observed at 50℃ (38.78±4.71 and 30.83±4.64 mg/g DM for the two varieties, respectively), followed by 60℃, 70℃, and 80℃. For polyphenols, the highest content was also observed at 70℃ (26.50±1.25 and 29.28±1.39 mg/g DM for the two varieties, respectively), followed by 60℃, 50℃, and 80℃. The drying temperature also affected the color and rehydration capacity of the dried cherries. The color difference ΔE increased with drying temperature, while the browning index BI decreased with drying temperature. The rehydration capacity decreased with increasing drying temperature. Overall, our findings suggest that 70℃ is the optimal drying temperature for preserving the nutritional and organoleptic quality of Moroccan sweet cherries, while still maintaining high sugar and polyphenol content. However, further studies are needed to optimize other drying parameters, such as drying time and airflow rate, to further improve the quality of the dried product.

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Phytochemical compounds, antioxidant capacity and micronutrient content of some Moroccan date palm fruit (Phoenix Dactylifera L.)

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The date palm (*Phoenix Dactylifera* L.) fruit is among the fruits most consumed in many countries due its nutritional qualities. In Morocco, there are more than 400 varieties, some of which, such as Khalt khal, Jdar lahmer and Rasse tmar, are mostly used for livestock feed.
The valorization of these varieties could significantly boost the economy of the oasian people. The main objectives of our work are as follows: (i) Analyzing the content of phenolic compounds, micronutrients, and antioxidant activity in different Moroccan varieties; (ii) valorizing low commercially valued varieties; (iii) researching biological activities to identify bioactive substances. Our results have shown that gallic acid and kaempferol are the predominant phenolic compounds. The antioxidant activity, assessed through various tests, showed the following results (2,2-diphenyl-1-picrylhydrazyl (DPPH) test: IC50 ranged from 1.149 mg/ml to 54.835 mg/ml, ferric reducing power (FRAP) test: IC50 ranged from 1.712 mg/ml to 3.464 mg/ml, and ferrous ion chelating capacity (FIC) test: IC50 ranged from 0.052 mg/ml to 1.580 mg/ml). High levels of zinc and iron were found in Khalt Khal, Jdar Lahmer, and Rasse Tmar varieties. These preliminary analyses suggest an antioxidant activity that may be attributed to the presence of phytochemical compounds. Additional analysis is needed to determine the complete phytochemical profile of the studied varieties, thus enabling a more effective approach to valorization."

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Benefits of virgin olive oil and its phenolic compounds on metabolic health

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Numerous studies have provided evidence for the beneficial impact of Virgin Olive Oil (VOO) on metabolic health. Current research on VOO's beneficial effects aims to define its activity on emerging factors contributing to metabolic disorders such as metabolic syndrome, obesity, or type 2 diabetes. These factors include inflammation, oxidative stress, platelet aggregation, coagulation, endothelial function, and lipid profile. In addition, studies have provided evidence that a diet rich in VOO can help prevent atherosclerosis mainly by improving the lipid profile. These beneficial effects of VOO have been attributed principally to its content of phenolic compounds (PCs). Therefore, the bioactivity of olive oil phenolic compounds (OOPCs) could be related to various properties such as antioxidant, anti-inflammatory, antimicrobial, anti-atherogenic, antithrombotic, antimutagenic, and hypoglycemic. Hydroxytyrosol (HT), Tyrosol (Tr), Oleuropein (OLP), Oleocanthal (OLC), and Oleacein (OLE) are the PCs mainly involved in antioxidant and anti-inflammatory activities, as well as resistance to oxidative stress. This work highlights the current knowledge of the effect of VOO, particularly, its PCs, on metabolic disorders, and discusses the underlying mechanism by which it exerts its effect.

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Malting Quality of ICARDA Elite Winter Barley (Hordeum vulgare L.) Germplasm Grown in Moroccan Middle Atlas

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The use of barley (Hordeum vulgare L.) in Morocco is still limited to food and feed despite the amplified demand by local industries for imported malt. This study aims to evaluate 36 barley elite lines for major grain physicochemical parameters and malt quality traits. Analysis of variance, Pearson correlation, principal component analysis (PCA), and hierarchical cluster analysis (HCA) were performed. The results showed significant genotypic variation among genotypes for individual grain and malt traits. High broad sense heritability was obtained for all traits except for plump grain percentage, malt friability, and germination capacity. Starch, malt extract, Kolbach index, grain area, and test weight correlated significantly and negatively with barley protein. Malt extract correlated positively with Kolbach index and starch, but a negative correlation with soluble protein and malt protein was found. Based on 12 characters, 77% of the total genotypic variation was explained by the three first principal components following PCA and four clusters were depicted based on HCA.

Genotypes of high interest with desirable levels of quality standards were identified to be used as a malt quality traits donor while designing crossing programs.

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Determination of the Level of Food Safety Information of Employees in Food and Beverage Establishments in Safranbolu Tourism Destination

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This research was carried out in Safranbolu's hotel establishments and food and beverage business cuisine areas in order to examine food safety information of food and beverage personals that were of great importance for tourism destination. The face-to-face questionnaire method was applied to the study. The data were formulated according to the number - percentage ratio of the cross - table test by using the statistical analysis program. According to the results of the survey, most of the personnel were male (62%), in the group of 40 years and older (33%), most of them are high school graduates (32%), the time spent in their profession was 5 years or less (41%), and the vast majority was the cook (50%), 63% of the staff had a typhoid vaccine and completed a food safety course. There was a significant relationship between what would happen to patients when they ate raw eggs and baked rice ($p<0.05$). There was a significant relationship between the term "safe freezing of the chicken on the machine for the resolution of frozen chicken" ($p<0.05$). There were 51 people (18%) and 188 people (64.4%) who had received food safety courses and who were aware of food safety and standards. There were 32 people (11.3%) who had not received food safety courses and 12 people (4.2%) who did not know if they did not take food safety courses, when they were asked. Conclusion, staffs expressed their knowledge about food safety rather than scientific data, rather than by means of experienced gain and estimated information. It was also determined that the majority of the personnel working in the sectors did not take food safety courses. It should be ensured that the working personnel take a food safety course during the period they start working. In addition, it would be beneficial to provide trainings covering theoretical and practical information on the issues in order to correct the existing deficiencies in the knowledge of the personnel and the errors in practice. These data have also been helpful in designing educational materials about safe food handling practices.

Keywords: Food Safety, Food and Beverage, Hygiene, Cross-contamination, Restaurant

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Acute and subacute oral toxicity assessment of Cladanthus scariosus in female Swiss albino mice

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Cladanthus scariosus (Ball) Oberpr. & Vogt is an endemic species to Morocco (Hight Atlas). It is generally used to treat all disorders where spasm is important; it has tonic, stomachic, analgesic, and antispasmodic properties. It is also renowned for its use in the treatment of diabetes mellitus. The objective of this study is to investigate the acute and subacute toxicity of methanolic extract of *C. scariosus* (CSME) in mice to evaluate its safety profile. During the acute toxicity study, three groups of female mice were selected: the first control group received distilled water, while the second and third received a single oral dose of 2000 and 5000 mg/kg CSME extract respectively. Abnormal behaviors, toxic symptoms, weight, and death were observed for 14 consecutive days to assess the acute toxicity. For the subacute toxicity study, the extract was administered orally at doses of 250, 500, and 1000 mg/kg and the distilled water was given to the control group daily to Swiss albino female mice for 28 days (n = 6/group) respectively. The general behaviors and body weight of the mice were observed daily. Biochemical, macroscopically, and histopathological examinations of the liver, kidney, spleen, and heart were conducted at the end of the treatment period. Regarding the acute toxicity test, no mortality or adverse effects were noted at the dose of 5000 mg/kg. In the subacute study, the CSME extract induced no mortality or treatment-related adverse effects concerning body weight, general behaviors, relative organ weights, and biochemical parameters. Histopathological examination of vital organs showed normal architecture suggesting no morphological alterations compared to the control group. The present study revealed that oral administration of CSME extract for 28 days at a dose of up to 1000 mg/kg did not induce toxicological damage in mice. Based on the acute toxicity study, the median lethal dose (LD50) of the extract was estimated to be over 5000 mg/kg.

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Effect of commune Moroccan Honey on cyclophosphamide induced genotoxicity in Vicia faba root

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The present study was carried out to evaluate the genotoxic effects of bioactive compounds of some selected Moroccan honeys in *Vicia faba* roots. The potential anti-genotoxic effect of honey extract against cyclophosphamide (CP)-induced cytotoxicity and genotoxicity were also assessed. This research was carried out in two stages. In the first stages, the exposure of *Vicia faba* plants to two to three concentrations of the phenolic extract of honey showed no significant differences in genotoxic and cytotoxic effects between the concentrations of the eight honey extracts (P value > 0.05). The determination of the genotoxic effect of the different treatments in comparison with CP shows essentially that the Fennel honey extract has the highest genotoxic effect in comparison with the other treatments with a genotoxic effect value of 64.36 ± 20.96 %. In the second stage, interactions between two concentrations of each type of honey extract (1 mg/mL and 0.1 mg/mL) and CP were used to test the effects of honey extracts on CP-induced toxicity. The results indicated that, especially for Thyme honey at the concentration of 0.1 mg/mL, a low micronucleus frequency and a high anticlastogenic efficacy in comparison with the genotoxic actions of CP only. These results show the potential beneficial effect of honey extract to attenuate the side effects of CP-chemotherapy.

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The protective effect of two types of Moroccan honeys against cyclophosphamide-induced toxicity in mice

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Cyclophosphamide (CP) is a common anticancer agent used for the treatment of various forms of cancer, autoimmune diseases and is also used as an immunosuppressant after organ transplants. However, upon treatment, it induces severe toxicity due to its oxidative stress capability. Honey, is a natural product collected by honey bees, has shown several biological activities, such as free radical scavenging and antioxidant agent. In this context, the present study aims to assess the protective effects of two types of Moroccan honeys against CP-induced genotoxic and cytotoxic effects in mouse bone-marrow cells. The ratio of polychromatic erythrocytes (PCE)/normochromatic erythrocytes (NCE) and the frequency of micro nucleated polychromatic erythrocytes (MNPCE) demonstrated that the tested concentration of CP alone or combined with sucrose, significantly induced an increase in the % MNPCE and significantly reduced PCE/NCE ratios demonstrating a potential genotoxic and cytotoxic effect of CP. While the cytotoxic and genotoxic effect was attenuated in the CP group pretreated with honey for 6 days. Also, the results indicated that the mice that were pretreated with honey have improved levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), and creatinine concentrations in mice serum compared to the other groups. Moreover, the intake of honey also reduced the incidence of liver damage induced by CP. These results indicate that CP had a marked damaging effect on liver tissue including steatosis apoptosis, necrosis, and massive infiltration of inflammatory cells with irregular general pattern of the tissue. The tested Moroccan honeys showed a potential protective effect against cyclophosphamide-induced hepatotoxicity in mice.

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Toxicological Evaluation of Saponin-Rich Argan Press Cake Extracts and Their Potential Use in Cosmetic Formulations

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Argan oil, a prized product extracted from the nuts of the argan tree in Morocco, has gained international recognition for its versatile applications in both the cosmetic and culinary worlds. In contrast, argan press cake, while being a byproduct of the oil extraction process, remains less celebrated primarily due to its unpalatable taste. Nevertheless, this underappreciated residue holds remarkable untapped potential, which is crucial for building a sustainable future.

Recent research has uncovered a promising facet of Argan press-cake, specifically its hydroalcoholic extract, rich with saponins, which are known for their bioactive properties and have exhibited positive results in promoting hair growth and skin lightening. Yet, their application remains uncharted territory in the realm of cosmetics due to concerns regarding safety, owing to the antinutrient nature of saponins.

Our ongoing research endeavors aim to bridge this knowledge gap by conducting a comprehensive safety assessment of Argan press-cake extract. This assessment begins with the extraction of saponins using a range of ethanol-water mixtures (0%, 25%, 50%, 75%, and 100%). Detailed characterization of the extract's composition revealed a complex and diverse profile, underscoring its potential multifaceted utility.

Furthermore, a micronuclei test, utilizing Allium cepa roots, was conducted across various concentrations of each extract (0.1, 1, 5 and 10 mg/ml). These tests uncovered that the 70% extract emerged as the most efficient concerning saponin content and yield. Notably, the results also demonstrated a concentration-dependent genotoxicity, with extracts below 0.1 mg/ml exhibiting no genotoxicity potential. This finding suggests that the extract may be suitable for cosmetic formulations, particularly those requiring concentrations for promoting cell proliferation and hair growth (5 µg/ml), as well as skin depigmenting and lightening (50 µg/ml).

In line with contemporary efforts to minimize animal testing and prioritize animal welfare, we explored an alternative computational method using the QASAR toolbox. With its latest iteration as of May 2023, this tool identified potential metabolites, such as hydroperoxides and neutral organics, which could potentially induce adverse skin reactions. This computational approach represents a promising avenue for conducting safety assessments, reducing reliance on traditional animal testing methods while maintaining a rigorous and responsible approach to product development.

These findings not only contribute to a more comprehensive understanding of this valuable resource but also pave the way for its responsible utilization, bridging the gap between sustainability, science, and beauty, and open the door for a wide range of further research and experiments.

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Characterization and Densification of Hydrochar Produced from Two-Phase Olive Mill Waste: A Sustainable Approach to Waste Management

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Biomass energy is an effective way to replace traditional fossil fuels. This study investigates the integration of hydrothermal carbonisation (HTC) as a valorisation route for two-phase olive mill wastes (TPOMW). HTC reactions were conducted at temperatures varied from 180 to 300 ℃. The resulting hydrochar is then subjected to a densification process, enhancing its energy density and handling properties. The results reveal that hydrothermal carbonization of TPOMW followed by densification produces a hydrochar with desirable attributes for energy recovery. The resulting hydrochar exhibits improved energy density, reduced moisture content, and enhanced handling characteristics. Furthermore, its chemical composition and thermal behavior make it a promising candidate for various energy utilization pathways, such as combustion or gasification

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In vivo evaluation of antivenom activity of Adenocarpus anagyrifolius methanolic extract against Hottentotta gentili scorpion venom

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The effectiveness of the methanolic extract from the aerial parts of *Adenocarpus anagyrifolius* in countering the venom of *Hottentotta gentili* was assessed through oral administration at doses of 100, 150, and 200mg/kg following the subcutaneous injection of a venom dosage lethal to 99% of the test subjects (LD99). The findings revealed a remarkably successful outcome, as the mice survived even after 24 hours. Furthermore, when LD50 and a dose of 200 mg/kg were administered, there was a noticeable reversal of damage in various tissues and a significant reduction in the levels of biochemical markers. The potent antioxidant activity, coupled with the presence of active metabolites, offers a plausible explanation for the potential of *A. anagyrifolius* as a natural product candidate for drug development.

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Phytotoxic and cytotoxic effects of Thymus pallidus Batt. essential oil

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Weeds impact the growth and yield of associated crops by competing for space and nutrients, resulting in significant economic losses. To counteract their negative impacts, numerous synthetic chemicals have been tested and employed. However, these not only pose environmental threats but also raise concerns about human health. Moreover, the repetitive and uncontrolled use of herbicides has led to the emergence of resistant weed strains. Consequently, farmers often have to either increase their application or switch to a different herbicide, further escalating maintenance costs. This underscores the pressing need for an innovative and sustainable approach to weed management.
Natural compounds derived from plants, compared to their synthetic counterparts, offer advantages such as rapid biodegradability, a low risk of inducing weed resistance, and reduced toxicity to non-target organisms. Among these compounds, essential oils, which have been extensively used in food preservation and medicinal practices for millennia, are recognized for inhibiting the growth of competing plants. Thus, they could serve as environmentally compatible alternatives to synthetic herbicides.
This study evaluates the phytotoxic and cytotoxic potential of the essential oil from Thymus pallidus Batt., a species endemic to Morocco. The principal components of this oil were o-cymene (45.13%), borneol (12.56%), and thymol (11.58%). The EO was observed to reduce germination rates, seedling growth (both root and shoot length), mitotic index, and the frequency of viable cells in a dose-dependent manner. It also caused noticeable alterations in nuclear structures, evidenced by chromosomal aberrations. In conclusion, the Thymus pallidus essential oil demonstrates potent phytotoxic and cytotoxic activities, suggesting its potential development into a novel bioherbicide for sustainable weed management in agricultural systems.

Governance and Policy / 16

The beliefs and attitudes of local councils in rainwater harvesting and their influence on implementation fidelity

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The quest to achieve sustainability in water supply will find success when governments believe that rainwater harvesting conserves groundwater, saves energy, reduces the destructive effects of stormwater runoff and benefits plants. The aim of this paper is to highlight the relationship between the beliefs and attitudes of the local council's employees in rainwater harvesting and their efforts in adhering to the Uniform Building By-Laws. To attain this aim, relevant qualitative data at the organisational level was compared to the employees' beliefs, attitudes and behaviour while performing their duties. Five themes emerged from data analysis: (1) economic consideration, (2) government administration, (3) governance, (4) environment, (5) homeowners' attitudes. It was discovered that insufficiently effective government administration and a lack of governance support resulted in substandard rainwater harvesting installation and harmed the environmental beliefs of local councils employees. The employees believed that the Principal Submitting Persons were responsible for approving substandard works when issuing the Certificate of Completion and Compliance. The findings also revealed that the local councils' beliefs on the disadvantages of rainwater harvesting were partially based on experiences of homeowners and developers, which reflected in the authorities' negative attitudes. Employees of a local council with strong environmental beliefs, on the other hand, recognised that their decisions would bring more beneficial changes and a better experience for stakeholders. As a result, they implemented rainwater harvesting with more fidelity and gained the confidence of both their community and the country. Positive attitudes and environmental beliefs affect how local councils behave in ways that promote water conservation and reduce reliance on non-sustainable water sources. The findings presented in this paper provide important information on beliefs and attitudes of government that can enhance the rainwater harvesting implementation fidelity.

Online session / 10

Optimizing hemicellulose extraction from barley biomass: a comprehensive evaluation of technology, costs, and environmental impact

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Extraction processes involving hemicellulose from barley bran and straw have garnered significant attention in recent literature, primarily due to their implications for the sustainable utilization of agricultural residues. In this meticulously crafted investigation, the salient application of process simulation techniques is foregrounded, delineating the profound effects of diverse operating conditions on hemicellulose extraction efficacy. When intertwined with comprehensive mass and energy balance calculations, such operational intricacies proffer an exhaustive analytical landscape of extraction dynamics, pivotal for advancing research in this domain. A noteworthy augmentation to this research trajectory is the integration of the Life Cycle Assessment (LCA) methodology, which not only refines the assessment of operational parameters but also extends the evaluative paradigm

to encapsulate overarching environmental implications. This synthesis ushers in elucidating optimal technological interventions, evidenced by an exemplary hemicellulose production flow rate of 2.52 kg/h. Concurrently, the economic ramifications of the extraction process are meticulously interrogated, yielding a compelling minimum production cost framework pegged at 9.23 USD. This harmonization of technological efficacy with economic pragmatism crystallizes the scalability and commercial potential of the extraction process, an insight of paramount significance for industry stakeholders. The environmental considerations, indubitably integral to contemporary academic discourse, form the fulcrum of this investigation. The meticulous derivation of minimized environmental impact metrics, encompassing facets such as human health (5.26×10-5 DALY), ecosystems (2.20×10-7 species per year), and resource utilization (0.8 USD), underscores the study's commitment to sustainable research paradigms. The judicious employment of semi-empirical models, especially in the context of LCA data extrapolation, is emblematic of the avant-garde methodologies championed in this study, reiterating their indispensability in the quest for refined eco-design frameworks in biorefining operations. In summation, this investigation serves as an exemplar, harmoniously juxtaposing technological innovation, economic viability, and environmental stewardship, thereby delineating an erudite roadmap for future endeavors in biorefining processes.

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Chitosan Derived from Hermetia illucens waste: A novel approch to mitigate heavy metal pollution

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Heavy metal contamination has harmful consequences for the ecosystem. They are naturally non-biodegradable, and can cause severe ecotoxicity and numerous pathologies. Several techniques have been used for metal pollution control. The aim of the present work is to exploit the rearing waste of the Black Soldier Fly Hermetia illucens (pupal stage) to produce chitin and its derivative chitosan, and to study the interaction of this biopolymer with Zinc and Cadmium. All the samples obtained were characterized by several methods, including FTIR, DRX, EDX, potentiometric and viscosimetric studies. The chitosan obtained has interesting physicochemical properties (DA = 3.40%, Mv = 220,378.88 g/mol, and ICr = 45.34%). Chitosan was also found to have an interaction rate with Cd and Zn of around 32.59% and 27.26% respectively. Taken as a whole, the work carried out constitutes an enhancement of a chitinous source (BSF) and confirms the high interaction capacity of chitosan with the heavy metals studied.

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Comparison between a Photovoltaic-Thermoelectric Hybrid System with and without Solar Concentrator

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This study aims to increase the solar energy conversion into electrical energy by integrating two different systems, namely the photovoltaic system PV and the thermoelectric generator TEG. The thermoelectric generator will convert by Seebeck effect the thermal energy produced by the photovoltaic panel which will add additional electrical power to the overall power. A comparison between the hybrid system with solar concentrator and without solar concentrator was carried out. The contribution of the thermoelectric generator in both types of the hybrid system is evaluated. The study also focused on the impact of climate factors, which are solar irradiation, ambient temperature and wend speed, on the performance of both hybrid systems. For this purpose a mathematical model that takes into account the environmental factors and thermal and optical losses in the hybrid system has been developed. Six energy balance equations were obtained with six surface temperatures. The resolution of the six nonlinear equations is carried out by applying the Newthon-Raphson method. Results showed that the contribution of the thermoelectric generator in the hybrid system with solar concentrator is large compared to the hybrid system without solar concentrator which shows a small improvement. The power generated by the hybrid system with a solar concentrator is very large with respect to a photovoltaic panel. While the power of hybrid system without solar concentrator shows only a slight improvement. Results encourage the use of a solar concentrator in this hybrid system for better solar energy conversion.

