Sher-e-Bangla Agricultural University

SDG Activity Report
on

SDG 06:
Clean Water And Sanitation

Contents

Faculty Research and Publications

Microplastics contamination through a mighty estuarine island: Distribution, influencing factors, and risk assessment.

Author:Mir Mohammad Ali
Year:2024
Abstract:
The global concern over microplastic (MP) contamination in diverse ecosystems is well-established, yet Nijhum Dwip Island (NDI), known for its ecological diversity, has not undergone a comprehensive study addressing the extent of MP pollution. This research aims to evaluate the spatial distribution, influencing factors, and ecological risks of MPs in both sediment and surface water surrounding NDI, situated in the Northern Bay of Bengal. A meticulous collection of 40 sediment and 40 tidal water samples from various sites facilitated a detailed analysis. The mean abundance of MPs in sediment was 138.39 ± 34.15 pieces/kg, while in water, it was 72.83 ± 30.76 pieces/m^3. Various shapes observed on NDI included films, fragments, fibers, and foams, with fragments dominating in sediment (64.05 %) and water (61.51 %). Analysis of FTIR spectra identified two primary polymer types, namely polyethylene (PE) at 57 % and polypropylene (PP) at 40 %. The results indicated elevated pollution levels on NDI, with sediment and water pollution load index measuring 1.32 and 2.01, respectively, signifying significant MP contamination in both compartments. Given the island's rare biodiversity, the vicinity of wastewater sewages, anthropogenic activities, and atmospheric deposition, could be behind MP contamination in water and sediments. No strong correlation between MP and physiochemical properties in water and PCA biplots showed their similar distribution, whereas MP abundances in sediment were significantly correlated with pH and organic matter ($p<0.05$), signifying a pivotal role in transporting MPs in the aquatic environment. Two canonical variables were identified as important by canonical correlation analysis, demonstrating the interdependence of MP contamination at the sample sites. This research contributes to better insights into the occurrence of MP in the rare islands, which are ecosystems that have been hardly examined for this type of pollution, and it can report sustainable interventions to lessen MP inputs to the Bay of Bengal.

The Novel Study On Arsenic Contamination, Health Risk, and Approaches to Its Mitigation From Water Resource of a Developing Country: A potential review

Author:Mir Mohammad Ali
Year:2024
Abstract:
The pollution and contamination by arsenic (As) in the water resources is a worldwide concern due to its adverse toxic effects on the environment and public health. The current study aimed to investigate arsenic levels in the groundwater system with the possible health risk, and sustainable mitigation strategies. The data on arsenic in the water system were collected from the Web of Science and Scopus databases. The published data showed that arsenic concentration (0.0002–19.0 mg/kg) in the water system in Bangladesh was higher than the permissible standards and data from other countries, indicating severe contamination of water resources by arsenic. The study concluded that the water resource in Bangladesh is not safe for human consumption. The review has also identified the research gaps in various strategies for controlling the arsenic problem and their impact on the ecosystems. The present study suggested future research directions on sustainable intervention, impacts assessment of arsenic on humans, and formulating existence policy that helps to combat arsenic contamination.

Biochar Outperforms Biochar-Compost Mix in Stimulating Ecophysiological Responses and Enhancing Soil Fertility under Drought Conditions
Author:Mirza Hasanuzzaman