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Evaluation of Bias-adjusted Euro-Cordex simulations on Morocco and future changes

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This study revolves around two main parts. First, we conducted an assessment of Bias-adjusted Euro-Cordex simulations to examine their capability to reproduce the thermal and precipitation characteristics, both in terms of mean and extreme values, at the local scale of Morocco. This assessment was performed in comparison to data obtained from observations at weather stations and ERA5 reanalysis. Several metrics are used including the mean bias, coefficient of variation, distribution through quantile-quantile diagrams, and the seasonal cycle. The assessment is also made in terms of indices of extreme events of temperature and precipitation. Then we proceeded to the evaluation of the future climate changes projected by one of the models on Morocco under the RCP scenarios at both horizons 2031-2060 and 2070-2099 compared to the base period 1979-2005. The changes were assessed for cumulative precipitation, mean temperature, as well as thermal and precipitation extremes. The evaluation results in terms of bias show the effect of the bias correction on all simulations. Indeed, the bias values are generally low at the annual and seasonal scales. The seasonal cycle pattern is also well reproduced by the models for mean temperature and cumulative precipitation. It was also observed that climate models generally exhibit good capability in reproducing temperatures. However, for cumulative precipitation, the models tend to overestimate heavy rainfall amounts. The thermal extremes are well simulated by the models. The rainfall extremes are reasonably well reproduced too. This analysis of comparisons, at the local scale, of the corrected simulations to the observation data showed the added value of the application of bias adjustment methods to the outputs of climate models before their use for the evaluation of future changes or impacts assessment. It also reveals that bias adjustment methods remain dependent on the observational data used and may not eliminate all biases, especially for extreme events at the local scale. Future projections show a significant warming generalized to the whole studied area. In terms of

total precipitation, the model projects a significant decrease in total rainfall for the middle and end of the century. The extreme indicators calculated in the study area confirm a convergence towards warming and drying up. These results will interest various socio-economic sectors in our country, particularly those related to water, health, and agriculture.

Online session / 9

Study of Climate Variability in the Year 2020 in Conakry

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Over the past 50 years, West Africa has experienced one of the greatest variations in rainfall observed on a global scale. These climatic fluctuations not only affected the precipitation regime but also had consequences on hydrological and plant resources. As a first approach, climatology is interested in the average values of meteorological parameters, their dispersion around this average, extreme values, and their duration of return. The calculation of averages is therefore the basis of climate analysis.
This study of climate variability and its consequences on water resources and dynamics in the Conakry area during the year 2022.
The variability of Meteorological parameters is a research that consists in analyzing and synthesizing data mainly the atmosphere of a place and whose complex action influences the existence of the beings which are subjected to it. The meteorological data used in this study are the Rainfall, the Temperature (minimum and maximum), the wind of the Synoptic Station of Conakry 1991 - 2020, and the climatic variability in the year 2022 in Conakry. These data were extracted from the well-preserved archives of the Dominion Command. The climatic data collected underwent statistical processing and analysis including analyzing the interannual variability of the rainfall indices, the standardized anomalies were calculated, the trend evolution during the study period, cumulative rainfall per year and monthly cumulative, the variation of the average maximum and minimum temperature and a study of the monthly rainfall of 2022 in Conakry, number of rainy days. The analysis of these variations and the interpretation of the results are the subject of this present work.

Keywords: *Rainfall index, Interannual variability, Number of rainy days 2022, Cumulative rainfall, climate variability*

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Monitoring of multidrug-resistant bacteria in domestic wastewater

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Wastewater treatment plants (WWTPs) provide optimal conditions for the maintenance and spread of antibiotic-resistant bacteria. In this work, we describe the occurrence of antibiotic-resistant fecal coliforms in the inlet and the outlet of WWTPs in Settat City Morocco. This leads us to identify the role of WWTPs in the dissemination and the spread of antimicrobial-resistant Enterobacteriaceae in the environment. Raw and treated wastewater are received monthly from WWTPs of Settat. For each sample, we evaluated physicochemical parameters namely: T°, pH, Turbidity, TA, TAC, TH, conductivity, chloride, Nitrate, Nitrite, Sulphate, DCO, DBO5, and MES. Samples were used also to study indicators of fecal contamination, and the frequency of the resistant fecal coliforms community to aminoglycosides, beta-lactams, fluoroquinolones, carbapenems, polymyxins, and penicillins. For each sample, diluted aliquots of 100 mL were passed through membrane filters of 0.45um pore sizes. The resulting filters were placed into six modified Lactose-TTC-Agar mit Tergitol-7 (LTTC), this agar was supplemented with different concentrations of gentamicin, ciprofloxacin, ceftriaxone, colistin, imipenem, and ampicillin. After overnight incubation at 37℃, Matrix-assisted laser desorption/ionization-time of flight (MALDI) mass spectrometry (MS) MALDI-TOF MS was used to identify resistant isolates, and antimicrobial susceptibility testing was used too. In the community, we found an ampicillin-resistance rate of 42.1 % for fecal coliforms. Resistance rates to ciprofloxacin and colistin were 15 and 17.2%, respectively. However, the resistance rate has significantly increased between seasons to the third-generation cephalosporins (3GC). Our results indicate that the microbiological quality of the treated wastewater from WWTPs of Settat meets the Moroccan standards recommended for irrigation water. However, wastewater is routinely contaminated with multidrug-resistant enterobacteria. This is a concern for both public health and animal agriculture.

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Effect of supplementing industrial chicken diets with tomato by-products on broiler performance and biochemical parameters

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The objective of the current study was to evaluate the nutritional value of tomato by-products on chickens. A total of 150 broiler chicks were randomly divided into groups of 15 pens and fed with standard diets supplemented with different percentages of tomato by-products (5%, 10% and 15%) for 39 days. The control group was fed only with standard diets under the same conditions as the treated groups. Then we measured biochemical parameters (ash, fat, protein, carbohydrate, and energy) and zootechnical parameters (weight, average daily gain, and consumption index) in both treated and control groups. As a result, after 39 days, all biochemical parameters were significantly improved in chicks treated with tomato by-products compared to the control (except proteins). In contrast, the weight, average daily gain, and consumption index were statistically similar between control and all groups of treated chicks. In conclusion, the results of the present study suggest that dietary supplementation with tomato by-products has a positive effect on biochemical characteristics of broiler chickens.

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Integrated Assessment of FWLE Nexus Interactions and Potential Synergies and Trade-offs in Europe

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Climate change and socio-economic development will have important implications on the long-term sustainability of natural resources supporting the human and ecological systems globally. These impacts also interact in complex and non-linear ways that transcend beyond traditional sectoral ad regional boundaries with cascading and potentially pervasive implications. This is particularly relevant for the food-water-land-ecosystems (FWLE) nexus, as it is fundamental for achieving a number of the Sustainable Development Goals (SDGs). A holistic understanding of the FWLE nexus interactions and associated response to various exogenous drivers is crucial for developing robust cross-sectoral adaptation strategies that facilitate sustainable use and management of finite natural resources under uncertain future changing conditions.
This work presents the findings of a landscape-scale simulation of the complex cross-sectoral linkages and interactions between six key land- and water-based sectors in Europe (i.e., agriculture, biodiversity, coasts, forests, urban, and water). The study applies a widely used regional integrated assessment (IA) model, the CLIMSAVE IA tool, taking into a wide range climate change and socio-economic development scenarios. The results highlight the key climatic and non-climatic drivers of Europe's future landscape change dynamics, and provide quantitative insights into key FWLE nexus synergies and trade-offs and potential implications for sustainability and the SDGs. It also demonstrates the role of systematic integrated model-based analysis of nexus issues across scenarios and scales, providing a methodological framework that can facilitate future nexus studies.

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Nuclear power for electricity generation and seawater desalination in Morocco : An overview

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North African nations, including Morocco, face increasing vulnerabilities due to global warming and rising electricity demand, driven by heavy dependence on imported fossil fuels. This dependency poses threats to both energy security and economic stability.
The adoption of nuclear energy in Morocco could serve as a viable and strategic alternative to address the country's growing energy-related challenges.
The general research objective is to examine the potential role of nuclear energy in addressing Morocco's rising electricity generation needs and the pressing demand for seawater desalination. This research rigorously evaluates the economic viability of nuclear power in Morocco, analyzing factors related to electricity economics. Environmental implications, including carbon emissions reduction and nuclear waste management, are comprehensively assessed. Additionally, safety, security, regulatory frameworks, and stakeholder engagement are examined.

While limited research exists on the subject, there remains a notable gap in understanding the potential opportunities and obstacles associated with the utilization of nuclear energy for both electricity generation and seawater desalination within the context of Morocco.

A comprehensive methodological approach that effectively combines quantitative and qualitative analyses is used to rigorously address the research objective. In terms of data collection, this research will undertake a thorough examination of various critical aspects linked to Morocco's energy landscape. This encompasses a thorough investigation into electricity demand projections, the existing energy mix, and specific environmental factors directly relevant to the study's focus. Simultaneously,

the study conducts research into global nuclear energy trends and best practices, providing a robust foundation for its comprehensive analysis. Ultimately, the findings are positioned to significantly enhance well-informed decision-making processes regarding the country's pursuit of a sustainable energy future. The results offer invaluable data and insights that serve as a guiding tool for developing a resilient and adaptable energy infrastructure, specifically tailored to meet Morocco's needs and effectively address its evolving challenges.

Key words: Nuclear power; Electricity demand; Desalination; Morocco; North Africa; Policy decisions.

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A Comprehensive Monitoring of Physicochemical Parameters of Composting Sheep Manure

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Addressing the global spike in organic waste, worsened by rising agricultural operations, is critical in the context of escalating environmental issues. The danger of non-point source contamination grows with improper handling of organic waste. This study emphasizes the need of thorough monitoring as a remedy across the composting process. This research focuses on organic waste management, with a particular emphasis on sheep manure composting. To guarantee successful waste management, it employs an experimental technique to monitor the composting process and examines several physicochemical characteristics. An experimental approach was used to monitor the composting of organic waste from sheep manure. Over the course of seven months, sheep manure and straw bedding obtained from a supermarket in Casablanca city supermarket were composted. The materials were sorted and cleaned from plastic, cardboard and glass and then well mixed using a bucket loader. The compost was produced by using the windrow composting method with a periodic mechanical turning. The examination took place on the grounds of a specialized compost producing company, which offered a suitable environment for the experiment. Throughout the procedure, variations in temperature in the various composting zones were noted, and samples were collected and taken periodically to the laboratory for physicochemical analysis. A variety of macro and microelements as well as evaluations of moisture, pH, conductivity, organic carbon, nitrogen, and nitrates were all included in the physicochemical examination. To ensure effective pathogen eradication and secure composting, the thermophilic phase of the composting process reached a maximum temperature of 73℃. The final composts had a pH that was virtually neutral (7.02), little organic matter (26.19%), more nitrogen, and an ideal Carbon to Nitrogen ratio (13.29), all of which pointed to stability. Capacity Exchange Capacity (CEC=67.03 meq/100g) and increasing CEC to Organic Carbon (CEC/OC: 1.95) were indicators of humification and maturity. The resulting high-quality compost contains important macro and microelements, which improve crop development and soil quality. This investigation underlines the significance of sanitary methods in producing safe and nutrient-rich compost. These discoveries hold great promise for sustainable agriculture, especially for Moroccan livestock producers and farmers looking to increase soil production. In addition to encouraging heap composting in the livestock sector, recommendations include researching various compost application methods in various agricultural situations.

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The promising pretreatment of olive mill wastewater by chitosan produced from Hermetia Illucens prepupal cases

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The aim of this work is the investigation of a natural organic coagulant for the pretreatment of olive oil mill wastewater (OMW), aiming to replace conventional metal-based coagulants. The goal was to produce healthy OMW that could potentially be reused in several fields of application such as pharmaceuticals and cosmetics. Chitosan was selected as a model natural organic coagulant, and the coagulation process was optimized by examining various interaction conditions such as agitation and temperature. The results showed high efficiency of chitosan interaction, with maximum removal rates of iron, copper, and phosphorus reaching 86.84%, 82.14%, and 43.47%, respectively. The optimal performance was achieved by using chitosan in an agitated reaction at a temperature of 45℃.

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Recent Progress in Managing Crown Gall Disease in Grapevines (Vitis Vinifera L.): Sustainable Control Methods.

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Grapevine (*Vitis vinifera* L.) is a highly significant perennial plant with more than 6.95 million hectares of vineyards worldwide, producing table grapes, wine grapes, and derivatives. Wine production alone generated a global market value of over 29 billion euros in 2020. Morocco ranks fourth among major grapevine-producing countries, with a vineyard area of 42,286 hectares. Crown gall (CG), caused by the plant pathogenic bacterium *Allorhizobium vitis*, is a critical soil-borne disease affecting grapevines globally. CG leads to tumor-like overgrowths on roots and can cause severe productivity loss and even death in infected plants. This review aims to provide insights into the recent research on grapevine crown gall, focusing on management strategies to control this disease. The review examines current methods such as preventive agricultural practices, and curative biological control based on beneficial microorganisms. It also explores the use of resistant vine varieties and agronomic practices to limit disease spread. Identifying gaps in knowledge, the review suggests future research directions, including the development of innovative technologies and biological approaches to protect vine crops and manage this destructive disease.

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Valorization of natural resources based cuttlefish bone waste by producing active biomolecules: chitin, chitosan and aragonite

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Industrially, the amount of chitinous waste based on cuttlebone discarded annually in some coastal areas of Morocco is considerable and harmful, is about 1,732, 034 tons. This biological waste constitutes a potential source of active biomolecules such as chitin, chitosan and aragonite. Interest in these natural resources is limited to fishing, and waste is dumped on the coast. In the present work, we propose an advanced valorization to obtain first chitin and chitosan with controlled physicochemical characteristics, and then the biomineral aragonite (CaCO3) by exploitation of the of cuttlefish bones marine waste. The composition of the ventral and dorsal face of the bone is well studied by ICP-OES. A chemical extraction process was applied on the dorsal side to extract chitin and chitosan, and aragonite on the ventral side was performed. Then, physicochemical characterizations by FT-IR, SEM, XRD, 1H-NMR, TGA/DSC, Potentiometry, and Viscosimetry were performed. In addition, DPPH and FRAP tests are performed to evaluate the antioxidant activity of chitosan.
Key words: Biological waste, Cuttlefish bone, Aragonite, Chitin, Chitosan, Physicochemical properties, Antioxydant activity

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Assessment of the Impact of Biofertilization Utilizing PGPR Strains Isolated from Moroccan Oasis Soils on the Growth of Salt-Stressed Date Palm (Phoenix dactylifera L.) Seedlings (cv. Boufeggous)

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The utilization of Plant Growth-Promoting Rhizobacteria (PGPR) has shown significant potential in mitigating the adverse effects of salt stress on the growth of date palm trees in saline environments. These beneficial microorganisms enhance the plant's ability to tolerate and adapt to high salt concentrations by stimulating root growth, improving nutrient uptake, and facilitating the synthesis of osmoprotectants. By colonizing the rhizosphere of date palm trees, PGPRs can improve soil structure and nutrient availability, ultimately promoting the growth and development of date palm even in salt-affected environments.

In this study, young seedlings of date palm (cv. Boufeggous) were subjected to salt stress (154 mM NaCl) and inoculated with selected strains of Plant Growth-Promoting Rhizobacteria (PGPRs) isolated from certain arid regions of Morocco. Following a period of three months, the ensuing effects of this intervention were meticulously evaluated through the assessment of diverse plant parameters that are indicative of both physiological and morphological attributes. The meticulous evaluations conducted in this study unveiled that the application of the biofertilizer effectively mitigated the

levels of oxidative stress. This alleviation was facilitated through the modification of enzymatic activities associated with antioxidant mechanisms, such as Catalase (CAT) and resulted in accumulation of proline and soluble sugars. thus indicating the efficacy of the biofertilization approach in improving the adverse impacts of salt stress on the date palm seedlings.

Key words: Date palm, tolerance, salinity, PGPRs, biofertilization.

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Spatial Modeling with GIS of Water, Soils and Sediments of Pit Lakes Contamination by Heavy Metals and Arsenic in the Abandoned Mine of Zeida (Morocco)

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The Zeida Lead mine is located in the center of the High Moulouya basin, 26 km in the north of the town of Midelt (Morocco). During the period (1972-1985), it experienced very intense mining. However, this activity has had a harmful impact on the surrounding ecosystem through the storage quantities of several million tons of mining residues excessively loaded with heavy metals and Arsenic deposited without any adjusting, in dams on either side of the Moulouya River. Indeed, numerous research studies have focused on the contamination of surface water, soil, and pit lake sediments by heavy metals. This work aims to compile all the analytical data obtained in the various works in the form of databases under GIS (ArcGIS), in order to produce thematic maps of different chemical elements to determine the anomalous zones in heavy metals and Arsenic, compared with the references of standards used.

Keywords: modeling, contamination, heavy metals, GIS, Zeida mine

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Breeding and genetic improvement of industrial hemp (Cannabis sativa L.) in Morocco

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Hemp (Cannabis sativa L.) is an increasingly attractive versatile crop for the sustainable production of fiber, seeds, and cannabinoids. This crop is of increasing interest for ecological and economic reasons. Additionally, hemp can be easily integrated into crop rotations, helping to improve soil structure and biology and interrupt the breeding cycles of weeds and pests. Additionally, all components of the plant are recycled and transformed into sustainable end products that can be composted and/or recycled. Hemp stems are widely used in the automotive, textile and paper industries as well

as in the construction and insolation. The seeds are also used in human and animal nutrition, oil extraction and cosmetics. The remaining inflorescences are used to produce cannabinoids used for medicinal purposes. The introduction and improvement of this species in our country is part of a doctoral research program between the Hassan II Agronomic and Veterinary Institute, the Tadla Regional Centre for Agronomic Research and Hempseed Morocco. The main aim of this research program is to study the behavior of this species in a Moroccan context and to contribute to the creation of a first Moroccan variety of industrial hemp. The first trial took place in June 2022 in the Tadla region with a very heterogeneous population originating from central Europe. The average straw yield for all the populations was 26.43 g/plant, of which 23% were fibers, with an average length of 7.94 mm and grain yield was 5.4 g/plant. Now that laws authorizing hemp production exist in most countries of the world, it's time to embrace this sustainable and versatile crop, which can be used to treat, feed, clothe and build while respecting our planet.

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How polyphosphate fertilizer can alleviate cadmium stress in tomato plants?

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Cadmium (Cd) is one of the most toxic elements in soil, affecting plant morphological, physiological, and biochemical processes. Many strategies have been developed to improve plant resilience against heavy metal stresses. Mineral plant nutrition was tested as an effective approach to mitigate Cd stress in several crop species. In this regard, the present study aims to elucidate how different phosphorus (P) fertilization regimes can improve some biophysiological processes in tomato plants exposed to Cd stress. In a hydroponic experiment, the impact of two P fertilizer forms (orthophosphate and polyphosphate) on the photosynthetic activity, plant growth, and nutrient uptake and acquisition was assessed under three levels of Cd stress (0, 12, and 25 µM of CdCl2). The results confirmed the negative effects of Cd stress on the chlorophyll content index and the efficiency and performance of the photosynthesis machinery, as assessed by the chlorophyll fluorescence technique. The application of highly polymerized polyphosphate fertilizer significantly improved the chlorophyll stability index under Cd stress, as compared to the ortho-P form. The analysis of the OJIP transient curve revealed that the amplitude of the Cd effect on the different steps of electron transfer between PSII and PSI was significantly reduced under the poly-P fertilization regime compared to ortho-P, especially under medium Cd stress (Cd12). The evaluation of the RE0/RC parameter showed that the electron flux reducing end electron acceptors at the PSI acceptor side per reaction center was significantly improved in the poly-P treatment. Similarly, the performance index for energy conservation from photons absorbed by PSII until the reduction of intersystem electron acceptors (PIAbs) was significantly ameliorated under the poly-P regime. This enhancement of photosynthesis activity under poly-P treatment resulted in higher biomass accumulation and nutrient uptake and reduced Cd accumulation.

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Enhancing the agrophysiological performance of chickpeas under low-P soil conditions with the co-application of bacterial consortia and P-fertilizers

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Chickpea (Cicer arietinum L.) is an important leguminous crop grown worldwide and plays a significant role in humans'dietary consumption. Alongside nitrogen (N), low phosphorus (P) availability within agricultural soils is one of the major factors limiting chickpea growth and productivity. The combined application of beneficial bacterial inoculants and Rock P-fertilizer could boost chickpea performance and productivity, increasing P-utilization efficiency and minimize nutrient losses under P-deficiency conditions. A greenhouse experiment was conducted to evaluate the response of chickpea to two P-fertilizers forms (RP and TSP) under N2-fixer and P-solubilizer consortium inoculation to improve biological N fixation and P nutrition under P deficient conditions. Under inoculation, chickpea chlorophyll content and chlorophyll a fluorescence (RP+I and TSP+I) were increased compared to uninoculated treatments. The RP+I treatment increased both shoot and root dry weights by 48,80% and 72,68% respectively compared to the uninoculated RP fertilized control. Indeed, the bacterial consortium contributed to enhancing root morphological traits (e.g., root volume, surface area, and diameter) of all inoculated treatments versus the uninoculated treatments. Furthermore, soil available P and root inorganic P were significantly improved in RP+I by 162,84% and 73,24% respectively, compared to uninoculated RP control. Our research outcomes suggest that the co-inoculation of chickpea with N2-fixing and P-solubilizing bacteria improve biomass yield and nutrients-uptake. Eventually, enhancing chickpea agrophysiological performance, especially in restricted P-availability conditions.

Keywords: Chickpea varieties, consortium, beneficial bacterial inoculants, phosphorus deficiency, Rock P-fertilizer, nutrient uptake.

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Bacillus sp. are Potential Biocontrol Agents against Fusarium oxysporum f. sp. albedinis Causal Agent of Palm Dieback Disease (Bayoud)

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Date palm (*Phoenix dactylifera* L.) is a crop of major importance in the Moroccan economy and ecosystem. In desert oases, date palm trees create a friendly microclimate environment suitable for cultivating legume crops and protecting lands from desertification. The fungus *Fusarium oxysporum* f. sp. albedinis (Foa), the causal agent of bayoud disease, is the most alerting pathogen that infects and causes heavy damage to the date palms. A promising approach for the eco-friendly management of plant diseases is the use of biocontrol agents (BCAs). Among these, *Bacillus* sp. are widely known as BCAs against plant pathogens and are reputed for their resilience in different types of environments. This present study aims to recover, from Moroccan soils, potential *Bacillus* BCAs against the fungal pathogen Foa. The heat-shock treatment of collected samples associated with the Gram staining and microscopic observation was conducted to isolate the spore-forming bacteria

Bacillus sp.. A total of 513 isolates have been recovered from the different sampled soils. For the in vitro antagonistic preselection tests, a total of 20 isolates were confronted in dual culture assays with Foa to assess their potential to inhibit fungal growth. Three (03) isolates showed the most effective inhibition of the pathogen mycelial development ranging between 72% to 76%. These isolates were molecularly characterized by sequencing their 16S regions and were identified as *Bacillus haynessi* NRRL B-41327, *Bacillus velezensis* strain CBMB205, and *Bacillus velezensis* strain FZB42. Our results highlight the potential of Moroccan soils for developing native BCAs with the potential of controlling bayoud disease and to our knowledge, the species *Bacillus haynessi* has never been reported as a BCAs.

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Anticyanobacterial and antimicroalgal potential of essential oils from Cedrus atlantica, Pistacia atlantica and Schinus molle

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Harmful algal blooms (HABs) are a severe hazard to human health in drinking water and freshwater ecosystems. Several methods including chemical, physical, mechanical, and biological strategies have been applied in HABs control. Nevertheless, the use of those strategies is generally not efficient because of their unforeseen ecological consequences, high costs, energy-intensive, and low efficiency. Recently, the application of natural substances such as volatile compounds is a promising eco-friendly alternative solution for harmful algae control in aquatic ecosystems. Through this work, we evaluated the potential algicidal activities of the essential oils from *Cedrus atlantica*, *Pistacia atlantica* and *Schinus molle* against a toxin-producing strain of *Microcystis aeruginosa* and an environmental strain of Chlorella sp. The essential oils composition was assessed by GC-MS. The anti-microalgal potential was evaluated qualitatively using the disc diffusion method, and quantitatively using the broth microdilution assay. The minimum cyanobactericidal and algicidal effects were also evaluated. The highest potential in solid media was showcased by *Cedrus atlantica* essential oils, whereas it was demonstrated by Pistacia atlantica in liquid media.

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A Comparison of Different Rear Irradiation Modeling Methods in a Bifacial PV System

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The Green Morocco Plan (PMV) has invested in making agriculture the engine of economic and social development, transforming the agricultural sector into a modern, competitive and inclusive sector [1]. However, strongly depends on a very erratic rainfall. In addition, Morocco is among the countries most highly vulnerable to the impacts of climate change, as it is going through an exceptional period marked by drought.
Agri Voltaic (APV) system combines solar photovoltaic modules (PV) with a crop field in the same land area. The APV can create a microclimate that is favorable for crops growth, and this may improve the crop yield, reduce water consumption and produce energy.
APV can be considered as one the strategic tools to confront the impacts of climate change and water stress on the agriculture sector, contribute to sustainable agriculture and the transition to renewable energies.

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Deciphering plant responses to various phosphorus sources in alkaline-calcareous soils

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Phosphorus (P) is an essential macro-nutrient that often limits plant productivity in alkaline-calcareous soils, because sorption and precipitation reactions are strongly favored in these typical soils. Hence, the importance of understanding the root-soil interface, known as rhizosphere, especially the processes and mechanisms involved in plant P utilization. A greenhouse experiment was conducted to investigate four P sources (Rock phosphate (RP), Orthophosphate (OrthoP), Polyphosphate (PolyP), and Triple superphosphate (TSP) compared to the control (zero P application) on: root morphological traits, plant growth parameters, shoots and roots P uptake, and root exudates, using white lupin (Lupinus albus) as indicator crop. Rhizosphere and bulk soils were collected and analyzed for pH, bioavailable P, and enzyme activities (acid and alkaline phosphatases). Our results showed a significant difference between the effects of different P sources on dry weights of shoots and roots, and root-to-shoot ratio. Acid phosphatase activity increased significantly in the rhizosphere soil compared to the bulk soil regardless of the P source with the highest activity ($p < 0.05$) observed under RP. However, no significant effect was found in the activity of alkaline phosphatase between the rhizosphere and bulk soils, except for RP and PolyP. Moreover, rhizosphere soil pH decreased significantly compared to the bulk soil pH, especially in the RP-treated and the control soils. We conclude that rhizosphere processes involved in plant P mobilization and acquisition are P source dependent.
Keywords: phosphorus source, root exudates, white lupin, alkaline soil, calcareous soil, phosphatase

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Non-Destructive Rapid Detection and Differentiation of Aflatoxigenic Aspergillus species using Fourier-Transform Infrared Spectroscopy in Kenyan Hybrid Maize Cultivars

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Rapid testing and identification of foodborne pathogens is paramount in the field of microbiology where the concept of food safety directly correlates to overall well-being of the human populace. Household fungi in particular pose serious health concerns due to their ability to produce spores, whose microscopic nature allows them to be easily dispersed in immediate and far-off environments. The detection, screening and identification of these fungal specimens often adopts conventional approaches that are not only expensive, but also time consuming, labor-intensive and hardly yield specific results. Fourier-Transform Infrared Spectroscopy (FTIR) offers a novel approach of rapid fungal screening and identification that is both cost-effective and time-saving; proving to be highly valuable to food processors, importers and traders altogether. The rapid assessment nature of FTIR spectroscopy has been shown to be highly valuable to the food industry, coupled with the fact that samples are analyzed in a non-destructive manner that requires little or no prior preparation. The current study aimed at determining whether aflatoxins were present in milled maize samples sourced from the Rift-valley region of Kenya; and how recovered strains differed from already known aflatoxigenic strains. Samples (whole grain maize kernels) were collected from two administrative counties that are known for high maize production; Uasin Gishu and Elgeyo Marakwet. FTIR spectral analysis was performed using a PerkinElmer Spectrum Two Spectrometer on all 156 samples. Absorbance spectra were obtained within the range of 4000-500 cm-1, with a further resolution of 4 cm-1. Single beam spectra of all the samples were obtained after running a background calibration measurement spectrum of air, which was subtracted at the end of each exercise. Spectra data preprocessing was done through baseline correction and Attenuated Total Reflectance (ATR), after which visualization of the differences in absorbance between different corn samples was done by plotting the peaks using Origin Pro software. The results showed significant variation in terms of Aspergillus species identity, with strains collected from sampled regions differing from already known aflatoxin producers. Despite aflatoxin levels not being alarmingly high, the discovery of new strains could indicate novelty in terms of strain identity; an aspect that should be investigated further by undertaking longitudinal studies in similar or neighboring Rift Regions of Kenya.

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Phosphorus efficiency levels of different moroccan chickpea genotypes under greenhouse conditions

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Phosphorus (P) is the second most important macro-nutrient required by the plants, next to Nitrogen and is considered among the main abiotic factors limiting chickpea productivity in Morocco. This study assessed P-efficiency levels of different Moroccan chickpea genotypes and interactive effects between P fertilizer and doses under greenhouse conditions at UM6P-Benguerir experimental farm. Five genotyps ("Bochra", "Arifi", "Farihane", "Taounate", FLIP 97) were screened under two P fertilizer formulas based on Triple Superphosphate (TSP) and phosphate rock (PR) with three P doses (i.e., 14.3, 28.6 and 42.9 mg P kg-1 soil) simulating a deficit and an excess of P intake compared

to an unfertilized treatment. The agrophysiological parameters monitored during the cycle are : growth, chlorophyll content index, chlorophyll fluorescence, P (total, inorganic, acid phosphatase) and precocity. At harvest, root parameters, aerial biomass and yield were evaluated. The first results showed changes in chickpea physiological parameters in reaction in different form and doses P for every genotyps. The best results on yield are obtained with genotypes Taounate and FLIP97. The highest P on shoot during Flowering was accumulated by genotype Taounate with TSP fertilizer 14.3 mg P kg-1 soil. P shortened fruit set duration on Flip97 (RP 14.3 and 28.6 mg P kg-1 soil) and Bochra (TSP 42.9 and RP 28.6 mg P kg-1 soil). On the other hand, no significant difference was noted for the Arifi, Farihane and Taounate genotypes. The best pod yields were obtained with the Taounate, Bochra and FLIP97 genotypes. The RP fertilizer significantly increased the yield compared to the unfertilized control without significant difference between the 3 doses for the Bochra but for the FLIP97 genotype dose 42.9 mg gave the best result.

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GREEN ADSORBENT SYNTHESIS FOR SUSTAINABLE REMOVAL OF PHENOL FROM OLIVE OIL MILL WASTEWATER

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Olive oil mill wastewater (OMWW) poses a significant environmental challenge due to its high organic loads and phenolic compounds (PCs) content. This study introduces two novel nanoparticle synthesis approaches and their environmental remediation applications. Copper oxide (CuO) nanoparticles were synthesized using microalgal cell lysate supernatant. In contrast, Verbena officinalis was utilized as a green reducing agent to synthesize reduced graphene oxide (RGO). Subsequently, RGO and CuO nanoparticles were cross-linked with sodium alginate (SA) to form SA-RGO and CuO-SA beads, respectively. The characteristics of SA-RGO and CuO-SA beads were assessed through scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), Fourier-transform infrared spectroscopy (FTIR), and X-ray diffractometer (XRD). Batch and fixed-bed column adsorption experiments for phenol were conducted to evaluate the sorption capacity of SA-RGO and CuO-SA beads. The results indicated a phenol adsorption capacity of 994 mg g-1 and 314 mg g-1 for SA-RGO and CuO-SA beads, respectively; this adsorption capacity was attained for initial concentration phenol of 4000 mg L-1.

Keywords: Green synthesis; Adsorption; Phenol; Olive oil mill wastewater

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Green Hydrogel Technology for Smart Irrigation

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The agricultural sector stands as one of the most rapidly expanding industries, driven by the escalating global demand for food and textiles to meet the needs of a growing world population. However, the use of water resources has become increasingly critical, especially in arid regions, as water scarcity contributes to soil degradation, desertification, and salinization due to the dryness of soils especially in arid and desert regions, in addition to the fact that plants and soils have low water retention capacity which results in the use of vast amounts of water during irrigation. All this reduces soil water availability and productivity, crop growth, and water wastage.
The objective of this study is to prepare hydrogels based on both commercial and bio-sourced polysaccharides extracted by valorizing waste materials such as those from the olive industry. These biobased hydrogels display significant advantages, including non-toxicity, ready availability, low production cost, biocompatibility, and biodegradability, with a huge water retention and absorption capacity without dissolution. In addition, it could be useful for wastewater treatment via an adsorption process or as a nutrient reservoir for slow-release fertilizer systems in agricultural uses. Nuclear magnetic resonance (NMR) Fourier Transform infrared spectroscopy (FTIR) confirms these materials' synthesis before studying their morphological, thermal, mechanical, and swelling properties.

KEYWORDS
Agriculture; Biobased; Polysaccharide; Hydrogel; Irrigation; Retention.

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3D Flower-like Bi2WO6 Microspheres Embedded in Chitosan Hydrogels: A Powerful and Highly Versatile Photocatalysts for Water Treatment

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Nowadays, providing access to clean and safe drinking water supply especially in the developing parts of the world must be one of the most important necessities of our modern society. Indeed, the widespread use of organic dyes, pesticides, antibiotics, phenols and other organic compounds in our daily life including industrial, scientific, medical, domestic and agricultural applications has accelerated their distribution into indoor and outdoor environments. In recent years, photocatalysis has shown great promise to manage water pollution using sunlight as a cheap, green and renewable energy source compared to traditional approaches [1][2]. Semiconductors based photocatalysts, particularly titanium dioxide (TiO2) is regarded as one of the most commonly used semiconducting materials for water-pollutant decomposition [3]. However, pure TiO2 suffers from some limitations, such as poor visible light absorption ability and fast charge recombination rate [4]. In this study, we report the preparation and photocatalytic application of a new 3D flower-like Bi2WO6 microspheres supported on chitosan hydrogel beads. The surface morphology, elemental composition, crystal structure and light absorption properties of the obtained photocatalysts were comprehensively examined by scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), Fourier Transform Infrared spectroscopy (FTIR), X-ray diffraction (XRD) and Uv-vis diffuse reflectance spectroscopy

(DRS). The performance of the prepared materials have been evaluated in the photodegradation of Rhodamine B and ciprofloxacin, as well as 4-nitrophenol reduction. The photostability of the prepared materials has been evaluated by recycling experiments. Thus, a good reusability of the photocatalyst has been observed in many successive catalytic runs.

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Incorporation of pumpkin peel extract into a pumpkin pulp formulation as a natural preservative

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Extract rich in preservative compounds was obtained from pumpkin peels by heat-assisted extraction, with water as solvent. This extract was incorporated into a ready-to-use pumpkin pulp product, in a concentration of 5g/kg, in order to replace the use of potassium sorbate (control). The product shelf-life was evaluated regarding microbial load and colour stability considering the best before date of the commercial product (30 days). For that purpose, the samples were stored at room temperature and evaluated on the day of production and after 7, 14, 21, 30, and 45 days of storage. Microbial load, it was evaluated in terms of aerobic plate count (total viable count; ISO 4833-2:2013), coliforms (and E. coli; ISO 4832:2006), and yeasts and moulds (ISO 21527-1/2:2008). For the physicochemical parameters, the colour was assessed by chromatic analysis in the CIELAB colour space, measuring L*(lightness), a* (redness), and b*(yellowness) to obtain the palette of tones and the chroma values of the pulp formulations. In both pulp products, with the addition of extract and control, no microbial growth was evidenced up to the 45th days of storage. This result demonstrates the great efficiency of using the natural extract to replace potassium sorbate, a traditional but artificial preservative widely used in the food industry. Meanwhile, despite the satisfactory result obtained in terms of antimicrobial protection, the colour was clearly affected. Through both the RGB and L*, a*, *and b* parameters it was possible to verify the loss of colour of the pulp formulation containing the natural extract during the storage days, while in the control formulation it was less noticeable. Considering the preservative potential of the extract, new formulations will be tested with different concentrations, aiming a healthier pulp product and promoting a circular economy.

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Arbuscular Mycorrhizal Fungi Improves Yield and Quality Attributes of Melon Fruit Grown Under Greenhouse

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Melon (Cucumis melo) is the most widely consumed fruit, with undeniable socioeconomic and nutritional importance, as proven by its large acreage (1 Mha) and output (28 Mt). However, melon farming has three challenges: producing enough to meet rising consumer demand, increasing the concentration of human wellness compounds, and reducing chemical inputs. The purpose of this study was to determine the potential effectiveness of two arbuscular mycorrhizal fungi (AMF), Rhizophagus irregularis (Ri), Funneliformis mosseae (Fmo) and their complex, in boosting yield and quality characteristics in the melon variety 'Ananas' cultivated in a greenhouse. Obtained results showed that inoculated plants exhibited higher production and fruit quality than the control. Indeed, Ri-plant exhibited the highest increases in yield (54%), fresh weight (65%), longitudinal (20%) and equatorial (33%) perimeters, Brix degree (20.6%), polyphenols (315.4%), carotenoids (353%), proteins (209.1%), flavonoids (114.38%), ascorbic acid (31.3%), reducing power (77.04%) and DPPH radical inhibition (16.43%), and the highest decrease in titrable acidity (62.5%). In addition, Ri-plant fruits were highly rated by participants in the sensory evaluation test. Therefore, R.irregularis application could be recommended for the sustainable production of high-quality fruits of melon.

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Olive by-products extract: Assessing the Polyphenols Content, Antioxidant, and Antiglycation Activities of olive cakes and olive waste water

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Olive wastewater and olive cake extracts are usually assocoiated with great bioactive compounds. In this work, we compared in vitro antioxidant activity, antiglycation activity and the phenolic content of olive mill wastewater extracts (OWWE) and the olive cake extracts (OCE) using two extraction solvent; ethanol 70% and ethyl acetate 100%. OWW ethyl acetate extract contained higher total phenol content compared to OC ethyl acetate extract (123.99 ± 4.12 mg/g versus 12.55± 2.17 mg/g) using the Folin Ciocalteux method,. The antioxidant activity was measured using DPPH and FRAP assays. Using the DPPH assay, the results show that olive cake ethanol 70% extract was more active than olive the ethyl acetate extract (EC50 = 11,87 ± 7,53 µg/mL; EC50 = 197,42 ± 7,52 µg/mL, resp.). in addition to that, the olive mill wastewater ethanol 70% extract also produced a great FRAP activity compared to the ethyl acetate extract and olive cake extract, with an IC50 of 312,5 ± 64,9 µg/mL. Moreover, olive wastewater ethyl acetate extract presented a great antiglycation activity, making it the most performed and active extract among others with an IC50 valued with 8,22 ± 2,51 µg/mL. The performed and active extract were then chemically characterized using HPLC-PDA to identify phenolic compounds.

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Mediterranean Knowledge of Acorn Based Food, Distribution and Diversity of Quercus Tree in Morocco

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All over the worldly historic period of humanity Oak tree forest has played a major role in food security providing a wide range of diversified food sources and constituting an essential element of climate resilience. Mediterranean Acorn-based food literature was found to be out of date and incomplete. Our curiosity prompted us to study related literature papers on the subject, the main aim of which was to highlight historical acorn recipes in the Mediterranean and indicate the main locations of Quercus trees in Morocco, in addition, ethnographic data collected from 34 people in 4 rural northern regions and 3 weekly souks.
This study records various categories of traditional acorn-based food in the Mediterranean from the documentation of ancient historical sources which demonstrated its culinary utilization in flour, breed, couscous, cookies, cake, pastries, soup, coffee, tea, and oil or consumed boiled, fresh or roasted with ash. In Morocco, two groups of Quercus Trees were distinguished Sclerophyll (*Q. suber*, *Q. ilex* = *Q. rotundifolia* and *Q. coccifera*) and deciduous (*Q. faginea*, *Q. pyrenaica* = *Q. toza* and *Q. lusitanica* = *Q. fruticosa* Brot.,*Q. humilis* Lam). Through the main results of fieldwork and literature review analysis, we are mapping the geographic Moroccan Quercus Tree distribution. In the Northern region even if the reclamation of historic Acorn food preparation has only been given by five interviewers. Greater detail as to its utilization as based food is found in the memory of the elderly population, and exact information also appears in rural regions where the Quercus trees are largely distributed.

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Exploiting the Potential of Nanochloropsis gaditana and Isochrysis galbana as Biostimulants for Wheat: Advancing Growth and Enhancing Nutritional Quality

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Adoption of microalgae-based plant biostimulant as an alternative to the harmful products commonly employed in the agricultural sector, would be a likely; solution for boosting wheat sector sustainability. The current research examines the effects of two marine microalgae species on wheat growth, nutrient uptake, grain yield, and nutritional quality (Triticum durum). Each microalgae extract was tested at four different concentrations: 0.1%, 0.5%, 1%, and 2%. As compared to the control, microalgal extract increased wheat height, shoot dry weight, and root length (14.89 ± 1.38 % and 19.64 ± 3.29 %, respectively for % I. galbana and % N. gaditana) and root dry weight in field experiments (untreated wheat plants). In laboratory analysis, the pigment concentration of chlorophyll b (78.5 ± 2.24 % and 48.75 ± 9.66 % for 0.1% I. galbana and 0.1% N. gaditana, respectively) and carotenoids increased significantly. Nutrient uptake has enhanced as compared to the control, particularly shoot nitrogen content (81.42 ± 26.85 % and 176.44 ±10.42 %, respectively, for % I. galbana and % N. gaditana) and potassium. Lipidomic analysis revealed an improvement of FAMEs, alkanes, and alkenes. In terms of grain yield, the findings revealed a significant improvement in grain number (40.10 % for 2% I. galbana), weight, and number of ears. According t*emphasized text*o biochemical studies, total sugar, fat, and polyphenol content in wheat grains enhanced (30.56 ± 6.84 % for 2% I. galbana) compared to the control. The analysis of wheat grain and flour quality demonstrated an elevation in manganese and calcium content, as well as flour yield and color. Seed lipidome profiling showed an increase in FAMEs, sterols, and alkanes. A biostimulant based on microalgae, which was tested in this study, can be recommended for efficient agricultural output.

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An Experimental Study on Forward Osmosis Desalination of Groundwater under Framework of Water-Energy-Food Nexus

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Desalination of brackish groundwater using Forward Osmosis technology is an emerging field of research. One of its application, Fertilizer Drawn Forward Osmosis (FDFO), represents a potential alternative water supply for irrigation. Adapting this technique, under the framework of the Water-Energy-Food "WEF"nexus perspective, is promising to overcome water scarcity challenges while preventing any trade-off between sustainability aspects. FDFO desalination can make irrigation water available at comparatively lower energy than the current desalination technologies. Being a low energy technology, FDFO can be operated using renewable energy, which makes it suitable for inland and remote applications and represent a great example of interlinkage between SDGs such as SDGs 2, 6 and 7.

This research investigates the application of FDFO technique and its potential use in Egypt under the Framework of the Water-Energy-Food Nexus. In this work, feed solution used is brackish groundwater extracted from a well in Sinai, Egypt. Two sets of experiments have been conducted. The objective of having two separate scenarios is to provide informative assessment useful for the two main agriculture techniques, the conventional soil-based and hydroponics. The first set examined three commonly used fertilizers in Egypt: Urea, Di-Ammonium Phosphate and Potassium Nitrate to compare between their performances. The second set examined standard hydroponic recipe, which is a mixture of nutrients, as a draw solution to fertilize crops in hydroponics systems.