Year:2024

Abstract: Purpose Biochar (BC) can directly enhance soil fertility, thereby improving land productivity and crop health and restoring degraded lands. This study aims to investigate the potential of BC, alone or combined with compost, to improve soil proper ties and plant drought tolerance, promoting sustainable agriculture amidst climatic and anthropogenic challenges. Methods Phragmites karka was cultivated in a controlled greenhouse with treatments: (i) 0% BC [control, well-watered, 65% water holding capacity (WHC)], (ii) 0% BC (drought), (iii) 1.5% BC (drought), and (iv) 1.5% BC + 1.5% compost (drought). Plant growth, water relations, mineral content, carbon and nitrogen content, proline, soluble sugars, gas exchange, chlorophyll, fluorescence, and soil respiration were measured using standard protocols and advanced instruments. Results Applications of BC or BC + compost improved soil fertility, plant dry biomass, number of tillers, leaf development, and root-to-shoot ratio. Biochar-treated plants showed better leaf water and osmotic potential, essential for turgidity and growth. Biochar also increased leaf proline, soluble sugars, and Ca2+, Mg2+, and K+/Na+ ratios, enhancing osmotic adjust ment and nutrient acquisition of plants. Net photosynthesis, carbon metabolism, photochemical efficiency, and electron transport rate were higher with BC under drought, outperforming the BC-compost mix. Both treatments significantly boosted soil respiration, enhancing soil fertility and drought resilience more effectively than unamended soils. Conclusion Our results show that amending soil with 1.5% BC was more effective in improving plant drought tolerance than a mixture of BC and compost for maximum water management, allowing P. karka to grow under water-limited environments

Impact of contemporary management practices in pond fish farming on the socio-economic condition of fish farmers in north-central Bangladesh

Author:Koushik Chakroborty, Jahid Hasan

Year:2024

Abstract:

Aquaculture in Bangladesh has greatly improved diet structure, ensured food safety, and facilitated the transformation of fisheries growth mode. The study aimed to investigate the existing management techniques of fish farming in ponds and assess its impact on the socioeconomic status of fish farmers in the Trishal upazila (sub-district), Mymensingh, a region in north-central Bangladesh, from January to June 2023. Data were collected using a well-structured questionnaire. The majority of farmers (62.50%) had ponds that were 0.5-1.0 ha in size. Over half of the farmers (52.50%) practiced monoculture, with catfish comprising 37.13%. The average stocking density was 50,000-65,000 fry ha-1 With conventional post-stocking management, the majority of farmers (90%) utilized probiotics, and 87.50% used vitamins and minerals. Around 90% had formal education, and most individuals resided in standard housing. All participants had access to electricity and potable water, 96% had adequate sanitary facilities, and 95% of the farmers had proper healthcare facilities. Half of the farmers (50%) were involved in fish farming as their primary occupation. Most farmers (75%) earned an annual income ranging from 700 to 1,300 USD, and a significant 90% invested their own funds into fish farming. More than half of the farmers (55%) received technical assistance from their neighbors. Fish farming in the region has intensified, and the existing management practices have led to enhanced production, thus benefiting the livelihoods of the fish farmers. However, achieving long-term sustainability necessitates a supply of high-quality fry, cost-effective and high-quality feed, comprehensive training, and effective marketing strategies.

Field Screening for Low Levels of Toxic Inorganic Arsenic in Dry-Season Rice Varieties from Bangladesh

Author:Md Tofail Hosain

Year:2024

Abstract:

Rice varieties with low arsenic content (As) could address some aspects of human health risks linked to As-tainted rice consumption. This study evaluated 46 rice cultivars from Bangladesh for their total and speciated As (inorganic and organic) in grains. The rice varieties were cultivated under a continuously

flooded irrigation system with As-tainted groundwater. The study revealed notable varietal effects on total and speciated As concentrations. The levels of total As in unpolished rice ranged from 219 to 562 μg kg–1 among different rice cultivars, with BRRI dhan47 exhibiting the lowest and BR7 showing the highest concentrations. In brown rice, inorganic As was the dominant form, contributing 54–91% of total As. Nevertheless, a 10% polishing process can significantly diminish the levels of total As (14–39%), inorganic As (12–46%), and DMA (12–36%) found in brown rice. Grain As revealed a negative relationship between the rice grain yield and some beneficial micronutrients. Based on grain As levels, a couple of low As accumulating rice varieties have been identified, which could be promoted to grow in As-prone areas as a low-cost mitigation strategy. Consequently, screening low-accumulation rice cultivars could minimize the As load in humans, which occurs through rice consumption in As-endemic areas.