The nutrients mixture performance was tested and compared to that of the individual components at the same concentrations. Regarding the first set, Di- Ammonium Phosphate resulted in the best performance as draw solute among the three tested draw solutes, where it exhibited a significant water flux equivalent to 13.8 LMH, a feed ions rejection reaching 98% and acceptable concentrations of draw solute ions in the final product water. For the Second set, The Hydroponics nutrients mixture exhibited better performance as draw solution compared to its individual macro-components. The use of the nutrient mixture as draw solute resulted in a flux of 11.7 LMH, 95% feed ions rejection compared to 9.2 LMH, 91%, and 10.03 LMH, 93% for its individual components. Mixing nutrients boosted the osmotic pressure and enhanced the driving force for fresh water permeation.

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Study of the performance of a prototype activated sludge treating secondary processing wastewater

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The objective of the current study is to evaluate the performance of a prototype activated sludge process treating secondary wastewater and the progression of biomass growth.The activated sludge pilot utilized in this experiment replicates the fundamental principles of biological treatment through the activated sludge process. Samples were collected daily from the influent, effluent of the reactor. The parameters monitored, following standardized methods, included biomass growth, organic load COD, as well as nutrient levels (nitrogen and phosphorus). The results indicated successful biomass growth, reaching 1.4 g TSS/L and 1gVSS/L. The activated sludge pilot consistently exceeded anticipated performance levels, with average removal efficiencies of 92.11% for Nitrites, 81.66% for Total

Nitrogen, 80.10% for Ammonium, 79.6% for Total Phosphorus and 57.3% for COD. Moreover, the final effluent measurements were consistently below or very close to the Moroccan discharge standards. Overall, the outcomes of this experimental study suggest that the prototype activated sludge pilot performed satisfactorily and complied with the Moroccan discharge standards.

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Diversity and relative abundance of solitary bees in Moroccan agroecosystem: the case of the almond tree

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Agroecosystems, despite their tendency to be impoverished, can host various insect communities essential for ecosystem services. Crops, in particular, benefit from pollinating insects, which enhance both quantity and quality of yields. However, there is still a need to fully comprehend the identification of diversity, abundance and ecology of pollinating insects, especially wild bees. In Morocco, there are over 1,000 different species of solitary bee, of which more than 81 are endemic. The almond tree is among the crops that rely on pollination, is a highly valuable crop, ranking as the second most important crop after the olive tree in terms of economic significance. Therefore, understanding the basic pollination requirements of the main almond varieties is essential for promoting production. For this purpose, we conducted an evaluation of pollinator diversity and abundance, with a particular focus on solitary bees, within an almond orchard located in the Marrakech region. The results obtained unveiled a highly diverse population of solitary bees, with varying levels of abundance corresponding to different stages of flowering. Additionally, the pan traps revealed variations in abundance across different insect groups, with a notably high abundance of dipterans, followed by coleopterans, and then solitary bees. The findings from this study underscore the significant role that solitary bees will play as pollinators for almond crops to achieve optimal pollination.

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Development of biothermosetting resins HNT/polycaprolactone via thiol-ene radical photocrosslinking for anticorrosive applications: Preliminary study

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The overall objective of this work is the elaboration of polymer-clay thermoset bionanocomposites (HNT/PCL). The aim is to create a covalent bond between the two components by a thiol-ene radical photocrosslinking addition. The external surfaces of the halloysite clay were modified with a

silylating agent, 3-(trimethoxysilyl)-1-propanethiol (TESP). On the other hand, functionalization of the chain ends of commercial diol-terminated PCL with acrylates (PCL-DA) was also successfully performed. Different bionanocomposites were developed by varying the percentage of clay filler. The modified HNT clay, PCL-DA as well as the obtained resins were analyzed by FTIR, 1H NMR and SEM spectroscopy. The morphological structures of the modified and unmodified HNT as well as the thermosetting bioresins were characterized by SEM, and the hydrophobic/hydrophilic surface properties were analyzed by contact angle measurement. Thermal properties of the nanocomposite films were performed by TGA and DSC, the results showed that the nanocomposites developed with 3% HNT showed a slight increase in thermal stability compared to PCL. Preliminary tests on PCL/HNTs 3% resin films as a protective coating against corrosion of an iron plate placed in acidic medium were carried out by following the appearance of the film as a function of time in comparison with an uncoated iron plate, and the first results obtained are promising and open investigation perspectives.

Posters session / 6

Synthesis, Characterization and Antibacterial activity of silver nanoparticles using Aqueous extract of Pulicaria odora roots

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The nanoparticle name itself implies a 'Nano'particle with size ranges from 1 nm to 100 nm [1], they can be classified into different classes based on their properties, shapes, or sizes. There are numerous ways available to synthesize metal nanoparticles, such as chemical, electrochemical, and radiation methods. However, chemical processes often produce toxic chemicals that may result in undesirables'secondary effects in medical applications. Green chemistry is a better solution as it can decrease or remove the use of hazardous substances. The current trend is to synthesize nanomaterials using aqueous extracts of medicinal plants due to their eco-friendly nature and cost-effectiveness [2].

In the present study, we synthesized silver (Ag) nanoparticles using an aqueous extract of *Pulicaria odora* roots and then estimated their antibacterial activity against five bacteria at different concentrations. Two parameters were considered for nanoparticle synthesis: AgNO3 concentrations (1, 5, and 10 mM) and aqueous extract concentrations of *P. odora* (25, 50, 100, and 200 ppm). According to SEAD results and analysis of TEM, the obtained nanoparticles have spherical shapes and sizes between 10 to 75 nm.

Results showed that the nanoparticles 10mM exhibited significant antibacterial activity. In fact, a potent antibacterial activity was observed against *Escherichia coli* BLSE, *Klebsiella pneumonia*, and *Acinetobacter baumannii*. The activity of nanoparticles was similar to or higher than those of the standard antibiotics. These results suggest that silver nanoparticles synthesis using *P. odora* aqueous extract can be used as an effective growth inhibitor of various microorganisms, making them applicable to diverse medical devices and antimicrobial control systems.

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Phytochemical profile and in vitro Allelopathic potential of alkaloid fraction from aerial parts of Senecio anteuphorbium, a Moroccan endemic plant.

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The present study aimed to investigate, for the first time, the allelopathic potential of pyrrolizidine alkaloids fraction obtained from aerial parts of *Senecio anteuphorbium,* an endemic plant growing in western Morocco and widely used in local folk medicine. *S. anteuphorbium* (syn. *Kleinia anteuphorbium* (L.) DC.), is a Moroccan medicinal plant locally known as "Achbardou," commonly employed in traditional medicine, especially in the Sousse region. Despite its extensive traditional usage, *Senecio anteuphorbium* remains relatively unexplored in terms of its chemical constituents and biological activities. Beyond the realms of chemical analysis, the focus of our study was directed towards investigating the allelopathic potential of the alkaloid fraction derived from this plant against the germination and growth of *Lactuca sativa.* The characterization of the metabolites was performed by Liquid chromatography (HPLC) coupled with a mass-mass detector (MS-MS). The results of HPLC-MS/MS analysis of the alkaloid fraction showed the presence of 20 Pyrrolizidine alkaloids notably: senecionine, sarracine, senkirkine and platyphylline. The allelopathic effect was evaluated by studying the inhibition of the germination and growth of *Lactuca sativa* seeds. A potent allelopathic effect was recorded by the alkaloid fraction at a dose of 100 µg/mL, with almost a total inhibition of germination. All the findings suggest an interesting application of the plant as an alternative bioherbicide.

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Modeling the Impact of Height and Diameter in Slow Sand Filtration for the Conservation of Contaminated Water Resources for Irrigation Reuse: A Novel Instrument for Sustainable Development.

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This study explores the potential of slow sand filtration as an economical alternative process to conventional water decontamination techniques for the removal of heavy metals from polluted waters. Specifically, we focus on the Tensift River, which is contaminated by metallic trace elements, notably Cd, Cu, Pb, and Zn, due to direct wastewater discharge from the Zn and Pb extraction industrial unit

at Draa Lasfar mine near Marrakech, Morocco. Our research centers on the implementation of this cost-effective approach to decontaminate wastewater for potential reuse in irrigation and to study the effect of height and diameter of filter bed on slow sand filtration efficiency to decontaminate wastewater. To develop an accurate mathematical model of the filtration process, it is crucial to understand:

- The behavior of contaminated water within the filtration system.
- The determination of various variables required for model development in the dynamic filtration system.

Our objective was successfully realized and validated through experimental results. These results not only facilitated the development of a comprehensive mathematical model but also offered insights about the slow sand filtration process.
Results unequivocally demonstrate that slow sand filtration (SSF) is able to achieve complete removal, up to 100%, of metallic pollutants from contaminated water. Furthermore, the efficiency of this decontamination process is closely linked to the height and diameter of the sand bed within the filtration system. In particular, taller filters demonstrate a greater ability to remove pollutants when compared to shorter ones, thanks to an increased adsorption area featuring additional active binding sites on the sand surface in larger diameter columns and taller bed configurations, and enhances the adsorption process for metallic pollutants.

The dynamic behavior of the adsorption mechanism employed in the SSF process is accurately described by applying Langmuir kinetics of adsorption-desorption, with no discernible axial dispersion. This kinetic model serves as a valuable tool for predicting and understanding the intricate dynamics of the adsorption process within the SSF system.

In summary, our research highlights the potential of slow sand filtration as a cost-effective and efficient method for removing heavy metals from polluted waters, with implications for improved water decontamination practices.
KEYWORDS: Sustainable development,slow sand filtration, heavy metals, decontamination, removal efficiency and modeling.

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PREDICTION OF FLOOD RISK IN AN URBAN ENVIRONMENT: CONTRIBUTION OF MACHINE LEARNING MODELS

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Due to intense precipitation, rapid snowmelt and rising sea and lake waters, river levels and groundwater, urban areas can be flooded. These flood risks are associated with several factors of a topographical, geological, hydrological, climatic and anthropic nature. These factors must be taken into account when managing floods and especially when delimiting vulnerable areas. This research aims to assess and compare Frequency Ratio, Weighting Factor, and Weight of Evidence Models for landslide susceptibility mapping using Geographic Information Systems and Remote Sensing data in Beni Mellal City, Morocco. A set of 5000 landslides were identified and mapped by evaluating observations from satellite images (Google Earth images) and fieldwork from 2018 to 2022. The landslide inventory data was arbitrarily divided into two groups for training (70%) and validation (30%). Thirteen landslide conditioning factors were selected for landslide susceptibility modeling, based on multicollinearity analyses and the information gain method. Validation of the results is based on statistical rules for the Spatial Effective Method, Statistical Measures, and Receiver Operating Characteristics Curve (ROC).

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Valorization of waste from Periplaneta Americana L. as a new chitinous source applicated in the treatment of a real effluent

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The objective of this study is to promote one of the cockroach species, *Periplaneta americana* L., native to the Zagora region, through the production of chitin and chitosan. We obtained chitins from different morphological sites of the species: wings (A), legs (P), exoskeleton (E), and whole body (CE). The characterization methods demonstrate the obtaining of chitins with Degree of acetylation and Icr which vary depending on the extraction site. Then, via the Broussignac process, we were able to obtain chitosans with DA, Mv, and Icr depending on the chitinous source. Subsequently, we specially studied the interaction of chitosan originating from chitin from the whole body, its DA is 15.3% and Mv (75KDa), with Copper and Lead, two polluting metals which have a harmful impact on health. The analysis methods (Zeta, EDX,) of these interactions have shown that chitosan has a better affinity for copper 5 mg than for lead 3.4 mg. The results of this study were used in the metal decontamination of real effluent.
This work could constitute an alternative solution to effluent pollution caused by heavy metals.

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Patterns and Fluctuations in Rainfall in West-Central Morocco and their Associations with Broad-Scale Atmospheric Teleconnections

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This study aims to analyze rainfall patterns in the west-central region of Morocco, characterized by a semi-arid climate with fluctuating rainfall and frequent droughts. The research employs the Mann-Kendall test and continuous wavelet transform (CWT) on monthly and annual rainfall data from six rain gauges. Furthermore, the investigation explores the connection between monthly precipitation and two climate oscillations, namely the North Atlantic Oscillation (NAO) and the Western Mediterranean Oscillation (WeMO). The results indicate insignificant decreasing trends in annual precipitation. However, the monthly precipitation patterns exhibit similarities to the annual scale both spatially and temporally. The CWT analysis identifies a notable and consistent 8-year cycle in rainfall, highlighting a robust association between the NAO and WeMO phases and rainfall patterns over time. These findings underscore the substantial correlations between NAO/WeMO and precipitation, with correlation values reaching as high as -0.61. Overall, this research marks an initial step in understanding the impact of climate indices on rainfall patterns in the North African region.

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Agro-physiological and biochemical assessment of half-sib families of alfalfa for tolerance to water stress.

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154 Half-sibs families from the offspring of a cross between three alfalfa cultivars (Mumuntanas, Sardi and Erfoud) were evaluated for their tolerance to water stress in summer field conditions the Haouz region. The test was first subjected to a moderate water deficit during the months of April and May, followed by a severe water deficit in early July until mid-September including irrigation was stopped throughout this period.
The evaluation of the trial focused on agronomic, physiological, and biochemical parameters related to the tolerance to water stress. The results showed that there exist significant differences between the half-sib families of alfalfa tested in the majority of agronomic parameters, physiological, and biochemical studies. Also, we found that the yield of green material has been positively correlated with the contents of the sheets of proline, soluble sugars, and chlorophyll. Therefore, these parameters are indicators for the selection of half-brother families having a good forage potential as a parent for the constitution of a synthetic variety. It could value dry lands that suffer from the scarcity of irrigation water.
Keywords: Alfalfa, water deficit, mortality rate, agronomic parameters, physiological parameters, biochemical parameters.

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Exploration of Moroccan soil microalgae and cyanobacteria diversity and screening of their biostimulant effects on wheat seeds germination performance

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Soil ecosystems enclose an important diversity of microorganisms assuring different ecological key roles. Cyanobacteria and eukaryotic microalgae can enhance soil organic matter, and support its stability, water retention, fertility, and nutrient availability. Microalgae can be exploited in many sectors, especially in agriculture, as a new emerging category of plant biostimulants and an environmentally friendly tool for sustainable agriculture. This study aimed to investigate the diversity of soil microalgae and cyanobacteria in the Marrakesh-Safi area and to screen their aqueous extracts' biostimulant effects on wheat seed germination. The soil cultivation approach showed twenty-nine

taxa in collected soils including sixteen cyanobacteria, eleven chlorophyta, and two diatoms. Redundancy analysis of soil physicochemical parameters and specific richness of the three algal groups revealed a positive correlation between the richness of cyanobacteria and nitrogen, ammonium, and humidity, whereas diatoms richness was more related to a high concentration of silica, whilst *chlorophyta* richness was associated with chlorine and pH. Six strains were chosen for the biostimulant bioassay based on their growth rate and biomass productivity, of which three cyanobacteria Nostoc sp.1, Nostoc sp.2, and *Phormidium* sp. and three chlorophyta: *Stichococcus bacillaris*, *Coellastrella* sp., and *Chlorococcum* sp. The results showed that all strains displayed a positive effect on wheat seeds by increasing the germination index, coleoptile length, and root length compared to the control (two-way Manova, $p<0.05$). Nevertheless, significant differences in terms of strain extract performance were observed. Aqueous extracts of Nostoc sp.1, *Stichococcus bacillaris*, and *Coellastrella* sp. were the most performant, as they increased germination index by 25.14%, 20%, and 19% respectively. Whereas the increases in coleoptile and radicle length were between 54.65% and 38.83% in comparison with the control. Our findings highlighted the potential of soil microalgae isolates for the production of liquid extracts with biostimulant activity and potential uses in agriculture.

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Formulation and characterization of O/W emulsions stabilized using eco-friendly aqueous extract from olive pomace

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Olive pomace (OP) valorization using aqueous extraction of bioactive compounds provide a potential tool to develop a sustainable process with minimum impact on health and the environment. The effect of different preparation and stress conditions on the emulsifying performance of crude aqueous extracts from untreated OP was investigated. OP aqueous extract contained important concentrations of surface-active compounds including proteins, saponins and polyphenols (1.65 ± 0.11 %, 6.43 ± 0.20 % and 3.23 ± 0.11 % (w/w), respectively) and reduced the interfacial tension by 43 % at the oil–water interface. The emulsions prepared using OP aqueous extract were stable for 30 days at 5 ℃. Optimal interfacial tension reduction (10.9 ± 0.4 mN m-1) along with minimal droplet size (590 nm) were obtained when using aqueous phases containing 1 % (w/w) OP extract and a homogenization pressure of 150 MPa. The emulsions were stable at pH values ranging from 3 to 6 and had a small particle size despite the reduced surface charge of the droplets indicating the possible involvement of a second stabilization mechanism such as steric repulsion. They were sensitive, however, to NaCl addition, heating and freezing. The present work suggests a novel approach for using water as a safe, green, and ecological alternative to harmful organic solvents to extract surface-active compounds from olive pomace.

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Evaluation of the Residual Extract of Rosmarinus officinalis as Fertilizer on tomato seedlingss

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In Morocco, Rosmarinus officinalis is among the most coveted aromatic plants for its leaves and essential oil. Nevertheless, the process of extraction of the latter generates a large quantity of residual water whose valorization will ensure the sustainable management of the territories of rosemary and the development of the networks associated with this resource. In this context, we evaluated the fertilizing efficiency of this co-product resulting from the hydrodistillation of rosemary on certain agronomic and biochemical parameters of the tomato. In this context, treatment tests with residual water were carried out on the tomato under the greenhouse. Two treatment methods at different concentrations (12.5% 25% 50%) were made. The culture was followed for 60 days and the treatment was applied once a week. After that, the agronomic and biochemical parameters of all treatments were evaluated. The physicochemical characterization of the rosemary residual water showed a richness in mineral elements, namely nitrogen, phosphorus, potassium, calcium, and macromolecules such as sugars, proteins, and polyphenols, as well as salinity and slight acidity. Foliar application of the 50% extract had significant effects on the parameters studied compared to the control, including aerial size (21.32%), aerial fresh biomass (94.75%), aerial dry biomass (69.42%), and chlorophyll (28.24%). Similarly, the plants irrigated with the residual extract at 12.5%, were improved in the aerial size (44.51%), aerial fresh biomass (38.84%), leaf area (29.62%), and chlorophyll content (33.33%). However, irrigation with 50% residual water significantly reduced the above parameters compared to the control. Therefore, applying residual water, either at a concentration of 12.5% for irrigation, or 50% per spraying would be a promising approach for improving the growth and yield of the tomato, using an ecological product for sustainable agriculture and adding value to rosemary.

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Vermicomposting as a tool to valorize organic waste

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Morocco is one of the countries that is currently living with the dilemma of a high consumption rate alongside another problem, which is waste management. This problem has been known a significant rise in Morocco with approximately 18000 t/day, characterized by a high rate of organic waste (approximately 80%). Morocco's multiple trials to treat these problems politically and financially seemed to be cost and time-inefficient leading to environmental, economic, and socially negative impacts. Ergo, thinking of other potential substitutes became the trend throughout the country. The present study highlighted the substantial potential of vermicomposting on different types of materials. The vermicomposting experiment along with the analysis of the initial and final feedstock took place in both INRA Agadir and BioMAgE laboratory at FSSM Marrakech. After one month of vermicomposting, the main chemical parameters indicating the biotransformation of substrates such as pH, EC, OM, TOC, HS, C/N, HN4+/NO3-⋯showed a significant variation.
The final vermicomposts exhibited a pH that was stabilized around neutrality, a C/N ratio that showed a significant decrease in comparison to the initial product with a value between 20 and 30. The degree of humification was evaluated by humic substance content which was in
the range of 0,71 and 3,02 g/Kg. The spectroscopy analysis UV-vis has shown that Q4/Q6 ratio articulated between a value of 8,74 and 12,48, as well as IR spectra evolved in favor of the humification process that occurred during the vermicomposting process, while SEM micrographs showed the fragmentation of the waste samples'surfaces.
The GI increased with a maximum percentage of 99% in CD and a minimum increase of 10% in SS

for the Turnip grains after vermicomposting. Together with a decrease in physicochemical, and spectroscopy analysis, as well as SEM micrographs, confirm that vermicomposting is a suitable bio-process to reduce the organic waste impact on the environment.

Keywords: vermicomposting, organic waste, Morocco, *Eisenia fetida*, humification, maturity, sewage sludge, cow dung, phytotoxicity, SEM, UV-vis, FT-IR

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Efficient valorization and biological treatment methods of olive mill wastewater

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Our studies, carried out on biological processes, offer one of the most viable approaches to the treatment of Olive Mill Wastewater (OMW). Effective utilization of these methods, which leads to significant reductions in COD and Phenolic compounds, will facilitate safe and economical disposal of OMW. Because of the greater part of olive oil production (98%) occurs in the Mediterranean region, using large amounts of water (10-30 million cubic meters) in a region of the world with limited water resources, the treatment and reuse of olive mill wastewater presents significant challenges due to the nature of olive oil production, and the characteristics of the wastewater (high chemical oxygen demand (COD), high phenolic content, etc.). Many studies have tested a range of different microorganisms (archaea, bacteria and fungi) and processes (aerobic or anaerobic bioreactors and composting) to treat OMW. Aerobic bacteria have been primarily tested as a method to remove phytotoxic compounds from OMW, although some studies have also focused on COD reduction. Mushrooms, on the other hand, have been shown to be effective in reducing COD and toxicity. Anaerobic digestion methods can effectively lower COD, but are adversely affected by Phenolic compounds in OMW.