Partitioning water footprints of rice for assessing their implications in the face of climate change in Bangladesh
Author:Mostafijur Rahman
Year: 2024
Abstract: To improve rice yields while conserving water and minimizing environmental impact, a lysimeter experiment was conducted at Bangladesh Agricultural University's field irrigation laboratory in Mymensingh. This study, spanning 2018–2020, aimed to measure the water footprint (WF) of the Aman-Boro-Aman rotation, considering green water footprint (GWF; rainwater) and blue water footprint (BWF; irrigation water), with a focus on climate change implications. Various irrigation methods, including rainfed and several interval-based irrigations (I9D–irrigation applied after nine days of ponded water disappearance, I6D, I3D, I3D + NP–I3D with no percolation allowed, and I1D), were evaluated. Results showed rainfed treatments had higher GWF (1155–1575 L/kg) due to reliance on inconsistent rainfall, while irrigated ones had lower GWF (375–1084 L/kg) but increased BWF, notably I1D with the highest BWF (2675 L/kg). This contrast highlights significant water usage differences among irrigation methods. The total water footprint (TWF) varied, with rainfed methods showing 1460–1960 L/kg and I1D the highest at 3603 L/kg. The consumptive water footprint ranged from 734 L/kg (I3D + NP) to 1097 L/kg (rainfed), indicating the efficiency of no-percolation strategies in water conservation. This also led to improved nutrient availability, resulting in higher plant height and rice yield. Seasonal variations in TWF were also observed, with the Aman season showing greater variability than the Boro season due to differences in rainfall and irrigation practices. The study underscores the importance of managing irrigation frequency, timing, and percolation for optimizing rice water footprints under changing climatic conditions.

Drought Stress Tolerance in Rice: Physiological and Biochemical Insights
Author: Sujat Ahmed
Year: 2024
Abstract: Rice (Oryza sativa L.), an important food crop, necessitates more water to complete its life cycle than other crops. Therefore, there is a serious risk to rice output due to water-related stress. Drought stress results in morphological changes, including the inhibition of seed germination, reduced seeding growth, leaf area index, flag leaf area, increased leaf rolling, as well as the decrement of yield traits, such as plant height, plant biomass, number of tillers, and 1000-grain yield. Stress also causes the formation of reactive oxygen species (ROS) such as O2−, H2O2, and OH−, which promote oxidative stress in plants and cause oxidative damage. The process of oxidative degradation owing to water stress produces cell damage and a reduction in nutrient intake, photosynthetic rate, leaf area, RWC, WUE, and stomatal closure, which may be responsible for the decrement of the transpiration rate and plant dry matter under decreasing soil moisture. Plants have the ability to produce antioxidant species that can either be enzymatic (SOD, POD, CAT, GPX, APX) or non-enzymatic (AsA, GSH) in nature to overcome oxidative stress. During drought, several biochemical osmoprotectants, like proline, polyamines, and sugars, can be accumulated, which can

enhance drought tolerance in rice. To meet the demands of an ever-growing population with diminishing water resources, it is necessary to have crop varieties that are highly adapted to dry environments, and it may also involve adopting some mitigation strategies. This study aims to assess the varying morphological, physiological, and biochemical responses of the rice plant to drought, and the various methods for alleviating drought stress.

Quantification of heavy metals in wild gravid female mud crab (Scylla olivacea) collected from different rivers of Sundarbans mangrove region
Author:Md. Abdul Hannan,
Year:2024
Abstract: Heavy metals pollution is one of our major problems in Sundarbans mangrove zone as we all their surrounding rivers. The presence of industrial development in the nearby areas of coastal and marine aquacultures sites are the cause of heavy metals pollution. The aim of the research was to quantify heavy metals in gravid female mud crabs (Scylla olivacea) in three different rivers of Sundarbans region. Mud crabs and their surrounding water and soil sediments were collected from Mongla, Kholpetua, and Kopotakkho rivers. Analysis of river water was conducted in the laboratory of Shiva Analyticals (India) Private Limited, India, whereas live mud crabs and sediment samples were analyzed from Quality Control Laboratory (QCL), Khulna, Bangladesh for the quantification of heavy metals. The results showed that the heavy metals As, Cr, Cd, Hg and Pb were detected in mud crabs and their surrounding river water and sediments, but the concentration of heavy metals in mud crabs was remains below the limit of human's consumptions except the heavy metal Chromium (Cr). Maximum concentration of heavy metals was detected Kopotakkho river followed by Mongla and Kholpetua river. The concentration of heavy metals was highest in soil sediments followed by mud crabs and river waters. Mud crabs were contaminated by heavy metals that bioaccumulated from their surrounding sediments and water sources. The hierarchy of mean concentrations (mg/kg) of the heavy metals were Pb>As>Cr>Pb>Hg. Heavy metals are carcinogenic for human consumption when exceeded their permissible levels. It is urgent to stop pollution in Sundarbans mangrove zone and led to serve healthy foods for the nations.