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Cured NaOH-Etched Heated Clay-Cellulose Composites: Characterization, Dye Adsorption, and Desorption Study Using Response Surface Methodology

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Water contamination by dyeing chemicals has become a worldwide problem. Adsorption by using low-cost adsorbents has been considered as an appropriate and economical method for water remediation. So, the process of the dye adsorption by cured alkali-activated heated clay-cellulose (up to 10 mass%) composites was investigated within the 288–318 K range using methylene blue (MB) as a dye-adsorbate model. For this purpose, X-ray diffraction, Fourier-transform infrared spectroscopy, and scanning electron microscope were used. Moreover, the effects of adsorbent dosage, solution

pH, contact time and temperature were assessed. Additionally, the dye release in different experimental conditions was studied by using the response surface methodology. It was shown that the composites were the object of formation of zeolites and geopolymers. The use of low adsorbent dosage (0.5 mg/L) and pH > 7 improved MB adsorption. The adsorption occurred spontaneously (G° < −35 kJ/mol) and endothermically (0 < H° < 12 kJ/mol). The desorption efficiency of the cellulose-rich adsorbent increased with the increase of pH or T, and with the decrease of the ionic strength. It did not exceed 50% in the optimal experimental conditions. The MB retention took place mainly by pores filling, and its rate was controlled by diffusion. MB was adsorbed as monomer, dimer and H-aggregates. Siloxane groups together with hydroxyls were the main active adsorption sites. The adsorption capacity (about 31 mg/g) was higher than those reported for some low-cost adsorbents. The adsorption cost was in the range of 0.19–0.20 US$/g of MB removed.
Keywords: Zeolites ·Geopolymers ·Cellulose ·Dye ·Retention ·Doehlert designs

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Evaluation of future water demand and supply in the Ourika watershed, high atlas, Morocco, considering IPCC climate change and socio-economic scenarios through integrated modeling approaches

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Climate change is poised to exert a notable impact on global and regional water resource systems. Over the last three decades, the High Atlas Mountains in Morocco have faced severe droughts, resulting in a diminished water supply that adversely affects both agricultural activities and urban water systems. This study aims to evaluate the repercussions of climate change and socio-economic factors on water supply and demand within the Ourika watershed (located in the High Atlas of Morocco). Additionally, we assess the effectiveness and sustainability of regional adaptation strategies for water supply management. To achieve this, we utilize the statistical downscaling model (SDSM) and the water assessment and planning tool (WEAP) to simulate and analyze the future water scenario. Following model calibration and validation, projections for precipitation, minimum (Tmin) and maximum (Tmax) temperatures, water demand, and unmet water demand are made for the year 2100, incorporating various climate change scenarios. The findings indicate satisfactory model performance, calibration, and validation. Analysis reveals a projected 49.25% and 34.61% decrease in mean precipitation by 2100 under A2 and B2 emission scenarios, respectively. The mean Tmax and Tmin are anticipated to rise compared to the baseline period, with Tmax increasing by 4.2 ℃ (A2) and 3.6 ℃ (B2), and Tmin by 3.5 ℃ (A2) and 2.9 ℃ (B2) by 2100. Water demand and unmet water demand are expected to rise across all scenarios, intensifying pressure on water resources and exacerbating water scarcity. The study predicts that, influenced by climate change, future unmet water demand could reach 64 million cubic meters (MCM) by 2100. While the proposed adaptation strategies demonstrate effectiveness, they may not be sufficient to guarantee water sustainability for the Ourika watershed.

Keywords: Climate Change; Statistical Downscaling; WEAP; Water Resources; Adaptation Strategies

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Bi5O7I Nanosheets Supported on Chitosan for Organic Dyes photo-degradation and 4-Nitrophenol Reduction

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Water pollution appears to be one of the greatest challenges the humane society is currently facing [1]. Here, we report the preparation of a new hybrid material based on Bi5O7I supported on chitosan and its application in organic dye photo-degradation and 4-Nitrophenol reduction. The composition, structure and morphology of the obtained hybrid materials were investigated using SEM, EDS, Uv-Vis DRS, XRD, FTIR and Raman spectroscopy. Photocatalytic experiments revealed that these materials have an excellent photocatalytic for degradation of methyl orange in aqueous media. Moreover, the materials showed a good performance in 4-nitrrophenol reduction using NaBH4 as reducing agent. More importantly, the photocatalysts could easily be recovered by simple filtration with no significant loss of their activity after many successive runs.

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Impregnation with toxic elements in the city of Marrakech: water, soil and nails.

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In order to evaluate the environmental impregnation of toxic metals in the city of Marrakech (Morocco), the concentration of elements (Al, Pb, Cd and Hg) in the soil, water and children's nails was determined by ICPMS. The mean values of Al, Pb, Cd and Hg found in the children's nails were respectively (28.19±22.63; 4.08±2.69; 0.14±0.25 and 0.09±0.11). All these toxic metals concentrations were found to be lower than the optimal value required and lower than the published values. Moreover, the results indicated that the values (maximum and average) of concentrations of toxic elements (Cd, Hg) in the soils of all the sampling stations are lower than the limit values. While higher values of aluminum and lead were found in the soil. In water, among the four toxic elements, lead was the only one to exceed the limit values. Given the deleterious effects of toxic metals on human health, immediate measures must be taken to monitor and control the levels of contaminants including lead and aluminum in the city of Marrakech.
Key words: Aluminum, Lead, Soil, Water, Nails, Marrakech.

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Green synthesis of silver nanoparticles using Moroccan Berberis vulgaris root aqueous extract and its antibacterial and antioxidant activities.

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Abstract
This study focuses on the characterization and assessment of the antibacterial and antioxidant properties of silver nanoparticles synthesized from the stems of Moroccan Berberis vulgaris. The nanoparticles were generated using a green chemistry approach, employing aqueous extracts from Berberis vulgaris root. The synthesis parameters, including AgNP concentrations (5 and 10 mM) and plant extract concentrations (25, 50, 100, and 200 ppm), were systematically varied. SEM, zeta sizer, UV, and IFTR analysis confirmed the spherical shape and sizes ranging from 10 to 200 nm of the synthesized nanoparticles. Evaluation of antibacterial activity demonstrated that the 10 mM nanoparticles exhibited significant efficacy, particularly against E. coli and Staphylococcus aureus, comparable to or surpassing standard antibiotics. Additionally, the study explored the antioxidant capacity of the silver nanoparticles. The findings suggest that the utilization of Berberis vulgaris stems for synthesizing silver nanoparticles offers a promising pathway for creating effective antimicrobial agents and antioxidants, with potential applications in diverse medical devices and antimicrobial control systems.

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Revealing the Potential of Chitin and Chitosan: Sustainable Extraction and Transformation of Marine Waste for Climate Action

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The recovery of chitinous waste from sea fishing discharged on Moroccan coasts can play a significant role in the fight against climate change. This chitinous waste comes mainly from the shells of crustaceans such as crabs, prawns, cuttlefish bones and lobsters, which are widely used in the fishing industry. They contain chitin, a polymer found in the shells of crustaceans such as prawns and crabs. Chitin can be extracted from fishing waste and transformed into chitosan, a versatile,

environmentally-friendly material with numerous applications. It is important to note that the conventional chemical method of extracting chitin has its drawbacks and poses various environmental problems. Recently, green extraction techniques have seen substantial development in the field of polymer chemistry. In this study, we focus on exploring two extraction methods, microwave-assisted extraction (MAE) and autoclave-assisted extraction (AEA), for upgrading cuttlebone waste to produce chitin and chitosan.
Key words: Chitinous waste, Chitin, Chitosan, Green chemistry, Ecofriendly methods, Climate change.

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Novel active food packaging based on electro-blow spun hybrid nanofibers: fabrication, characterization

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In the modern food packaging industry, the role of nanostructured materials has become increasingly crucial in ensuring food safety, quality, and sustainability. The use of nanostructured materials such as nanofibers in food packaging can potentiate their properties and functionalities. These materials offer remarkable advantages in the packaging field due to their exceptional barrier properties, providing improved resistance to gases, moisture, and external contaminants. Gelatin/Chitosan/polyamide 6 hybrid nanofiber was prepared through the electro-blow spinning technique, a hybrid nanofiber manufacturing technique that combines the benefits of both solution blow spinning and electrospinning. In this technology, the electric field aids in the uniform stretching of the solution, resulting in more uniform fibers of higher quality. The incorporation of *Cedrus atlantica* essential oil improves the antimicrobial activity of the resulting nanofiber, making it suitable for food packaging applications. In addition, the morphological properties, thermal behavior, FTIR analysis, contact angle, air permeability, and mechanical properties of the hybrid nanofibers were determined. This study has yielded promising results for the hybrid nanofibers produced. These nanofibers exhibit favorable thermal properties, and thin morphology with an average diameter of around 410 nm. Notably, the contact angle measurements showed values exceeding 90°, indicating hydrophobic characteristics, a valuable attribute for food packaging applications. The originality of this study lies in producing a hybrid nanofiber, implementing a blow spinning technique, with a higher mechanical and antibacterial efficiency for food packaging application.
Keywords: electro-blow spinning, food packaging, hybrid, nanofibers.

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Intercropping with Faba Bean to Boost Wheat Growth, Yield, and Nutrient Uptake in Water and Phosphorus Deficient Conditions.

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Intercropping offers vital benefits, particularly under abiotic stress conditions. It enhances resource utilization, abiotic stress management, biodiversity conservation, and soil health, making it an innovative cropping system to sustain agriculture. This study assesses the agronomical performance (growth, yield, and nutrient use efficiency) of field-grown faba bean and wheat intercrops compared to sole crops under the combined constraints of drought and phosphorus (P) deficiency. Field experiments were conducted during two successive years in P-deficient farmers'fields in the semi-arid Haouz area of Morocco, using Faba bean (Vicia faba L. cv. Aguadulce) and wheat (Triticum durum L. cv. Karim) as sole or intercrops. Irrigation regimes consisted of 80% Field capacity (FC) for control plots and 40% FC for stressed plots. The positive controls received 80 kg/ha of P2O5, while the combined stress plots received no P. Plant growth was assessed at the flowering stage, and yield and seed quality parameters were determined at the maturity stage. Intercropping significantly improved wheat biomass of shoots and roots, reaching 6.63 g plant-1 and 1.06 g plant-1, respectively, compared to sole-cropped plants with 2.56 g plant-1 and 0.52 g plant-1 under combined stress. Intercropped wheat plants exhibited a 77.14% increase in total nitrogen, 66.67% in P, and 113.33% in potassium contents, compared to sole crops, under combined stress. Additionally, grain yield, spike length, grain total proteins, and starch contents were significantly improved by 23.39, 26.12, 1.93, and 3.29%, respectively, for wheat plants intercropped under combined stress compared to sol crop. Intercropping with faba bean emerges as a promising strategy to enhance wheat production under stressful conditions, particularly in low input agrosystems.

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Influence of soil microalgae-cyanobacteria consortium inoculation on microbial communities and soil fertility

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Several studies have reported that the intensification of agricultural production using excessive chemical inputs has depleted soil organic matter responsible for storing nutrients, altered the pH and soil structure, and unbalanced the microbial flora. In recent years, Microalgae and cyanobacteria have gained particular attention as renewable organic biomass inputs that can be exploited in agriculture to promote and preserve soil fertility, stability, and prolonged productivity. This study

investigated the effect of soil microalgae (*Chlorella vulgaris*, *Klebsormidium flaccidium*, and *Nitzschia* sp.) and cyanobacteria (*Anabaena cylindrica*) inoculation individually or in consortium combination on soil physico-chemical properties, nutrient contents, and soil microbial biomass and enzymatic activity. The results showed that the application of the diatom strain *Nitzschia* sp. alone, and the microalgal consortium significantly improved the N, P, Ca, K, and Na soil contents, as well as the soil chlorophyll-a and total polysaccharides. This dual inoculation improved the abundance of soil microbial communities (such as bacteria, fungi, and microalgae) and soil enzymatic activity (Dehydrogenase and alkaline phosphatase activity). An improvement of 141.8, 48.2, 188.1 and 184.6% was observed for bacteria, fungi, dehydrogenase and alkaline phosphatase activity, respectively.
Key words: Soil microalgae; microalgae-cyanobacteria consortium; soil nutrients; soil microbial communities; soil enzymatic activity.

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The effectiveness of Rosmarinus officinalis in controlling citrus nematodes T. semipenetrans under in vitro and greenhouse conditions

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Tylenchulus semipenetrans is a highly damaging obligate plant parasitic nematode (PPN) that poses a significant threat to citrus crops. the use of chemical nematicides has proven effective in reducing T. semipenetrans populations, but their repeated use can have negative environmental impacts, necessitating the adoption of more ecological strategies. The current study aimed to evaluate the nematicidal effect of Rosemary (Rosmarinus officinalis) against Tylenchulus semipenetrans under greenhouse and laboratory conditions.
T. semipenetrans eggs and juveniles were subjected to varying concentrations of aqueous extracts (1%, 4%, 8%, and 10%) for different durations (48, 96, and 144 hours for eggs; 24, 48, and 96 hours for J2), with distilled water serving as a control. Citrus Volkameriana plants, artificially infested with the citrus nematode Tylenchulus semipenetrans, were selected for a greenhouse biological control experiment involving the soil application of a 10% Rosemary aqueous extract at a rate of 20 ml/tree. Results showed that the Rosemary extract exhibited high toxicity against T. semipenetrans, with juvenile J2 mortality ranging between 9.52% and 75.17%, compared to 1.0 to 13.6% in the distilled water treatment, and egg hatch inhibition varying between 0% and 38%, compared to 73 to 95% in the distilled water treatment. Toxicity increased with increasing Rosemary aqueous extract concentration and incubation period, reaching 75% mortality after 96 hours and complete egg hatch inhibition after 144 hours of incubation at an aqueous extract concentration of 10%. In the greenhouse experiment, the aqueous extract of Rosmarinus officinalis significantly reduced the population density of T. semipenetrans J2 in the rhizosphere of Citrus volcameriana compared to the control treatment, with nematode populations ranging from 500 J2/100g of soil and 122 nematodes/10g of roots, compared to populations of 99.33 nematodes/100g of soil and 185 nematodes/10g of roots in the control treatment. As a result, it was concluded that the aqueous extract of R. officinalis can be used as an effective and healthy nematicidal product against T. semipenetrans.
Keywords: Tylenchulus semipenetrans, Rosmarinus officinalis, Citrus, Nematicidal activity

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Chemical composition and antioxidant activity of Pistacia lentiscus fruit oil by-product

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Pistacia lentiscus oil is increasingly appearing on the Moroccan market, and several cooperatives are starting to sale it for massage and cosmetic uses. Extracting the oil from the fruits generates cakes that, depending on the chosen extraction method, may still contain bioactive compounds such as phenols.
The main objective of the current study was to characterize and compare the chemical composition of the phenolic extracts of Pistacia lentiscus fruit and its oil cake. Fruit samples were collected in the Al Haouz region. The phenolic profile was studied by HPLC and the antioxidant capacity of the two extracts was assessed by DPPH (IC50) and FRAP (EC50).
The results showed that the oil cake contains 10.06% oil, corresponding to an oil loss of around one-third. Oil cake contains a polyphenol content of 78.1 mg GAE/g DM, whereas fruits only contain 69.4 mg GAE/g DM. The phenolic profile is similar between the oil cake and the fruits. Nine compounds have been identified, with myricetin digalloyl rhamnoside being the major compound. Regarding the antioxidant activity, the two extracts showed an interesting capacity, in agreement with the flavonoid-rich phenolic composition found. However, the IC50 and EC50 of oil cake extract are slightly lower than those from fruits.
In the light of these results, it would be interesting to extend our work towards finding innovative ways of developing the use of the Pistacia lentiscus oil by-product.

Key words: Pistacia lentiscus; lentisc oil cake, chemical composition; antioxidant activity.

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Lavandula maroccana: Antibacterial and antioxidant potentials of endemic Moroccan plant's essential oil

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Various lavender species contain essential oils (EOs) rich in bioactive compounds known for their important biological properties, such as antimicrobial, antioxidant, and antidepressant. These EOs also possess significant economic value due to their uses in producing perfumes, cosmetics, and flavoring agents. *Lavandula maroccana* is an indigenous medicinal and aromatic plant in Morocco that has recently gathered significant attention.

The main objective of this study was first to investigate the antimicrobial potential of the essential oil obtained from *Lavandula maroccana* against pathogenic microorganisms (*Escherichia coli Staphylococcus aureus*, *Enterococcus hirae*) using the microdilution method. Moreover, we evaluated the antioxidant potential of *Lavandula maroccana*'s EO using the FRAP and DPPH assays.
Determination of minimal inhibitory concentrations (MIC) revealed that the essential oil gave an inhibitory effect on all bacterial strains in different concentrations. The highest anti-bacterial activity was against *E. coli* (0,83 mg/mL), followed by *S. aureus* (2,08 mg/mL), while the lowest activity was against *E. hirae* (2,5mg/mL).
On the other hand, essential oil exhibited significant antioxidant activity, with IC50 and EC50 values of 4.17 ± 0.31 mg/mL and 1.05 ± 0.12 mg/mL, respectively.
These findings suggest that *L. maroccana*'s essential oil exhibited inhibitory effects on the tested microorganisms. Additionally, the phenolic extracts showed promise as a potential agent against damage caused by free radicals.
Key words : *Lavandula maroccana* ; Essential oil ; Anti-bacterial activity ; Minimal Inhibitory Concentration (MIC) ; FRAP ; DPPH

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Biofertilizing effect of Anabaena cylindrica aqueous extract on soil fertility

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Recently, microalgae extracts have received greater interest as biostimulants for plant production, and environmentally friendly alternative to chemical fertilizers in agriculture. Among them, cyanobacteria extracts have shown a number of beneficial effects, such as increased nutrient uptake, tolerance to abiotic stresses and improved crop yield and quality. A greenhouse experiment was conducted to study the potential of blue-green algae Anabaena cylindrica as a biofertilizer. Microalgae extract was applied as a soil drench, to assess its effect on soil physico-chemical properties. The main objective of the study was to enhance soil fertility. Different concentrations (25%,50%, and 75% v/v) of microalgae extracts were used over a period of 3 months. A total of 12 drenches were applied at 7 days. A statistically significant improvement ($P<0.05$) of soil physico-chemical properties (pH, electrical conductivity, total organic carbon, organic matter, total nitrogen, available phosphorus, potassium, sodium, and calcium.) was recorded after the application of different extract concentrations compared to untreated soils. In general, our results revealed that the 75% aqueous extract exerted the strongest positive effects on the parameters studied. The study also reported presence of sugars, protein, and macronutrients (such as N, P, Ca, Na, and K), in A. cylindrica aqueous extract, which makes it a potential biofertilizer.

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HPLC analysis and biological activity assessment of Moroccan Pistacia lentiscus fruit phenolic extract

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The present work investigates the HPLC analysis and two biological activities (antioxidant activity and antibacterial activity) of the phenolic extract fruit of *Pistacia lentiscus* from the national park of Toubkal, Morocco. The Phenolic extract were obtained by maceration. HPLC analysis of phenolic extracts showed the presence 7 major phenolic compounds in the fruit extracts, by co-injection of standards. Present findings highlights that the fruit extract was characterized by a high percentage of hesperidin (20.69%) as the major compound. The antioxidant activity of the fruit phenolic extract evaluated by 2, 2-diphenyl-1-picrylhydrazyl (DPPH) free radical inhibition method showed a high antioxidant activity with an IC50 ranging from 0.147±0.001 mg/ml. The antibacterial activity of the phenolic extract was carried out on four bacterial strains, including two-gram positive and two-gram negative strains using the disc diffusion method at varying concentrations between 100 and 1.56 mg/ml.

The diameters of the inhibition were measured, and the results show a strong sensitivity of the phenolic extract from fruits against *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Enterococcus faecalis*, with a diameter that varies between 0,7 and 12 mm. The results showed that the fruits phenolic extract affects significantly the growth inhibition of *Pseudomonas aeruginosa* and *Staphylococcus aureus* more than *Escherichia coli* and *Enterococcus faecalis.*

Keywords: *Pistacia lentiscus* ; Phenolic extract ; HPLC ; Antibacterial activity ; Antioxidant activity.

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Influence of Diverse Priming Substances on Enhancing Quinoa Seeds Germination under Severe Salinity Stress Conditions

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Global food security is constantly threatened by a range of detrimental abiotic stresses, including salinity emerging as a serious challenge for conventional crop production and hence adversely food and feed availability. In light of this pressing limitation, the prompt implementation of various interventions, including the cultivation of salt-tolerant crops like quinoa, has become an imperative solution to adapt to this issue and ensure sustainable agricultural production. Quinoa (*Chenopodium quinoa* Willd.) has been introduced in Morocco as a promising alternative crop due to its exceptional attributes mainly its tolerance to salinity. Nonetheless, the impact of salinity on quinoa's physiological performance remains a concern, particularly during the critical germination stage, which is known to be vulnerable to salinity-induced stress. The aim of this research was to assess the influence of seven distinct seed priming solutions on the salinity tolerance of three quinoa varieties (Titicaca, ICBA-Q5, and Puno) during the germination phase under two high salinity stress levels (300 & 400 mM of NaCl). Different priming treatments were applied to seeds, including chemical priming using zinc sulfate (ZnSO4) and sodium metasilicate (Na2O3Si), biopriming utilizing raw

plant extracts of halophytes such as *Peganum harmala* (Ph), *Suaeda vermiculata* (Su), and *Atriplex halimus* (Ah), as well as seaweed raw extract of *Fucus spiralis* (Fs), and finally, *Rosmarinus officinalis* hydrolat (Rh). Negative controls with no priming for both salinity stress levels (C-300 & C-400) and positive controls with no priming and no salinity stress were considered. The results showed significant increases in the final germination percentage "FGP"especially under 300mM NaCl, and mainly by the treatments Zs, Si, Ah & Rh. For instance, for ICBA-Q5 seeds germinated under 300 mM of NaCl, Zs and Rh increased their FGP respectively by 70.23% and 54.76% compared to the negative control, and increased by 91.2%, 95.8% and 84.45% respectively for Zs, Si and Ah compared to C-300 for Puno, for Titicaca the increase was more pronounced by 84.2% for Zs by & 86% for Si compared the negative control. The mean germination time "MGT"was significantly reduced by most of the tested treatments as compared to their negative controls, especially for the treatments mentioned before for each variety.