Toxoplasmosis in animals and humans: a neglected zoonotic disease in Bangladesh
Author:Delower Hossain
Year: 2024
Abstract: Toxoplasmosis, caused by Toxoplasma gondii, is a zoonotic disease that affects a wide range of warm-blooded animals, including humans. The parasite undergoes both sexual and asexual reproduction in intermediate hosts (humans and animals) and definitive hosts (cats). Transmission in humans occurs through consuming oocyst-contaminated water, fruits, vegetables, and raw or undercooked meats. In Bangladesh, several factors contribute to an increased risk of contracting toxoplasmosis. The parasite is reported to cause diseases among livestock such as goats and sheep in this country, and it has also been associated with some human illnesses. Toxoplasmosis prevalence varies significantly worldwide, with developing countries like Bangladesh experiencing higher rates. Diagnostic methods include both conventional non-DNA-based tests and molecular detection techniques, while treatment options involve using antiparasitic drugs like sulfadiazine and pyrimethamine. To control toxoplasmosis, essential steps include improving sanitation, promoting safe food handling, and educating the public about risks related to cat ownership and undercooked meat consumption. Implementing prenatal screening and treatment is also important. With the growing popularity of pet ownership in urban areas, it becomes essential to emphasize the veterinary and public health significance of toxoplasmosis in Bangladesh. This article comprehensively reviews various aspects of toxoplasmosis, with a specific focus on the situation in Bangladesh.

Pre-emergence herbicides widely used in urban and farmland soils: fate, and potential human and environmental health risks

Author:Aney Parven,Islam Md Meftaul,

Year:2024

Abstract: We determined the distribution, fate, and health hazards of dimethenamid-P, metazachlor, and pyroxasulfone, the effective pre-emergence herbicides widely used both in urban and agricultural settings globally. The rate-determining phase of sorption kinetics of these herbicides in five soils followed a pseudo-second-order model. Freundlich isotherm model indicated that the herbicides primarily partition into heterogeneous surface sites on clay minerals and organic matter (OM) and diffuse into soil micropores. Principal component analysis revealed that soil OM (R2, 0.47), sand (R2, 0.56), and Al oxides (R2, 0.33) positively correlated with the herbicide distribution coefficient (Kd), whereas clay (R2, – 0.43), silt (R2, – 0.51), Fe oxides (R2, – 0.02), alkaline pH (R2, – 0.57), and EC (R2, – 0.03) showed a negative correlation with the Kd values. Decomposed OM rich in C=O and C–H functional groups enhanced herbicide sorption, while undecomposed/partially-decomposed OM facilitated desorption process. Also, the absence of hysteresis (H, 0.27–0.88) indicated the enhanced propensity of herbicide desorption in soils. Leachability index (LIX, < 0.02–0.64) and groundwater ubiquity score (GUS, 0.02–3.59) for the soils suggested low to moderate leaching potential of the herbicides to waterbodies, indicating their impact on water quality, nontarget organisms, and food safety. Hazard quotient and hazard index data for human adults and adolescents suggested that exposure to soils contaminated with herbicides via dermal contact, ingestion, and inhalation poses minimal to no non-carcinogenic risks. These insights can assist farmers in judicious use of herbicides and help the concerned regulatory authorities in monitoring the safety of human and environmental health.

Unlocking the potential of co-application of steel slag and biochar in mitigation of arsenic-induced oxidative stress by modulating antioxidant and glyoxalase system in Abelmoschus esculentus L.

Author: Mirza Hasanuzzaman

Year:2024

Abstract: This study investigates our hypothesis that how effect of arsenic stress on okra (Abelmoschus esculentus L.) can be alleviated through the use of waste materials such as steel slag (SS) and corncob biochar (BC). Different growth variables, biochemical parameters, oxidative stress markers, enzymatic and non-enzymatic antioxidants and glyoxylase enzyme activities were assessed. When okra was exposed to As, there was a noticeable decrease in seedling length, biomass, relative water content, various biochemical attributes, however, electrolyte leakage and lipid peroxidation in okra were enhanced. The supplementation of SS and BC—either individually or in combination—improved the growth parameters and reduced oxidative stress markers. Application of SS and BC also lowered As accumulation in roots and shoots of okra mitigating adverse effects of As exposure. Additionally, the activities of antioxidant and glyoxalase enzyme increased when SS and BC were present, concurrently reducing methylglyoxal content. Arsenic-induced stress led to oxidative damage, an enhancement in both enzymatic and non-enzymatic antioxidants, induced the synthesis of thiol and phytochelatins in roots and shoots. These may play a vital function in alleviating oxidative stress induced by As. Superoxide dismutase, catalase, ascorbate peroxidase, and glutathione reductase activities were significantly enhanced in As-treated plants. These enhancement were further amplified when SS and BC were amended to As-treated okra. Therefore, synergistic application of SS and BC effectively protects okra against oxidative stress induced by As by increasing both antioxidant defense and glyoxalase systems. Both SS, an industrial byproduct, and BC, generated from agricultural waste, are cost-effective, environmentally friendly, safe, and non-toxic materials which can be used for crop production in As contaminated soil.

Influence of Effective Irrigation Water Usage on Carrot Root Productivity and Quality Properties in Soilless Culture

Author: Md. Dulal Sarkar,Sarmin Akter

Year:2024

Abstract: The availability of irrigation water is becoming an increasingly significant concern for crop production in urban areas of Southeast Asia, particularly in Bangladesh. To ensure optimal plant growth and development, it is essential to establish precise irrigation scheduling. Therefore, this study examines the effects of limited irrigation usage on the root quality, production, and morphophysiological features of carrots grown under soilless conditions. Irrigation treatments were in intervals of 200 mL 3-day, 250 mL 2-day, 300 mL 3-day, and 350 mL 4-day. Plants were grown on biodegradable substrates, including cocopeat, sawdust, rice husk, and a mixture of all three with 10% wood ash and 40% cow dung following a randomized complete block design (RCBD). Significant differences in root yield and quality of carrots were observed by irrigation water levels and media types. The yield and quality attributes decreased most when they were subjected to reduced watering, accompanied by a decline in morphological traits (plant height, leaf number, root mass, root length, and diameter) and physiological aspects (relative water content, membrane stability index, and chlorophyll content of leaves). Root quality metrics, i.e., brix, vitamin C, sugar content, beta-carotene, and phenolic content, were also influenced by the frequency of irrigation water used. Root yield and irrigation water usage efficiency were highest with the 2-day interval of 250 mL treatment. The growing media, cocopeat, was found to have acceptable levels of water-holding capacity (87.73%), porosity (69.80%), bulk density (0.10 g cm−3), pH (6.73), and EC (0.14 dSm−1), allowing for optimal carrot growth and development. Watering the plants with 250 mL every 2 days was the best irrigation schedule for growing carrots under a cocopeat-based growth medium, ensuring effective carrot root production considering quality and water use efficiency.