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Bi5O7I nanosheets supported on chitosan for organic dyes photodegradation and 4-Nitrophenol Reduction

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At the global level, it is well acknowledged that today's world is at a turning point. More than ever before, it is universally admitted that our modern society faces enormous catastrophic challenges that urgently and immediately need to be addressed e.g. global warming, climate change, environmental destruction, energy shortage, global water crisis, food insecurity, global peace and security and political stability. Even though many national and international agreements have been established by most governments and countries around the world, many of these challenges look like never-ending problems and many of them may become worse and more frightening in the near future. In this alarming situation and in order to achieve the sustainable development of human society and keep a sustainable world for our children and our future generations, serious attention as well as urgent if not immediate solutions are required to quickly solve those challenging problems before they persist and become irreversible. This will require substantial changes in all aspects of our society: on how we use natural resources, how we use land, water and energy, how we protect the environment, how we grow food, transport goods, how we perform all our economic, social, technological and political decisions and actions and so on. Toward this goal, multi-pronged, fully committed and cooperative efforts are needed from central and local governments, national and international agencies, voluntary organizations, private and public sectors, scientists, researchers, individuals and the whole community in general. In this context, researchers and policymakers from all over the world have been working on various approaches by doing their best to address environmental and energy related problems through solar energy utilization. Indeed, the sun is considered as a free, renewable, inexhaustible, readily available and eco-friendly energy source accessible on Earth. Among the numerous appealing and attractive technologies available today, heterogeneous photocatalysis has been recognized as one of the most promising strategies for solar energy utilization. This technology has recently attracted much attention for settling the energy crisis and global environmental issues we are currently facing, owing to its applicability in air and water purification, electricity generation, phototherapy, solar fuels generation, CO2 reduction, bacteria inactivation, green hydrogen production and N2 fixation. In this contribution, I will give a short overview about the effectiveness of heterogeneous photocatalysis in the field of solar energy utilization for applications in the areas of clean and renewable energy production-conversion-storage as well as environmental protection and remediation.

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Assessment of water content in almond leaves (LRWC) in rainfed areas, when subjected to different soil maintenance systems

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Portugal is a country with a tradition in almond production, producing annually around 34,000 tons of almonds in the shell. In the region of Trás-os-Montes (Portugal), where the largest production area is concentrated, almond groves are mostly rainfed and have different soil maintenance systems. Taking this reality into account, we carried out this work with the aim of studying the water conditions of almond trees when subjected to different soil maintenance systems in rainfed almond groves, in the Trás-os-Montes region. The experimental trial took place in an almond grove, in full production, located in Corujas –Macedo de Cavaleiros (41°36'16.5"N 6°58'19.0"W), between June and September 2023. The almond grove was divided into three treatments: covered with chickpeas (intercropping), covered with short-cycle clover and mobilized soil. Each treatment is constituted by three replications each with 5 almond trees (15 almond trees per treatment). Three leaves were collected from each tree, between 12:30 and 1 pm. Once in the laboratory, these leaves were put through the hydration and dehydration processes and weighed (fresh, turgid and dry weight) and the leaf area was determined in order to calculate the relative leaf water content (LRWC).
The results reveal that the LRWC varied between 89% and 60%, in the months of July and September respectively. The short-cycle clover treatment obtained lower LRWC (%) values overall. In September, closer to harvest, the almond leaf presented lower LRWC values in all treatments.
In this first year of study, the results obtained prove the need for water in certain periods of the almond tree's life cycle, deficit irrigation can be a possible solution for regions with little water availability.

Key words: LRWC, treatments, intercropping, cover, water.

Acknowledgment: Project VALMEDALM –Valorization of Mediterranean Almond orchard through the use of intercropping integrated strategies (PRIMA/0015/2021).

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Supporting Sustainable Management of Water in Sebou's Apple Farming

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The Sebou Water Fund (SWF), established in 2019 by the NGO Living Planet Morocco (LPM) in collaboration with several national and international partners, represents a groundbreaking initiative within the Mediterranean basin and the MENA region. The SWF operates on the fundamental principle of "payment for ecosystem services" and is dedicated to promoting sustainable water resource management for the benefit of both society and the fragile ecosystems within the Sebou River basin. In response to the urgent need for sustainable water management in apple farming at the upstream part of the basin, the Sustain Sebou Farming project was launched in the Imouzzer Kandar region.

Its main objectives include strengthening the capacity of local farmers in sustainable water management and sharing best practices at the local and national levels. Notably, the project is part of the SWF and aligns with its mission to promote sustainable water resource management. The project conducted a series of training workshops on water conservation practices, educating local apple growers on the importance of responsible water use. These workshops laid the foundation for knowledge and collaboration within the community. Furthermore, the project organized an exchange visit to the Souss Massa region, a pioneer in climate-smart irrigation, where participants learned valuable lessons and strategies for efficient water use. To demonstrate the effectiveness of various water conservation techniques, the project implemented five showcase projects. These projects showcased improved hydro-agricultural systems, precision irrigation, and the benefits of using low-flow drippers. Preliminary results indicate significant water savings and improved yields. The project's efforts to disseminate results and best practices extended to weekly markets, where extension and awareness-raising stands were set up. This approach allowed local farmers to access information and training tailored to their needs. A capitalization workshop held near Dayet Aoua lake brought together stakeholders from various institutions and the local community. It fostered collaboration between small-scale and large-scale apple growers and facilitated the creation of the "Large Apple Growers Association," dedicated to sustainable water management. In conclusion, the Sustain Sebou Farming project, as part of the SWF, has made substantial progress in enhancing sustainable water management practices in apple farming. It has successfully engaged the local community, shared valuable insights, and demonstrated the benefits of responsible water use. The project's approach serves as a model for addressing water management challenges in agriculture.

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Participatory hub for effective mapping, acceleration and capitalization of EU-MPC NEXUS best practices (PHEMAC)

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PHEMAC aims to develop and disseminate an interactive platform that gathers and shares best practices focused on PRIMA SRIA priorities, involving a wide range of stakeholders from the farming system, water management, and agri-food sectors. Through a participatory approach, PHEMAC facilitates the knowledge exchange among the involved actors on PRIMA SRIA priorities-related programs, policies, and results in the Mediterranean region. Thanks to the development of an integrated platform and approach, the project will help stakeholders to become aware of what already has been developed and implemented, avoiding duplication and using consolidated existing knowledge to create new value.
Besides, PHEMAC strongly encourages successful and sustainable public-private partnerships to counter the phenomena of the inefficient use of resources and reduce the gap between involved countries to boost economic and social reforms.

These ambitious goals will be achieved thanks to the combination of different actions such as the development of an online platform and the active involvement of the relevant stakeholders through a series of events and dedicated policy actions.

Phemac is implemented through:
1. A comprehensive project mapping with many projects mapped? categorized, and in deep analyzed
2. Best practices catalog with many initiatives and related multiplying methodology to maximize the impact of these success stories
3. PHEMAC iHub –the one-stop shop for an effective knowledge transfer in the WEF NEXUS domain
4. Mobilization of the relevant stakeholders through the organization of a series of events and specific communication actions and policy recommendations
5. A capitalization plan to define a sustainable strategy for the project results implementation, exploitation, sustainability, and maintenance beyond the project lifespan.

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Desalination performance comparison of MCDI and LPRO –Results of pilot-scale plant in SmaCuMed

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The use of saline water resources in agriculture is becoming a common practice in semi-arid and arid regions such as the Mediterranean. The joint EU-PRIMA research project "SmaCuMed"aims at developing and testing an all-in-one smart irrigation cube system for smart-sensor controlled irrigation and the energy-autonomous treatment of brackish groundwater. This study focused on the testing and comparison of two desalination technologies: (1) low-pressure reverse osmosis (LPRO) and (2) membrane capacitive deionization (MCDI)—for the first time at pilot scale.

Both desalination units MCDI and LPRO were integrated in a "Smart Cube"as a holistic technological solution. In this study, both units were used in parallel to desalinate groundwater of different salinites. The Smart Cube as tested at two typical Mediterranean locations in Morocco (each over one full year) with different hydrogeological conditions. Location 1 was situated in Douar Foulouste, a rural municipality Sidi Kaouki, Essaouira, Morocco) for the irrigatation of argan trees (Argania spinosa). Groundwater here had a salinity of TDS = 2.8 g/L. Location 2 was situated in in Efoud, Errachidia in cooperation with a cooperative and association of Aoufouss for irrigation of Date palms. Groundwater here had a salinity of TDS = 5 g/L. The desalination technologies were compared at each location for 33% and 66% salt removal, respectively.

Concentrate disposal was carried out in evaporation ponds, thereby reducing leaching of brine salts and the environmental impact. During the pilot trials, approximately 145 m^3 of brine was discharged into the evaporation basins, adding to a total of 550 kg of salt. Salts obtained from the basins could have potential indwustrial uses. However, salt was contaminated by dirt and sand and no economically feasible use was possible.

Results of desalination showed that MCDI had 40-70% lower specific energy consumption (SEC) and 10-20% higher water recovery. In general, the MCDI showed a better performance than LPRO when at lower desalination rates (33%). However, the throughput of LPRO (2.9 m3/h) was up to 1.5 times higher than that of MCDI. In addition, both technologies were successfully powered by PV solar energy with total water costs ranging from €0.60 to €1.34 per m^3. Specific water costs of LPRO were significantly lower at higher desalination rates (66%). However, to evaluate both technologies, additional criteria such as environmental criteria, ease of use and operability, and brine disposal need to be considered.

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Institutional Analysis of the Implementation of Innovative Technologies in the Agricultural Irrigation in Morocco –The Case of SDI and MCDI

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The implementation of innovative technologies in the agricultural sector requires a deep understanding of its specific requirements as well as of possible hindering –or fostering –natural, institutional, economic and social factors.

Since long time, Moroccan policymakers have given a strong priority to the dissemination of localized irrigation techniques and, therefore, taxes on the import of equipment for drip irrigation have been reduced or canceled. Drip irrigation has been promoted by the Moroccan state as a technical solution for saving the scare resource and large subsidies to support the adoption of this technique have been offered.

In arid and semi-arid regions like Goulmima and Idelsan in the Tafilalet region, Morocco, farmers are practicing subsistence agriculture since many decades, where the available quantity and quality of irrigation water is of major importance for the success or failure of irrigation projects.

Our study focuses on specific aspects which could be considered as challenges for the adoption of innovative technologies like the Subsurface Drip Irrigation (SDI) and the brackish water Desalination through Membrane Capacitive Deionization (MCDI) in the targeted regions.

This research is part of a larger BMFB-financed Client II project on "Novel Solutions to Strengthen Agriculture under Arid and Semiarid Conditions as an Important Contribution to Sustainable Land Management in Morocco"(SuLaMo).

The empirical research revealed a number of influencing factors that could inhibit the adoption of the addressed technologies at local level and beyond. Many agricultural policies and state instruments like the national plan for saving water for irrigation (PNEEI), the national plan Green Morocco (PMV), the green generation program or aquifer contracts are intended to support farmers for better planning and executing irrigation projects and regulate shared water use purposes. However, the diversity and complexity of working rules and coordination mechanisms within these policies make the implementation of the addressed technologies difficult. The access of farmers to SDI and MCDI faces many hindrances such as the complexity of state subsidies and credit systems, the lack of specific technological knowledge, the multiplicity of land and water use rights (private, collective and customary use rights), and the perceptions (risks, uncertainty about outputs and achievements, path-dependency) and cognitive schemata (informal rules) of the practicing farmers about how to manage sustainably the use of these technologies.

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Response of date palm fields (Phoenix dactylifera L. cv. Mejhoul.) to different desalinated water regimes using SmaCuMed technologies.

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The Smart Irrigation Cube for Sustainable Agriculture in the Mediterranean Region (SmaCuMed) is a collaborative research initiative supported by the European Union's EU-Prima initiative. This project integrates advanced desalination technologies, including membrane capacitive deionization (MCDI) and low-pressure reverse osmosis (LPRO), into a comprehensive smart irrigation cube system. The system enables the autonomous purification of brackish groundwater and precise sensor-controlled irrigation in remote Mediterranean areas. it specifically focuses on cultivating date palms and argan

trees in Essaouira and Erfoud respectively.
As a project partner (UMI), our work involves conducting meticulous testing of this technology on date palm plants (cv. Mejhoul) in the desertic conditions of our designated pilot site (Erfoud). We have utilized both desalination technologies to irrigate three distinct fields: the Red field (2 g.l-1), the Blue field (3.5 g.l-1), and the Yellow field (Control: irrigated with well water containing a salt concentration of 5 g.l-1). Throughout the experiment, we have diligently monitored the plant responses to these different water regimes, investigating various aspects to evaluate the effectiveness of the desalination technologies. We have specifically assessed osmotic stress, oxidative stress, and ionic stress on a graded scale. Our findings clearly indicate significant differences among the three fields since the initiation of irrigation, particularly with regards to total chlorophyll concentrations, which are most noticeable in the Red field. Additionally, our analysis has revealed interesting results concerning the concentration of total phenolic compounds, known for their antioxidant properties, as well as the activity of some antioxidant enzymes. Moreover, we have observed an increase in the levels of osmoprotectants, particularly in the non-irrigated field and the control field. However, it is important to note that, apart from variations in chlorophyll content, significant differences have also been recorded in terms of chlorosis occurrence and offshoot generation among the three irrigated fields, which deviate considerably from the non-irrigated field.

Keywords : date palm, Mejhoul, desalination, SmaCuMed

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Economic Assessment of Membrane Capacitive Deionization (MCDI) and Low-Pressure Reverse Osmosis (LPRO) for sustainable irrigation in the Mediterranean region

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The EU-PRIMA project SmaCuMed offers an integrated approach by providing a sustainable and innovative solution for groundwater desalination in the field of smart irrigation. SmaCuMed consists on integrating a novel desalination technology membrane capacitive deionization (MCDI) with low-pressure reverse osmosis (LPRO) in an all-in-one "Smart Irrigation Cube"system.
Nowadays, it becomes necessary to evaluate the environmental and socio-economic impacts of a product or a system in order to guarantee its sustainability. In this context, the SmaCuMed project evaluated the socio-economic issues and sustainability of the Smart Irrigation Cube (WP6) using the Life Cycle Sustainability Assessment methodology. Based on a Life Cycle Cost Analysis, the two desalination technologies LPRO and MCDI were compared to identify the most economical option. Different scenarios were defined to assess the potential impacts of the technologies on the production of irrigation water. Based on the cost calculation of 1 m3 of desalinated water, obtained results showed that MCDI is the most economical option when using solar PV. However, increasing the salt removal target to 66% increased the costs to 1.21 EUR/m3 and 1.34 EUR/m3 for LPRO and MCDI, respectively. This highlights the better performance of the MCDI at lower salt removal rates.

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The nexIK Vision: Data-Driven Insights for Energy Efficiency in Industrial Kitchens

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Industrial kitchens (IKs) stand out for their disproportionately high energy consumption, surpassing other commercial spaces, such as office buildings and retail stores, by a factor of 5 to 7 times per square meter. Nevertheless, despite the size and ubiquity of this industry, its role in the global quest for sustainable energy systems is still widely under-explored, particularly when it comes to the opportunities that emerge from the massive electrification of this industry.
In this sense, the electrification of IKs has a solid potential to contribute to the energy transition targets by increasing the efficiency of the industrial kitchens'operation through better coordination between the use of appliances, the integration of small production and storage technologies, and even the participation in electricity markets.
This work unveils the preliminary results of two data-driven methodologies developed in the scope of the nexIK project (https://nexik.tecnico.ulisboa.pt). The nexIK project positions itself as a unique real-world testing ground for pioneering research on unraveling how the Water-Energy-Food (WEF) Nexus can be harnessed to promote efficiency opportunities in IKs. To this end, the project spans several research aspects, including resource monitoring and eco-feedback, data-driven analysis and modeling, and energy resource optimization (Oliveira A. et al., 2023).
The first methodology was developed to manage energy consumption in IK by tapping into the inherent flexibility of each appliance. It accomplishes this by modeling the IK devices based on two fundamental aspects: the required operating duration and the maximum power demand. The proposed methods were tested under two distinct optimization scenarios –one focusing solely on real-time data and another incorporating a one-hour lookahead period, using consumption data monitored from one IK during its daily routines.
The second methodology seeks to create consumption profiles for different types of IKs. This methodology leverages actual IK device consumption by employing clustering techniques to identify the different modes of operation of the devices and Markov chains to model the most probable sequence of activations. The profiles generated for each appliance are summed in the final step to arrive at an aggregated consumption profile representing an IK. This methodology was tested with data from 15 devices, encompassing four refrigerators, two convection ovens, one blast chiller, and one dishwasher.

Oliveira A. et al. (2023). On The Role Of Industrial Kitchens In Sustainable Energy Systems: The nexIK Vision. CIRED 2023 - The 27th International Conference and Exhibition on Electricity Distribution. CIRED 2023, Rome, Italy. https://www.alspereira.info/pubs/cired-2023/

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Electricity-Water Nexus Analysis in Industrial Kitchen Appliance Water Consumption

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Industrial Kitchens (IKs) are notorious energy and water consumers, particularly for cooking and cleaning. Surprisingly, while domestic consumption patterns receive ample scrutiny from researchers,

the energy and water dynamics within IKs have largely remained uncharted territory. In this context, the nexIK project (https://nexik.tecnico.ulisboa.pt) aims to set itself as a one-of-a-kind real-world test bed for conducting exploratory research in IKs to understand how the Water-Energy-Food (WEF) Nexus can be leveraged to promote responsible resource consumption and cleaner energy Oliveira A. et al. (2023).
This work unveils the preliminary findings of a data-driven methodology developed to explore the water consumption of wet IK appliances. The proposed methodology, driven by only aggregated water and electricity consumption data, comprises six key stages: 1) identification of the activations of the wet appliances in the electricity consumption signal; 2) linking these power surges to water consumption; 3) identification periods of simultaneous with water concurrent demand from these appliances; 4) isolating and subtracting baseline water use unrelated to the wet appliances, 5) quantifying the water volume associated with individual activations, and 6) determine the cumulative water volume consumed by each device.
To validate this approach, electricity and water usage data from an IK in Portugal (Pereira L. et al., 2021) was employed, featuring two appliances—a glasswasher and a dishwasher—with water and electricity demand sampled at 5-second intervals over approximately two weeks.
The evaluation yielded intriguing insights. First and foremost, despite both devices being used daily, the dishwasher has considerably more activations than the glass washer (1554 vs 417). Second, in both devices, two operation models can be distinguished, one that only consumes electricity and another that consumes electricity and water. Interestingly, water is only consumed in roughly 15% and 9% of the dishwasher and glasswasher activations, respectively. Finally, the results also show that about 50% of the dishwasher activations consume up to 12.4 Liters of water. In contrast, the water consumption of the glasswasher events displayed more diversity, with 21% of events requiring 1 to 4.2 liters and another 21% ranging from 10.95 to 14.27 liters.

Oliveira A. et al. (2023). On The Role Of Industrial Kitchens In Sustainable Energy Systems: The nexIK Vision. CIRED 2023 - The 27th International Conference and Exhibition on Electricity Distribution. CIRED 2023, Rome, Italy. https://www.alspereira.info/pubs/cired-2023/

Pereira, L. et al. (2021). FIKWater: A Water Consumption Dataset from Three Restaurant Kitchens in Portugal. Data, 6(3), Article 3. https://doi.org/10.3390/data6030026

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Numerical study on the performance of rocks as thermal energy storage materials in a granular bed

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The numerical modeling of thermocline systems, particularly in granular fixed beds, is an important step toward understanding the physical phenomena that can reduce energy losses and improve the performance of a fluid and solid-phase storage system.
The Schumann mathematical model used in this study is a one-dimensional continuous model that

generates the temperature profile of natural rock, which is used as a storage medium, and the fluid temperature, which is the air exchanging heat with the solid material. Understanding the heat transfer processes in compact beds of natural rock is crucial for building a more efficient storage system. The primary goal of this work is to investigate how applied pressure, particle size, and fixed radial and axial bed dimensions affect heat transfer by measuring effective thermal conductivity. The results of this storage system's numerical modeling show that the thermophysical properties of the storage material (conductivity, specific heat, particle size) significantly affect the quality of energy stored in the packed bed when a constant air mass flow rate and pressure are used. On the other hand, the influence of the axial bed geometry is negligible, whereas the influence of the radial dimension of the bed is significant.
This modeling provides an opportunity to visualize temperature profiles in the bed of the rocks over time and space in order to evaluate the stored energy that can be recovered later.

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The Possible integration of the Double Perovskite Ba2XSbO6 (X=Sc,In) Compounds in solar cells technologies

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In this work, we have comprehensively investigated DFT investigation on optoelectronic, properties of Ba2InSbO6 and Ba2ScSbO6 double perovskite oxides. The structural optimization was carried out using generalized gradient approximation (PBEsol-GGA). Moreover, the new Becke-Johnson (new-mBJ) was utilized in the framework of PBEsol-GGA to precisely evaluate the electronic bandgaps. the material demonstrates a direct bandgap of 1.62 eV and 4.02 eV for Ba2InSbO6 and Ba2ScSbO6 respectively. Based on these bandgap values and the optic properties, the studied materials illustrate different properties, signifying different possible applications. Especially, for solar cell technologies and light-emitting elements.