River pattern influences the composition of small indigenous species (SIS) of fish in deltaic Rajbari district, Bangladesh

Author:Zubyda Mushtari Nadia, Md. Abdul Baten, Kazi Ahsan Habib, Mohammad Rashed

Year:2024

Abstract: Bangladesh is endowed with diverse rivers providing huge ecosystem services, but the diversity status and the abundance of the small indigenous species (SIS) are not identical in all rivers due to the natural water flow regime and anthropogenic challenges. Therefore, the present study endeavors to elucidate the composition and conservation status of SIS fish from four rivers namely, the Padma, the Gorai, the Chandana and the Horai rivers of Rajbari District, Bangladesh. Data were meticulously collected through fish sampling in each season, field observations, focus group discussions, and individual interviews by using a semi-structured questionnaire spanning from May 2021 and April 2022. The number of SIS in the Padma, the Gorai, the Chandana and the Horai rivers of Rajbari were 60, 36, 33 and 26, respectively, whereas a predominant concentration of fishes was notably observed in the benthopelagic zone of these rivers. Among the 60 riverine SIS, 23 fish were common in the four rivers. Additionally, Cyprinidae (>30%) was observed to be the most abundant SIS in the studied rivers. The fishermen in the research area used seven major fishing equipment of which cast nets are the most common for catching fish species. The abundance of SIS during the rainy season was the highest for all the studied rivers than the other seasons and 12 SIS were available throughout the year. Notably, the least concerned SIS outnumbered the other categories whereas, more than 10% was under the vulnerable category in the four rivers. The leading threats to the fish diversity were pollution followed by illegal and overfishing, siltation, reduced depth, degeneration of rivers and others. Consequently, to safeguard the existing SIS, reducing human pressure, implementing fishing regulations strictly, establishing and administering fish sanctuaries, and raising public awareness can be helpful for the sustainability of aquatic resources in deltaic areas.

EXPLORING WATER QUALITY AS A DETERMINANT OF THE EXISTENCE OF SOFT SHELL CRAB (SCYLLA OLIVACEA) IN DIFFERENT HABITATS OF THE LARGE MARINE ECOSYSTEM IN THE BAY OF BENGAL.

Author:Md. Abdul Hannan, Kazi Ahsan Habib

Year:2024

Abstract: The present study determined the concentration of semicarbazide (SEM) in water and soil samples from diverse habitats of mud crabs encompassing natural breeding grounds, mangrove-associated rivers, different commercial farms and the tissue samples in soft-shell crabs. Semicarbazide is a residue of banned veterinary drug nitrofurazone that can be found in some natural crustaceans that have never been exposed to nitrofurazone. Analysis of water and soil sediment confirmed the presence of SEM in natural habitat, however the concentrations was very low as <0.1 ng/g throughout the study. The extraction and analysis of nitrofuran metabolites was conducted by using liquid chromatography-tandem mass spectrometry (LC-MS/MS) methods. The commercial farms of mud crabs were also exhibited the lowest levels of SEM in both water (0.0003 ng/g) and soil sediment (0.0005 ng/g). Tissue-specific SEM analyses encompassing muscle, shell-muscle composite, and shell revealed a distinct spatial gradient in which shell tissues exhibiting the highest concentration of SEM (3.51±0.03 ng/g) in commercial farms, surpassing those observed in muscle tissues (0.33±0.01 ng/g). Remarkably, crabs from commercial farms exhibited higher SEM concentrations across all tissue types compared to those from natural breeding grounds. However, no SEM was detected in crab feed snail and tilapia fish in commercial farms, suggesting feed composition may not be a major contributor. The lowest concentrations of SEM in water and soil sediments towards physiological processes rather than environmental contamination as the source. This study highlights limitations of SEM as a sole nitrofuran abuse marker, advocating for broader regulatory frameworks and calls for reevaluating regulations to ensure public health and responsible aquaculture.