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Effect of subsurface water retention technology on argan reforestation

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Argania spinosa (L.) is a horticultural forest endemic to the arid and semi-arid zones of south-west Morocco. This species is adapted to the harsh conditions and plays an important socio-economic and ecological role in Morocco's sustainable development. However, this crop faces multitude of constraints, notably drought, which has a negative impact on the density and success of reforestation. The use of current techniques such as traditional field transplanting is characterized by higher failures, hence the importance of researching new technologies and biological methods to avoid this challenge and consequently improve the success of argan reforestation, conserve the environment and preserve biodiversity. The aim of this work is to evaluate the potential effect of applying Subsurface Water Retention Technology (SWRT) using biodegradable plastic in the reforestation process of the argan forest. Results obtained after 8 months of transplanting show that the application of SWRT improves reforestation success by 97.19%, soil moisture by 64.58%, aerial elongation by 85.23%, stomatal conductance by 69.43% and chlorophyll fluorescence by 92.16%. Thereby, this technology could be an efficient tool to promote efficient reforestation of the argan forest in Morocco.
Keywords: argan forest, subsurface water retention technology, reforestation, soil moisture

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Exogenous silicon improves photosynthetic machinery, biological nitrogen fixation, antioxidant systems and tolerance of fenugreek (Trigonella foenum-graecum L.) under salt stressed conditions

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In the present study, we investigate the impact of treatment with exogenous silicon (Si) on agronomic traits, photosynthesis, oxidative markers, antioxidant systems and biological nitrogen fixation on salt stressed fenugreek (*Trigonella foenum-graecum* L.) plants. The experiment was carried out in a growth chamber at 25 ± 1 ℃, 60% - 80% relative humidity and a photoperiod of 16h. Fenugreek seedlings were submitted 200 mM NaCl (*vesrus* 0 mM NaCl for control) and treated or not with 3 mM Si (CaSiO3). Our results indicated that salinity stress significantly decreased growth parameters, chlorophyll content and all assessed photosynthetic traits. However, Si supplementation in rooting medium mitigated the negative effects observed. In fact, Si treatment alleviated the salinity effect on the plant growth parameters, relative water content, photosynthetic pigments, and the functions of photosystems (PSI and PSII). Interestingly, Si had a great beneficial effect on the function of PSII in comparison to PSI. Nodule number and nitrogen content, as symbiosis-related parameters, were significantly improved in salt-stressed plants by Si treatment compared to untreated and stressed

plants. The ameliorative effects of Si could be explained by significant induction of antioxidant activities leading to significant decrease in oxidative stress markers. Taken together, Si mediated salt tolerance of fenugreek plants by enhancing photosynthesis and biological nitrogen fixation, which are among the vital processes for legume development, thus in return, their application could be a promising way to overcome the harmful effects of salinity on agricultural production.

Keywords: Fenugreek, Silicon, Salt stress, Photosynthesis machinery, Biological Nitrogen Fixation, Antioxidant activity, Salt tolerance.

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Biostimulatory effects upgrade soil fertility and plant resilience to field-drought stress: attribute-evidence from date palm (Phoenix dactylifera L.), var. Boufeggous

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The phenomena of climate change and global warming are already exerting negative effects on plants, which are projected to worsen by the end of the 21st century. Furthermore, the challenge of nourishing some 10 billion people by 2050 versus intense drought versus extensive agriculture is further complicating an already complex problem. For the aforementioned, the sustainable reliance on biostimulatory microorganisms and/or products may upgrade both plant productivity and soil fertility, contributing to practical elements of the solution. Thus, Arbuscular Mycorrhizal Fungi (AMF), Plant Growth-Promoting Rhizobacteria (PGPR), and organic amendment (e.g., compost) are gaining wide attention for their multi-beneficial effects. In this regard, the present study aimed at assessing AMF (AMF), and/or PGPR (B), and/or compost (C) addition on date palm vitroplants, var. Boufeggous, traits as well as soil physicochemical properties under field, with well-watered (WW) and drought stress (DS) imposed regimes. The obtained results revealed the tripartite combination (AMF+B+C) considerably attenuated DS in date palm, an attenuation manifested through enhanced biomass (76%), shoot phosphorus (P) (293%), and upgraded plant-water relations. Moreover, the decreased levels of hydrogen peroxide (H2O2) and malondialdehyde (MDA) were connected to ameliorated total soluble sugar (TSS, 208%) and protein (TSP, 84%) contents under DS, compared to the control. On the other hand, the applied biostimulants and their different combinations showcased an improvement in soil physicochemical properties, notably total organic carbon (TOC), total organic matter (TOM), available phosphorus (P), and glomalin content compared to the control, despite water deficiency. All in all, the recorded results are highly encouraging and underscore the significance of combining the studied biostimulants to deal with deleterious drought stress. Thus, plants' resilience

to drought can be boosted under (semi-)arid climates relying on biostimulants, as evidenced in date palm.

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Optimization of irrigation and fertilization of winter wheat in Tensift Al Haouz (Morocco) using the DSSAT-CERES-Wheat model.

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Improper winter wheat management limits yield, nitrogen and water use efficiency, given the increasing constraints on agricultural productivity in Morocco. The use of crop growth models is a potentially effective tool for evaluating management practices to enhance yields and resource use efficiency. This study focused on using the DSSAT-CERES-Wheat model to identify the best management practices, including irrigation and nitrogen fertilization for winter wheat in semi-arid irrigated Mediterranean conditions. The model previously calibrated and validated on six fields in Tensift Al Haouz (Morocco) over two growing seasons (2002/2003 and 2003/2004) using yield components, phenology and water dynamics was then used to simulate the effect of irrigation, and fertilization amounts on winter wheat grain yield based on 30 years of historical weather data including temperatures, precipitation, wind speed, solar radiation and relative humidity. Water use efficiency WUE, irrigation water use efficiency (IWUE), nitrogen physiological efficiency (NPE), and partial factor productivity of nitrogen (NPFP) were employed to identify the most suitable nitrogen and water applications. The results revealed that irrigating winter wheat when soil moisture reaches 50% of total available water capacity results in the highest yield (4.6 t/ha), and applying 300 kg/ha N gives the highest yield (11.6 t/ha) as well as water use efficiency (2.04 kg/m3) for flood-irrigated winter wheat in the region while applying 60 kg N/ha gives the highest NPE and NPFP averages. The model's simulations, once confirmed by field experiments, can be used as a basis for effective crop and resource management.

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Subsurface Drip Irrigation and other water saving strategies to enhance plant production in the context of arid and semiarid environments in Morocco

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A significant share of global crop production is limited by the availability and quality of water resources. At the same time, global freshwater resources from rivers, lakes and groundwater ("blue water") are today widely used for irrigation. The countries of the Middle East and North Africa (MENA) are considered to be the region with the largest proportion of used to available surface freshwater in the world. Negative effects of global climate change are already evident today and will further exacerbate the distribution problem of the scarce resource water in the future. The characteristics

of the MENA countries, with high population growth, fast-growing food deficits and limited natural resources - especially arable land and water - make it essential to use water resources in the agricultural production as efficiently as possible through innovative technologies and adapted cropping systems. While surface Dripline Irrigation (DI) is established worldwide and a system widespread all over Morocco, burying driplines underground as so-called Subsurface Drip Irrigation (SDI) systems is still rare. That is the case despite the fact that the high potential of enhancing plant water use efficiency of these systems is known from field research as well as practical applications in (semi)arid regions due to the possibility to apply water and fertilizer directly in the plant root zone. Nevertheless, for a successful implementation, the system design and management must be adapted to local conditions and agricultural practices. The BMBF Client II funded project SuLaMo addresses these questions for arid and semiarid regions in Morocco. Field studies are carried out at four trial sites covering different climatic areas in Morocco. During the installation phases, a wide range of valuable experience was gained regarding the establishment of the SDI system under local conditions. In the Meknès region, potatoes were grown in 2023 while in the Ouarzazate region maize was tested, providing first test results regarding the performance of SDI partly in combination with mulching under Moroccan conditions.

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Inoculation of wheat plants by arbuscular mycorrhizal fungi (AMF) and plant growth-promoting rhizobacteria (PGPR) to alleviate water shortage

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One of the severe abiotic stresses leading to reductions in agricultural production is drought stress (DS). This study was conducted to examine the efficacy of arbuscular mycorrhizal fungi (M: consortium) and plant growth-promoting rhizobacteria (R and B: consortium), individually or in combination, as an appropriate strategy for improving durum wheat productivity under two water regimes: well-watered (75% FC) and DS (25% FC). Exposure to DS reduced biomass, stomatal conductance and increased malondialdehyde and hydrogen peroxide content. Under DS, AMF promoted plant growth, such as shoot dry weight by 48%, by activating the photosynthesis mechanism and increasing osmolytes content in wheat plants treated with AMF, and antioxidant enzyme activities, such as polyphenoloxidase (PPO), in leaves by 36% in plants inoculated with B. After the experiment, total organic matter and soil carbon were improved by the single application of B by 99 and 317%, respectively. These findings indicate that the combination of mycorrhiza and PGPR regulates the physiological and biochemical functions of wheat in coping with drought, and enhances our understanding of the soil-plant relationship.

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Comparative study of conventional irrigation and nano-irrigation on the agronomic parameters of the "Maroc late" citrus variety in the Tadla irrigated perimeter

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Irrigation water management has become an imperative for the sustainability of Morocco's agricultural sector. In Morocco, rainfall, the main source of water for agricultural production, is becoming increasingly irregular as a result of climate change. In this context, the adoption of new and innovative irrigation techniques and strategies represents new directions for improving the resilience of agriculture in the face of diminishing water resources. The present research project, carried out at INRA's "Afourer" experimental field, located in the Beni Moussa Est sub-perimeter, aims to test two new subsurface irrigation techniques (Moistube and SLECI), known as nano-irrigation, on a citrus orchard. The aim of this study is to assess the feasibility of applying subsurface irrigation under the climatic and edaphic conditions of Tadla. To achieve this objective, an experimental trial was set up for the "Maroc late" citrus variety, where the two systems (Moistube and SLECI) were compared with the conventional drip system. The results show that flowering and fruit set are favored at T0 and T1, while the rate of physiological drop is more remarkable in trees irrigated by the SLECI system (0.73%). This stress is confirmed by stomatal conductance (15.67 mmol m-2s-1), indicating a reduction in transpiration due to stomatal closure. End-of-cycle observations show that yield and juice content are high in trees following treatments T0 and T1. Fruit acidity was high in trees irrigated with the SLECI system, indicating significant water stress. According to our results, irrigation water does not reach the soil surface for Moistube and SLECI systems, compared with surface drip systems.

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Biofertilizer-Biostimulant effects of silicon and the rhizobia on Cicer arietinum tolerance to deficit irrigation under field conditions

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This work aimed at evaluating the biostimulative and biofertilizer effects of silicon (Si) and the rhizobial inoculum on the growth and development of the Moroccan Zahour chickpea (*Cicer arietinum* L.) variety under water deficit conditions. A field experiment was conducted at Beni-Mellal region under three factors: (i) Water irrigation (optimal irrigation versus deficit irrigation); (ii) Si application (plants were treated or not with 1.5 mM CaSiO3) and (iii) The seed coating with rhizobial inoculum. The obtained results indicate that deficit irrigation significantly ($p < 0.01$) reduced plant biomass, grain yield and disturbs different physiological and biochemical processes governing plant growth and development. However, the Si application significantly ($p < 0.01$) contracted the negative impacts of deficit irrigation and significantly increased all the studied growth parameters and reduced the contents of malondialdehyde, hydrogen peroxide and electrolyte leakage. In the same sense, simultaneous application of Si and the seed coating with the rhizobial inoculum reduced the oxidative damages of deficit irrigation by mitigation the negative effects of reactive oxygen species (ROS). The reduction of ROS contents under the simultaneous treatment with of Si rhizobial inoculum seems to be related to their capacity to modulate superoxide dismutase and polyphenol oxidase activities and

to increase total polyphenol and flavonoid contents. Besides, compatible osmolytes, such as proline, glycine betaine and soluble sugars were found to be increased in comparison to Si-untreated and non-inoculated plants. Our findings suggest that the combined use of Si and seed coating with rhizobia constitutes a promising way to mitigate the negative effect of deficit irrigation and to achieve sustainability in chickpea production under dry field conditions.

Keywords: Biofertilizer-Biostimulant; Chickpea; Deficit irrigation; Growth; Rhizobia; Silicon; Yield.

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Chitosan-graft- poly (ε-caprolactone) copolymers: synthesis and use as a biodegradable coating for slow release of water-soluble fertilizers

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The urgent need for efficient agriculture to increase crop and food has fueled the development of coated fertilizers with slow-release kinetics, water economy, and full degradability to avoid negative environmental impact. In this context, we herein report the synthesis of poly (ε-caprolactone) (PCL) grafted from chitosan (CS) as a new class of biodegradable coating materials. The CS-g-PCL were prepared following a one-pot, two-step strategy, in which the primary amines of CS first react with ε-caprolactone (CL) to form CL-oligomers linked to CS via amide bonds terminated with hydroxyls, which together with the native hydroxyls of CS initiate the ring-opening polymerization of CL after addition of Sn(C≡CPh)4 as catalyst. Owing to the great stability of the used catalyst, the high molar mass of PCL grafted onto CS was successfully obtained under trivial open-air conditions. Different copolymers (CS-g-PCL) were prepared by varying the CS content. The structural characterization of CS-g-PCL was carried out using FTIR, X-ray diffraction, contact angle, and size exclusion chromatography while the thermal and mechanical characterization of the prepared CS-g-PCL were compared to the neat PCL. Next, using a laboratory rotary drum, CS-g-PCL was implemented to uniformly coat granular diammonium phosphate fertilizer (DAP). Consequently, the kinetic release of nitrogen and phosphorus was significantly delayed compared to that observed with uncoated DAP (conventional fertilizers). The degradation of CS-g-PCL was examined under aerobic conditions and showed a significant increase in their biodegradability with respect to neat PCL.

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Physiological screening and molecular identification of rhizobacteria from nodules and rhizospheric soils of alfalfa

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The objective of this work is the characterization and the screening of effective Plant Growth Promoting Rhizobacteria (PGPR) for alfalfa growth and production. Twenty PGPR were isolated from nodules and soil rhizospheric of alfalfa in the Beni-Mellal region. The isolates were tested on YEM agar plates for their tolerance to abiotic stresses and for their plant growth-promoting traits. Results indicated that at 2% NaCl, all isolates tested showed a normal and identical growth. Beyond this concentration, the growth of some isolates decreased with increase of NaCl in the medium and at 6% NaCl, only 50% of the isolates were able to grow. The results indicated also that all isolates were not affected by the concentration of PEG-6000 ranging from 8 to 15%. For pH level, results indicated that more than 70% of isolates were able to grow under acidic pH conditions (pH=4). Nevertheless, all isolates were able to grow under pH levels ranging from neutral to alkaline pH (7 to 10). For solubilization potential of Tricalcium phosphate (TCP), the solubilization indexes more than two (>2) were noted with isolates *01;02;03;04;05;08;09;10;12;14;16 & 19*. The results showed that most of rhizobacterial isolates, which presented TCP solubilization halos in NBRIP agar, were able to release high quantities of soluble phosphorus in NBRIP broth with a significant variation between them. For indole acetic acid (IAA) production, 75% of the tested isolates were assessed to be IAA producers with the highest IAA concentration (1.63 µg mL-1) recorded with the isolate *05*, followed by the isolate 03 (1.26 µg mL-1), the isolate *01* (1.19 µg mL-1) and the isolate *04* (1.16 µg mL-1). Exopolysaccharide synthesis was detected in all tested isolates with different degrees. The most productive isolates being the isolate 01 (121.09 µg glucose mL-1). The screening of isolates using MALDI-TOF MS followed by genomic identification through housekeeping genes gyrA, gyrB and rpoD showed that selected strains represent 99-100% of similarity to one species. The strains represent 03 bacterial genera: *Ensifer*, *Pseudomonas* and *Bacillus*. The *Ensifer* represents 50%, followed by *Pseudomonas* (30%) and *Bacillus* (20%).

Keywords: PGPR; Alfalfa; Abiotic stress, P solubilization, IAA, Exopolysaccharide; MALDI-TOF MS; Housekeeping genes.

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Potential of sandgrouse (Aves: Pteroclididae) for future prospects for food security and nutrition in rural resource-poor arid areas

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Possibilities of domesticating certain wild birds have been suggested many years ago. Several of such species exhibit qualities that might make them suitable for sustained production. Collectively, poultry has become the most useful of all livestock—and the most widespread. Yet only a handful of species are employed. Of the 10,000 extant bird species, only a few (e.g., chickens, ducks, geese, pigeons, and turkeys) have been domesticated for farm use. Poultry meat is in ever-increasing demand, but there are many niches where the main species are subject to disease or are affected by humidity, altitude, heat problems, or other risks. For such areas, a new species might become a vital future food resource. In arid hot environments, Sandgrouse are a unique family of birds with multiple adaptations that allow them to survive in extremely harsh conditions (water shortage, extreme heat flows, and low biological productivity). They are granivorous and live in flocks, which makes them likely to be easy to feed and to keep in crowded conditions. Morocco has a comparatively rich sandgrouse fauna of five species among the 14 Afro-Eurasian species of the genus Pterocles: three pre-saharan and two arid/semiarid steppeland species. We conducted an experimental captive breeding of the Black-bellied sandgrouse, P. orientalis, the largest species. Flock breeders originated from wild-laid eggs collected in west-central Morocco, were hatched and hand-reared in captivity. Pairs of different ages were housed in an aviary. Egg-pulling procedure was used and eggs incubated artificially. Breeding parameters, hatchability, and post-hatching mortality were recorded. The Black-bellied Sandgrouse showed a seasonal breeding pattern with a laying period extending 7 to 12 weeks. The clutch frequency varied from 3 to 7 clutches per female per season. The mean clutch size was 2.66±0.47 (1-3) eggs and the mean inter-clutch interval was 10 ± 2.7 days. The average total egg production was 12 ± 5.83 eggs per female varying with age from 8 to18 eggs per female. Incubation duration is 28 days. Egg fertility and hatchability of fertile eggs increased with age and varied respectively from 50 to 85.1% and from 75 to 88.2%. Chick mortality occurred only in the first week after hatching averaging 60.5%. Chicks are precocial and fast-growing becoming sexually dimorphic by 6 weeks of age and reaching a mean asymptotic body weight (350 g) by approximately 10 weeks. Therefore, sandgrouse would provide a new promising source of low-cost animal protein through small-scale poultry in rural poor-resource arid areas

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Contribution to In Situ Conservation Efforts of Orchidaceae in the West Rif Area (Northern Morocco)

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Mohamed Libiad, Yahya El Karmoudi, Abdelmajid Khabbach, Soumia Fahd
The northern Moroccan mountains constitute a hotspot of biodiversity in the Mediterranean basin and are rich in orchids. However, threats to orchids are still poorly understood, particularly the effects of climate change and human activities. Moreover, information on their distributions is limited. This study aims to study the diversity of orchids and the factors affecting their distribution and their conservation at the level of the West Rif Area (Northern Morocco). In the study area, 53

stations were surveyed during the orchids flowering period. At each surveyed station, various parameters were recorded, namely the specific richness and abundance of orchids, altitude, exposure, slope, percentage of station cover, and the plant group associated with the orchids. A GPS location of the various stations was carried out. Our investigation allowed the inventory of 25 orchids taxa belonging to 7 genera. The genus Ophrys is the richest, with 15 taxa. However, Serapias parviflora Parl. is the most abundant species, covering 19 stations. In total, five taxa were identified for the first time in Morocco, namely Ophrys phryganae Devillers-Tersch. & Devillers, O. sicula Tineo, O. subfusca (Rchb. f.) Batt., O. tenthredinifera subsp. grandiflora (Ten.) Kreutz and O. villosa Desf. Ten categories of human activities threaten the conservation of orchids in the study area have been identified, namely urbanization, agriculture, olive growing, grazing, forest cutting, harvesting medicinal plants, tourism, trampling, waste dumping and fire. The massive flowering of Ophrys apifera Huds. during the 2023 dry year in comparison with other species could be explained by the effect of climate change. The results of this study could constitute a basis for ex-situ and in-situ conservation of orchids at the regional level. A specific conservation and enhancement actions are recommended; namely the adaptation of ex-situ restoration and conservation programs (seed collection, germination test, acclimatization, etc.).
Keywords: In situ conservation, Human activities, Northern Morocco, Wilds Orchids.

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Production characteristics of the Common Meagre Argyrosomus regius (Asso, 1801) (Teleostei: Sciaenidae) of the Moroccan Saharan Atlantic coastal waters: a comparison among fisheries, and aquaculture for restocking and industrial processes

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Common Meagre, *Argyrosomus regius*, represents one of the largest fish of great economic importance as both natural fishery resource and farmed fish, in eastern Atlantic Ocean and Mediterranean and Black seas. It has excellent biological characteristics with high feed conversion and fertility rates, euryhalinity, and relatively rapid and optimal growth between 16 and 20℃. It is appreciated for its flesh quality and flavor, high selling price for fish weighing over 2 kg. Fished specimens can reach maximal body size and weight over 1.80 m and 50 kg, respectively. The common meagre is considered as a strategic species for the developing marine aquaculture in Morocco, allowing a specific diversification of marine fish farming. To this end, an experimental farm of this species has been operating at the Aquaculture Centre of the National Institute of Fishery Research in Mdi'q, northwest Morocco. We aimed at assessing the growth parameters, mortality and exploitation of this species in southern Morocco, with a comparative analysis among fisheries and farmed populations. 115 specimens were measured for body length at the Dakhla landing port. Individual age was estimated by scalimetry and monthly length frequency data were analyzed using FiSAT II software for evaluating the Von Bertalanffy growth parameters, which include the asymptotic body length (L∞), the growth constant rate (k). Body weight was calculated using a length to Weight relationship. An auximetric analysis at the inter-specific level within the sciaenids, was carried out to correct k values for differences in L∞. Recorded standard body length ranged from 28 to 137 cm with corresponding ages of 1+ to 12+ years. Estimated L∞ was 213 cm and k was 0.075 year-1 and a high growth performance index (Ø) of 5.53 and body weights of 366g and 1835g, respectively at ages of 2 and 4 years. L∞-corrected k was similar to that of other congeneric species, but much lower than those of other sciaenids. Total mortality (Z), estimated by the capture of converted length curve, was 0.56 year-1, natural mortality (M) of 0.16, and fishing mortality (F) of 0.40 year-1. The exploitation level (E) of A. regius was then 0.7, which is higher that the optimal exploitation efficiency (E=0.5) indicating that

the fishing pressure on A. regius is very high. Thus, the status of the stock in the Moroccan southern Atlantic zone seems to be over-exploited. Besides fishing regulatory measures, restocking fisheries and the production of ready-to-cook portions should be developed.