Role of Plants in Fluorides and Fluorocarbons Toxicity Remediation

Author: Sheikh Muhammad Masum, Tanvir Ahmad Sourav, A. S. M. Fazle Bari, Md. Hasanuzzaman

Year:2024

Abstract: Fluorine and fluorocarbons, emitted from natural and human-made sources like brick kilns, industrial manufacturing, and agricultural production, are found throughout the natural environment. The overabundance of fluorine and fluorocarbons, which pose a significant threat to various forms of life, including plants, through soil and water pollution and disruption of soil composition, is a cause for concern. The accumulation of this substance in plants has the potential to significantly impede their growth and development while also presenting a substantial threat to human health. This chapter highlights the crucial role of plants in effectively removing fluoride and fluorocarbons from polluted environments through phytoremediation. By studying how various plant species absorb, translocate, and detoxify these pollutants, we elucidate the potential of phytoremediation as a sustainable and eco-friendly approach to mitigate fluoride and fluorocarbon pollution. Through a comprehensive review of recent research findings, this chapter highlights the effectiveness of different plant species in the remediation process, emphasizing their suitability for diverse environmental conditions. The synergistic effects of plant–microbe interactions and the implications for ecosystem health are discussed. Overall, this study underscores the significance of harnessing the natural capabilities of plants in addressing pressing environmental challenges posed by fluoride and fluorocarbon contamination.

Concentration and Ecological Risk of Heavy Metals in River Sediments of a Developing Country: A Meta-Analysis

Author: Marjana Yeasmin

Year:2024

Abstract: Heavy metals (HMs) contamination in sediment presents a straightforward issue, particularly noticeable in developing nations. Addressing this problem requires an extensive inquiry into the present

situation and potential remedies to keep safe environment. This document compiles statistical procedures concerning various heavy metals such as chromium (Cr), nickel (Ni), copper (Cu), cadmium (Cd), lead (Pb), and arsenic (As) that are available in sediments from Bangladesh spanning the years from 1998 to 2021. The average levels of Ni, Cu, Cd, Pb, and As in sediments of the available data exceeded the corresponding background values, upper continental crust values, and toxicity reference values, indicating severe contamination of sediment by heavy metals. Metal concentrations (Cr, Ni, Cu, and As) generally remained lower than the average shale values, except for Cd and Pb. By utilizing the Pearson correlation coefficient (CCA) and principal component analysis (PCA), it was evidenced that human activities, apart from natural ecological factors, stand as the primary sources of heavy metal pollution in sediment from Bangladeshi waterways. Cd emerged as the key contributor to heightened contamination levels in riverine sediments, as indicated by pollution indices, signifying an ecological hazard. Overall, the data underscored the significant ecological risk posed by the considered hazardous metals. To mitigate sediment heavy metal levels, strategies such as reducing heavy metal discharges at their origins and implementing phytoremediation techniques in sediment, along with improving effluent treatment facilities, could aid in alleviating the issue.

Application of biochar and humic acid improves the physiological and biochemical processes of rice (Oryza sativa L.) in conferring plant tolerance to arsenic-induced oxidative stress
Author: Mirza Hasanuzzaman, Farzana Nowroz, Ayesha Siddika, Md. Mahabub Alam
Year:2024
Abstract: Biochar (BC) and humic acid (HA) are well-documented in metal/metalloid detoxification, but their regulatory role in conferring plant oxidative stress under arsenic (As) stress is poorly understood. Therefore, we aimed at investigating the role of BC and HA (0.2 and 0.4 g kg−1 soil) in the detoxification of As (0.25 mM sodium arsenate) toxicity in rice (Oryza sativa L. cv. BRRI dhan75). Arsenic exhibited an increased lipid peroxidation, hydrogen peroxide, electrolyte leakage, and proline content which were 32, 30, 9, and 89% higher compared to control. In addition, the antioxidant defense system of rice consisting of non-enzyme antioxidants (18 and 43% decrease in ascorbate and glutathione content) and enzyme activities (23–50% reduction over control) was decreased as a result of As toxicity. The damaging effect of As was prominent in plant height, biomass acquisition, tiller number, and relative water content. Furthermore, chlorophyll and leaf area also exhibited a decreasing trend due to toxicity. Arsenic exposure also disrupted the glyoxalase system (23 and 33% decrease in glyoxalase I and glyoxalase II activities). However, the application of BC and HA recovered the reactive oxygen species–induced damages in plants, upregulated the effectiveness of the ascorbate–glutathione pool, and accelerated the activities of antioxidant defense and glyoxalase enzymes. These positive roles of BC and HA ultimately resulted in improved plant characteristics with better plant-water status and regulated proline content that conferred As stress tolerance in rice. So, it can be concluded that BC and HA effectively mitigated As-induced physiology and oxidative damage in rice plants. Therefore, BC and HA could be used as potential soil amendments in As-contaminated rice fields.