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Biological and Ecological Assessment of Freshwater Fish within the Zat Watershed (Morocco) Across an Altitudinal Gradient

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The phenotypic flexibility and adaptability of freshwater fish can lead to morphological and structural changes in response to variations in their environment. The study of these responses is of paramount importance in understanding the vulnerability of these species to environmental perturbations, whether of natural or anthropogenic origin.
In this research, we used an altitudinal gradient as an indicator of upstream and downstream environmental variations and examined its impact on fish morphology and population structure. We chose the barbel, which occupies four different geographical stations, as a suitable biogeographical sample. We explored correlations between several variables using biological, ecological, morphological, and environmental analyses.
Analyses of water quality revealed a clear improvement upstream, favoring the isolation of Luciobarbus ksibi in terms of its adaptation to high altitudes, while downstream, the disappearance of Luciobarbus magniatlantis highlighted the sensitivity of these populations to variations in environmental quality. Along the altitudinal gradient, Ait Ourir barbels showed a reduction in the distance between their dorsal and pectoral fins as they moved upstream, while Tamgounnssi barbels showed an increased eye diameter and maximum body depth. In contrast, upstream barbel from Mriouate and Zerouane showed higher values for eye diameter, with Mriouate showing a longer pre-orbital distance and Zerouane a shorter pre-orbital distance. These observations suggest potential adaptations of fish to different environmental conditions along the altitudinal gradient, in response to thermal and hydrological variations. Other morphometric and functional characteristics were also influenced by selective environmental factors.
These results highlight the sensitivity of barbel to climate change, paving the way for future studies in the field of ecological conservation.

Keywords: Zat basin, Barbel fish, geometric morphometry, population structure, Vescero-Somatic Index, Gonado-Somatic Index, Scaled mass index.

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Production of H3PO4-Activated Carbon from Biomass-PFCP for Methylene Blue dye removal from water: Characterization, kinetics, isotherm, thermodynamics and regeneration

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There is a growing interest in the adsorption of pollutants on biosorbents, especially those of plant origin. This study deals with the development of activated carbon based on PFCP waste by phosphoric acid activation and their application as adsorbents of methylene blue dye. The activated carbon obtained was characterized by physicochemical methods and complementary analyses. The different adsorption experiments were followed by varying the mass of the adsorbent, the contact time, the pH of the solution, the initial dye concentration, and the variation of temperature. The obtained results indicate that the adsorption equilibrium is reached after a contact time of 110 min. The adsorption rates remain proportional to the mass of each adsorbent with an adsorption capacity of 74.58 mg/g. PFCP could be a potential precursor for the preparation of ecological carbon for the reduction or elimination of organic pollutants with a high surface area and microporous mesoporous structure.

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Water filtration by use of molybdenum disulfide MoS2 nano-membrane

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Desalination of seawater and brackish water is one possible response to water crises and shortages. In our work we have explored one of the desalination methods based on Reverse Osmosis, using a layer of a two-dimensional material as a membrane in the filtration process of this fluid.These criteria led us to choose a material from the Transition Metal Dichalcogenide (TMD) family, the chosen material being molybdenum disulphide.

Given the size of the particles and the simulation time required, the ideal method is based on molecular dynamics. The simulation will therefore describe the system on an atomic scale by describing the movement of the atoms (chlorine and sodium) and molecules (water) that make up our system. We used the Lenard Jones and Coulombian potentials to describe the interactions between the water molecules and the chlorine and sodium atoms respectively. The hardware we used to model our system was VESTA (Visualization for Electronic and Structural Analysis) and Packmol, and for the simulation code we used LAMMPS (Large-Scale Atomic/Molecular Massively Parallel Simulator) and some basic tools for representing the results. For the simulations we chose pressures of 50MPa, 100MPa, 150MPa, 200MPa, 250MPa and 1000MPa respectively and simulation times ranging from 0ns to 10ns with a composition of 900 water molecules and 32 salt ions (16 chlorine and sodium atoms). The simulation was carried out on a molybdenum disulphide monolayer with a pore size of 1nm.

In short, our study shows that molybdenum disulphide is a very good material for the water desalination process. The results obtained in the study of a monolayer of this material are highly relevant, as the performance of molybdenum disulphide allows us to predict that this study could well be developed on a large industrial scale to solve the problem of access to drinking water for a large proportion of the world's population.

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Optimizing Wastewater Treatment Using Biochar-Based Column Filtration System.

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Wastewater treatment for water reuse has received considerable attention owing to water resource shortage. One of the most effective wastewater treatment methods involves the use of column filtration systems (CFS). Biochar-based column filtration systems (BCFS) for wastewater treatment have gained attention in the last decade. In this study, decanted wastewater was treated by using a biochar-based column filtration system. The biochar using in this study was produced from exhausted olive pomace at a temperature of 590℃ and maintained for a residence time of 2h with a heating rate of 10℃/min. Four BCFS were constructed on the basis of the volume ratio of biochar in common sand (0%, 10%, 25%, and 50%) to explore the influence of biochar dosage on the treatment performance. The results showed that the biochar added to BCFS provided higher removal efficiencies for ammonium (54.6%–75.2%), COD (44.7%-56.3%), total phosphorus (36.6%-42.9%), orthophosphate (37.7%-43.1%), and total suspended solids (84.7%-93.1%). The BCFS with 10% biochar showed the best removal performance toward the NH4+ (75.2%), COD (56.3%), TP (42.9), PO43- (43.1), and TSS (93.1%), compared with control column filtration system (CCFS) for ammonium (53.6%), COD (32.3%), total phosphorus (27.3%), orthophosphate (31.9%), and total suspended solids (79.2%) respectively. Moreover, this performance in eliminating these pollutants is accompanied by a release of nitrate, nitrite, and sulfate pollutants by all CFS.
Based on this preliminary study, the efficiency of BCFS in removing pollutant from wastewater is optimal with the small amount of biochar (10%).

Keywords: Biochar; Wastewater treatment; Column filtration systems; Optimization

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'The removal of phenolic compounds using Navicula permitis algae: a potential treatment method for olive mill wastewater'

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Abstract:
Microalgae hold promise as sustainable and renewable resources for phenolic compound removal. Industrial mill wastewater often contained phenol. In this work, we isolated and identified a freshwater diatom through 18S DNA analysis, Navicula permitis. Then, we assessed its ability to grow and effectively eliminate phenolic compounds at concentrations ranging from 50 to 250 mg/L to address incomplete treatment issues. Chlorophyll fluorescence was measured under stress, and phenol degradation was examined through phenol hydroxylase and catechol dioxygenase activity in N. permitis. Our findings revealed that N. permitis could remove phenol concentrations up to 145.9 mg/L, with optimal conditions at 50.08 mg/L phenol, 106 cells/mL N. permitis, and 11.38 days of treatment. A zero-order kinetic model described the elimination of phenol. The metabolism mechanism supposed to biodegrade the phenolic compound in this experiment is that N. permitis may employ PHase. The metabolism of phenol included the ortho-pathway. N. permitis generated biomass while degrading phenol, making it a good choice for ecological remediation.
Keywords: phenolic compounds, wastewater, Navicula permitis, enzymes, biodegradation.

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Advancing Wastewater Treatment: Innovative Ceramic Membranes for Sustainable Reuse

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This study introduces transformative ceramic membranes for sustainable wastewater treatment and reuse, focusing on regions grappling with water scarcity and pollution. The integration of magnesium aluminosilicate-based ceramics, derived from industrial by-products, yields efficient membranes with exceptional properties. Comprehensive microstructural analyses reveal their composition and structure.

Filtration experiments targeting textile effluent demonstrate substantial reduction, with over 70% decrease in turbidity, BOD, and COD levels. This research showcases innovative ceramic membranes' potential to revolutionize wastewater treatment, fostering sustainability. Furthermore, our study's implications extend beyond laboratory findings. By bridging the gap between advanced materials, scientific investigation, and practical application, this research contributes to addressing pressing global challenges. As communities seek solutions for water-related issues, our work underlines the significance of innovative approaches in meeting the demands of a rapidly changing world.

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Olive Mill Waste-Derived Biochar for Sustainable Removal of Organic Compounds from Olive Mill Wastewater

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Olive mill wastewater (OMWW) remains a primary environmental challenge in regions with significant olive oil production. This by-product is rich in polyphenols, organic compounds that, despite their health benefits when consumed in foods, can be environmentally detrimental when released untreated into ecosystems due to their potential toxicity, recalcitrance, and the oxygen depletion they can cause in aquatic environments.
Addressing the twofold challenge of waste management from olive oil production and the treatment of polyphenol-rich OMWW, this study explores the use of biochar, specifically derived from olive mill solid waste, as an innovative and sustainable adsorbent solution. The olive mill waste, which typically comprises residual olive skins, pits, and pulps, is pyrolyzed at a pilot scale under controlled conditions to produce biochar, a porous material known for its impressive adsorptive capabilities.
This research characterized the derived biochar using various techniques, noting its surface area, pore size distribution, and inherent functional groups conducive to adsorption. Systematic experiments were then conducted to assess the biochar's efficiency in adsorbing polyphenols from OMWW, studying variables including contact time, pH, biochar particle size, and initial polyphenol concentration.
Preliminary results indicate that biochar derived from olive mill solid waste exhibited a high affinity for polyphenols, achieving removal efficiencies surpassing many commercial adsorbents. The adsorption process was best described by the total organic carbon, pointing to a multilayer adsorption mechanism. The DCO data closely followed the pseudo-second-order model, suggesting chemisorption as the rate-limiting step.
This study's findings highlight the dual environmental benefits of transforming significant agricultural waste into a value-added product that can, in turn, remediate another environmental concern. The potential scalability and cost-effectiveness of this approach offer a promising avenue for sustainable wastewater treatment in olive oil-producing regions, ensuring both waste valorization and the protection of aquatic ecosystems.

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The use of landfill leachate treated by sugar lime sludge for watering green spaces

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Morocco is among the countries, in Africa, exposed to the lack of water. In order to optimize water resources, it is advisable to both consider an appropriate water management strategy and find new sources of water. In this context, the leachate from landfills may constitute a relevant source of water. Our study aims to treat leachate with sugar lime sludge and phosphates washing sludges to make it usable for the irrigation of green spaces.
Barrels were filled with 30 l of leachate and sugar lime sludge (or phosphate washing sludge) was added at two concentration levels (35 % and 50 %) before homogenization. After 24 hours, the solutions were filtered and the supernatants recovered were analyzed from a bacteriological and physicochemical point of view before being tested in watering rosemary plants. The decantats were mixed with green waste and composted.
After 24 hours of contact, bacteriological analysis showed total elimination (100 %) of fecal streptococci after adding 35% of sugar lime sludge. Physico-chemical analysis has proved the elimination of organic matter from the leachate by adsorption on the calcium carbonates shown by an increase in organic matter in the decantate from each treatment. The pH and the electrical conductivity values of supernatant were within the norms for unconventional water discharges. The phytotoxicity test confirmed the non-toxicity of this supernatant. Measurement of stomatal conductance and chlorophyll fluorescence after watering rosemary showed that plants grew in normal conditions. As far as compost is concerned, analysis of certain physico-chemical showed clearly a good evolution and degradation of organic matters.
The results will allow landfill managers to obtain an economic impact aiming at lower-cost treatment, a social impact consisting of eliminating the environmental and health hazards of leachate,

and a recycling of water in the leachate for irrigation of green spaces.
Key words: Leachate; sugar lime sludge; phosphates washing sludges; Compost; green waste

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New Polysaccharide-based bio-superabsorbents for Water Stress Control in Agriculture: Preparation and Properties

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Water management is rapidly becoming one of the most pressing issues all countries in semi-arid and arid parts of the world are facing. Global water consumption is predicted to increase by 50% in 2030 , which will cause an acute water shortage. Presently, the agricultural sector consumes more than 70% of freshwater in most regions of the world1, putting more pressure on water needs and worsening water scarcity. To address this issue, scientists and researchers are exploring innovative solutions, among which the development of ecofriendly polysaccharide-based bio-superabsorbents stands out, in fact, the bio-superabsorbents are materials that have the ability to absorb and release large quantities of water. Commercially available synthetic petroleum based super absorbents, based on acrylic monomer, are harmful for the environment and human health as reported in many scientific reports . Polysaccharide-based bio-superabsorbents are typically derived from natural sources, such as plant-based polymers, and are designed for various applications, including agriculture, horticulture, hygiene and environmental remediation. The objective of this work is to develop new biodegradable superabsorbent materials using cellulose composites extracted from various plant sources. These materials are intended to be effective for agricultural applications and presenting water absorption a retention property that make them very competitive compared to those commercially available.

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Eco-Friendly Wastewater Treatment: A Key to Resolving Water Scarcity in Arid Areas

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The utilization of wastewater presents a sustainable solution to combat water scarcity, offering numerous advantages like bridging the gap between supply and demand, reducing pollution of freshwater sources, providing a robust approach to addressing water scarcity and climate change, and contributing to the achievement of the Sustainable Development Goals. The Multi-Soil-Layering (MSL)

system emerges as an environmentally friendly wastewater treatment technology, particularly suitable for small and medium communities. It offers cost-effective treatment technology, generating effluents with minimal contaminants. Additionally, MSL operating and maintenance are relatively simpler compared to conventional treatment systems. This study aims to assess the effectiveness of a full-scale multi-soil-layering (MSL) treatment system in removing contaminants from urban wastewater and to investigate the correlations between physicochemical and bacteriological parameters. The treatment facility is located at Cadi Ayyad University in Marrakech, Morocco, and consists of a septic tank, and a sequential arrangement of a vertical flow MSL (VF-MSL) unit and a subsurface horizontal flow MSL (HF-MSL) unit. Both the VF-MSL and HF-MSL units are constructed with alternating layers of gravel and soil-based materials in a brick-like pattern and operate at a hydraulic loading rate (HLR) of 250 L/m2/day. To assess the performance and the quality of treated wastewater by the MSL system, we conducted sampling every 15 days at the inlet and outlet of each unit within the treatment system. The parameters monitored include pH, electrical conductivity, chemical oxygen demand (COD), suspended solids (SS), nitrogen compounds (NH4+, NO3-, NTK, NT), phosphorus compounds (PO43-, PT), as well as microbiological parameters such as fecal coliforms (FC), fecal streptococci (FS), and staphylococci (ST). Obtained results demonstrate the substantial removal efficiency of the hybrid MSL system in treating domestic wastewater. Significant removals ($p<0.05$) in organic matter and phosphorus were obtained, as well as noteworthy nitrogen removal, including TSS (97%), COD (88.57%), TP (79.93%), and TN (88.49%). Furthermore, the hybrid MSL system achieved substantial log reductions in fecal bacteria indicators and pathogens, with removal rates of 4.21 log for FC, 3.90 log for FS, and 2.43 log for ST. The correlation tests indicate a significant correlation between the studied parameters, with a correlation factor close to 1 for most of the parameters. In conclusion, the implementation of multi-soil-layering eco-technology for domestic wastewater treatment results in treated water that adheres to Moroccan discharge and irrigation standards. This treated water can be effectively reused in landscaping and agriculture, offering a valuable solution to address water scarcity.

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Synthesis of Activated Carbon/Sodium Alginate Composites for Wastewater Treatment

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In this study, we present a sustainable approach for the production of activated carbon derived from olive pits using chemical activation with potassium hydroxide impregnation. The resulting activated carbon is subsequently employed to fabricate composite materials in combination with sodium alginate (AC/Alg) for potential applications in wastewater treatment.
The production process involves impregnating olive pit precursors with KOH, followed by chemical activation to create activated carbon with high porosity and specific surface area. Composite beads are then formed by mixing the activated carbon with sodium alginate, offering an eco-friendly and effective adsorbent for pollutant removal. Various AC/Alg formulations were tested to optimize adsorption efficiency. The research explores the influence of adsorption parameters, such as contact time, initial pH, and initial pollutant concentration, on the removal of a model molecule.
The findings demonstrate the potential of AC/Alg composites for efficient and environmentally friendly wastewater treatment. This study contributes to the development of sustainable solutions in the field of water purification and underscores the importance of utilizing agricultural waste for environmental benefit.

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Ultrathin Bi3O4Br Nanosheets Embedded in Chitosan Beads as a Heterogeneous, Reusable and Highly efficient Photocatalyst for Water Treatment

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Water is one of the most precious natural resources. It is an essential need and an indispensable component for the survival of all forms of life on this planet. Without water there is no life on Earth. Sadly, however, water contamination by organic, inorganic and biological pollutants has become a serious problem throughout the globe. Much worse, the recent expansion of human activities mainly domestic and industrial activities (e.g. textile, paper, food, plastic, cosmetic, photographic, and pharmaceutical industries) has resulted in a significant increase of pollutants in different environmental compartments such as soil, water, and atmosphere. In this study, a new hybrid material denoted Bi3O4Br@Chitosan has been successfully prepared through a multistep process and evaluated in the photodegradation of rhodamine B in aqueous solution and reduction of 4-nitrophenol in the presence of NaBH4. The surface morphology, elemental composition, crystal structure and light absorption ability of the obtained photocatalysts were comprehensively examined by scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), raman spectroscopy and Uv-vis diffuse reflectance spectroscopy (DRS). Experimental studies revealed that the prepared materials exhibit a good photocatalytic activity for the degradation of rhodamine B in aqueous medium and reduction of 4-nitrophenol in the presence of NaBH4 as a reducing agent. Additionally, good reusability of the photocatalyst was also observed in many successive catalytic runs. Thus, the combination of adsorption and photocatalytic wastewater treatment could provide a new, highly efficient and more advanced route to address the global water crisis the human society is currently facing.

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Chitosan supported bismuth oxyiodide : a powerful and highly efficient photocatalyst for water treatment

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The global water crisis (e.g. water shortage, water pollution, and water-related disasters) is one of the greatest risks the human society is currently facing. Recently, photocatalysis over semiconducting materials has emerged as a promising technology for wastewater treatment1. Thus, looking for inexpensive and highly efficient photocatalytic materials toward the complete degradation of water contaminants remains one of the most challenging tasks nowadays. Here, we report the preparation and photocatalytic application of a new hybrid material based on bismuth oxyiodide (BixOyIz) supported on chitosan. Actually, chitosan is a green and highly abundant polysaccharide obtained from

the deacetylation of chitin; the second abundant biopolymer after cellulose2,3. This material was prepared by a simple, eco-friendly and cost-effective three-step process. The composition, structure and morphology of the obtained hybrid materials were investigated using scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), Uv-Vis diffuse reflectance spectroscopy (DRS), X-ray diffraction (XRD), raman spectroscopy and Fourier transform infrared spectroscopy (FTIR). The prepared materials were used as heterogeneous photocatalysts for degradation of methyl orange in aqueous media. Photocatalytic experiments revealed that the photocatalytic activity of the prepared materials is much higher than many reported photocatalytic materials. More importantly, the photocatalysts could easily be recovered by simple filtration with no significant loss of their activity after seven successive runs. The novelty of the present work lies in the combination of both adsorption and photodegradation in a single photocatalytic system. It is believed that chitosan plays two major roles in this photocatalytic system. On the one hand, chitosan acts as catalytic support to enhance the dispersion of photocatalytic species and to facilitate the recyclability of the materials, which is highly essential for large scale applications. On the other hand, chitosan provides a high surface area to enhance the adsorption of organic pollutants on the surface of the materials by improving the contact between the photocatalysts and the pollutant. Thus, the prepared photocatalytic system combines a remarkable adsorption capacity and high photocatalytic ability. Therefore, this contribution may offer a great opportunity for using bismuth-based nanomaterials in photocatalytic wastewater treatment, environmental protection-remediation using clean and renewable energy.

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Marine Biomass-Supported Zinc Oxide for Congo Red Removal: Synthesis Characterization and Adsorption Study

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The ability of Marine Biomass-supported Zinc Oxide (CT/ZnO) biocomposite has been tested for the removal of Congo Red (CR) from an aqueous solution. The biomaterial characteristics were analyzed, and X-ray diffraction (XRD) results confirmed the presence of peaks associated with zinc oxide and calcium carbonate. The optimum conditions for the effective removal of CR onto CT/ZnO are pH= 6, initial CR concentration= 50 mg/L, nanocomposite dosage= 20 mg, contact time= 90 min and temperature= 25℃. Adsorption isotherm studies and kinetic studies were done. Freundlich isotherm fits with the experimental data very well with high coefficient of determination (R2 = 0.984) and experimental maximum dye uptake was 69.43 mg/g. In kinetic studies, pseudo second-order model was obeyed (R2 = 0.998). Thermodynamic properties were assessed, demonstrating the spontaneous and exothermic nature of the adsorption process, accompanied by an increase in randomness. Desorption studies illustrated the bioadsorbent effective reusability for up to four cycles. In conclusion, the CT/ZnO biocomposite proved to be a highly efficient, recyclable, and cost-effective adsorbent for treating dye-contaminated water.

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1D Diffusion model of slow sand filtration for wastewater decontamination

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In regions where wastewater laden with high concentrations of trace metallic elements, emanating from industrial activities like mining, pose an imminent threat to both the environment and public health, innovative purification techniques become imperative. This study focuses on the application of one such technique, Slow Sand Filtration (SSF), in the context of wastewater treatment near the Draa Lasfar mine in the Marrakech region, Morocco.
Slow Sand Filtration, a well-established water treatment method, involves the passage of contaminated water through a bed of sand, promoting physical, biological, and chemical processes that lead to the removal of impurities. In this context, SSF acts as a vital tool for decontaminating wastewater before it is released into the Tensift River, which serves as a crucial source for irrigation in the region.

To enhance the understanding of the intricate processes at play within this SSF system, we employed mathematical model. Specifically, we developed a one-dimensional diffusion model, designed to represent the intricate reality of SSF far more accurately than conventional logistic models. This model, tailored to the unique conditions of our study site, incorporates the diverse physical and chemical interactions involved in the removal of trace metallic elements.
Comparative analysis between the simulation results of our diffusion model and the observed data highlighted a superior fitting to the real-world scenario. This reinforced the efficacy of the 1D diffusion model in capturing the nuances of SSF for trace metallic element removal.
In conclusion, this study underscores the significance of Slow Sand Filtration as an eco-friendly and efficient solution for decontaminating wastewater in regions facing the imminent threat of waterborne pollutants. Furthermore, the development of our 1D diffusion model provides valuable insights into the intricate mechanisms at work within SSF systems, offering a promising avenue for optimizing their performance and ensuring the safety of downstream users and ecosystems.
KEYWORDS: Model of diffusion, slow sand filtration, heavy metals, decontamination, removal efficiency and modeling.