Farmers perspectives on options for and barriers to implementing climate resilient agriculture and implications for climate adaptation policy
Author: Shilpi Kundu,
Year:2024
Abstract: The impacts of climate change in low lying coastal areas, such as Bangladesh, are adversely affecting food and livelihood security, requiring adaptation to build resilience. However, effective implementation is limited by a lack of local-level knowledge regarding the barriers that prevent adoption and up-scaling of climate resilient agriculture (CRA). Case studies in coastal Bangladesh provide novel insights regarding barriers to planned and autonomous adaptation from the perspective of farmers facing multiple climate change impacts across seven key dimensions of CRA (agrometeorology services, water management practices, nutrient management activities, technologies and knowledge management activities, infrastructure development, socio-economic resilience, and institutions and good governance). Farmers

generally perceive that adaptation actions increase resilience in crop production systems and their surrounding social systems, but also identify the important barriers that inhibit or constrain planned and autonomous adaptation opportunities. Planned adaptation actions are perceived to be limited by institutional arrangements and lack of implementation capacity. Autonomous adaptation was found to be dependent on income level, farm-holding size, access to input resources and services and peer/social influences. Planned and autonomous adaptation actions were both affected by specific social and geographic contexts and cultural factors. Recommendations are suggested to address key constraints and thereby promote CRA in coastal agricultural landscapes in Bangladesh and in other developing countries confronting similar challenges.

Status and health risk assessment of heavy metals in vegetables grown in industrial areas of Bangladesh

Author: Md. Muradul Islam, Md. Wadud Ahmed, Mominul Haque Rabin, Md. Abdur Razzaque, Mahbuba Sidddika, Sheikh Shawkat Zamil

Year:2024

Abstract: The presence of toxic heavy metals in vegetables is a matter of concern worldwide as they impose significant public health hazards. This study quantified heavy metals such as lead (Pb), cadmium (Cd), chromium (Cr), copper (Cu), and zinc (Zn) in widely consumed vegetables such as red amaranth (Amaranthus cruentus), radish leaf (Raphanus sativus), brinjal (Solanum melongena), spinach (Spinacia oleracea), bottle gourd (Lagenaria siceraria), carrot (Daucus carota), and fenugreek (Trigonella foenum-graecum) grown in Savar industrial areas of Bangladesh to assess human health risks. Atomic absorption spectroscopy (AAS) was used to determine heavy metals in vegetables (n = 96). Studied heavy metals were detected in most vegetable samples, whereas 59.38% and 40.62% of samples contained carcinogenic Pb and Cd higher than the Food and Agriculture Organization (FAO) maximum allowable concentration (MAC). Principle component analysis (PCA) revealed that wastewater irrigation due to anthropogenic activities is the main source of heavy metal contamination in vegetables of the study area. Human health risks were assessed in terms of estimated daily intake (EDI), incremental lifetime cancer risks (ILCR), target hazard quotient (THQ), and hazard index (HI). EDI values of all heavy metals were lower than the corresponding maximum tolerable daily intake (MTDI) values. The ILCR values of Pb in most samples (except fenugreek) for children were found above the threshold value (ILCR> 10−4), indicating carcinogenic health effects from lifetime consumption of these vegetables. The THQs of Pb in sample red amaranth and carrot were greater than 1.0, indicating potential non-carcinogenic risks of consuming contaminated vegetables. The HI values of all heavy metals in red amaranth and carrot >1.0 for adults and children, suggesting health hazards from these samples. This study might help policymakers and concerned authorities to implement a strategic plan for safe vegetable production and minimise the health risks of consuming heavy metal contaminated vegetables.