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CHEMICAL EFFECTS

Comprehensive assessment of straw returning with organic fertilizer on paddy ecosystems: a study based on greenhouse gas emissions, C/N sequestration, and risk health

2024-12-06

High greenhouse gas emissions and soil deterioration are caused by the overuse of chemical fertilizers. To improve soil quality and crop productivity, it is necessary to utilize fewer chemical fertilizers to achieve sustainable agriculture. Organic substitution is a scientific fertilization strategy that will benefit future agricultural productivity development, little is known about how it affects the heavy metal content and trace gas emissions in rice grains. A field experiment using straw return to the field (SRF), organic fertilizer application (OFA), and their combination (SRF/OFA) fertilization strategies. The results demonstrated that SRF, OFA, and SRF/OFA increased the yield by 19.40%, 22.39%, and 28.36% than the natural growth control group (NG). The OFA has the highest STN stock and SRF/OFA has the highest STN sequestration rate, while SRF achieved the highest SOC stock and sequestration rate. The OFA reduced CO₂, CH₄, and N₂O emissions by 17.73%, 71.87%, and 86.06%, resulting in a minimum global warming potential and greenhouse gas intensity yield among these strategies. Cumulative seasonal CO₂ and CH₄ emissions were negatively correlated with soil paddy soil C/N and C/P ($P < 0.05$). Moreover, Cu, Cd, and Pb contents in grain were reduced by 66.18%-70.31%, 35.45%-40.91%, and 76.62%-77.92%, respectively. The health risk evaluation revealed that all metals had a target hazard quotient of < 1 , except for NG. The hazard index (0.42-0.53), which measures the additive effects of contaminants, exceeded the threshold. The implementation of the organic alternative strategy can reduce the trend of increasing surface pollution, slow down the excessive utilization intensity of agricultural resources, and encourage the development of a greener, more sustainable agricultural way.

Authors: Keqi Zhao, Xichen Zhao, Liuqin He, Nanyi Wang, Ma Bai, Xiaobing Zhang, Ge Chen, Anwei Chen, Lin Luo, Jiachao Zhang

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ENVIRONMENTAL RESEARCH

Differential effects of polyvinyl chloride microplastics and kaolin particles on gut immunity of mussels at environmental concentrations

2024-12-01

Both microplastics (MPs) and kaolin are marine suspended particles capable of influencing the physiology of bivalve mollusks. However, the current research on MPs lacks the analysis of their own physical and chemical toxicity, and the comparative study of the toxicity of microplastics and natural suspended particles (NSPs) in aquatic environment. In this work, three experiments are layered, with Experiment 1 directly comparing polyvinyl chloride MPs (PVC MPs) and kaolin and showing that MPs have greater deleterious effects on thick-shelled mussels than kaolin, with the exception of physical damage and effects on gut microorganisms. As the presence or absence of chemicals may be the main difference between MPs and kaolin, in Experiment 2 the toxicity drivers of PVC MPs itself were investigated, demonstrating that the chemicals in MPs are indeed toxic and that the harmful effects of MPs on mussels may be due to the superposition of their own physical and chemical toxicity. Finally, in Experiment 3 mussels were exposed to the chemicals in PVC MPs and kaolin in a composite and found that the toxicity of the composite exposure was greater than that of the single exposure to kaolin, suggesting that the chemicals may be the main factor contributing to the difference in toxicity between PVC MPs and kaolin. In conclusion, this work addresses the lack of a natural particle control group in current studies of MPs, confirms that the toxicity drivers of MPs are due to both physical and chemical factors, highlights the role of NSPs in the environment, and provides new insights for evaluating the toxic effects of MPs in the natural marine environment.

Authors: Liming Chen, Zhihan Tu, Zhen Zhong, Shuaishuai Wei, Menghong Hu, Youji Wang

Full Source: Journal of hazardous materials 2024 Dec 1:484:136711. doi: 10.1016/j.jhazmat.2024.136711.

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Plastic pollution in a special protected area for migratory birds

2024-12-07

Plastic pollution in Special Protected Areas for Migratory Birds and Sites of Community Importance is a growing environmental concern. These areas, often designated to provide safe habitats for migratory bird species, are increasingly threatened by plastic litter. In this study, we conducted the first assessment of plastic litter, ranging from macro to microplastics, in beach sediments from two sites (Montorsoli Beach and Pylon Beach) along the coast of the Strait of Messina, a Special Protected Area, to assess beach quality and ecological risk. The selected beaches for this study are representative example of two different possible source of anthropogenic contaminations. Plastic density ranged from 1.2 pieces/m² to 0.1 pieces/m², Montorsoli and Pylon Beach, respectively. The most abundant plastic litter consisted of plastic pieces ranging in size from 0.5 cm to 50 cm. Several anthropogenic microparticles were identified, including Polypropylene, Polyethylene, Polyethylene terephthalate, Polytetrafluoroethylene, cotton fibers and cellulose-based materials. Montorsoli beach had a high percentage (91 %) of Polymethyl methacrylate (PMMA). While in Pylon beach the main polymer was cotton (49 %). Furthermore, calculated pollution indices showed that Montorsoli was very dirty compared to Pylon beach. Furthermore, the presence of PMMA pellets found at Montorsoli beach may endanger marine birds that depend on the resources of these areas, which are designated as Special Protection Areas for rare and vulnerable bird species. This baseline assessment not only provides crucial information on the current status of plastic pollution, but also offers valuable data that can be instrumental in effective regional management efforts.

Authors: Caterina Branca, Francesca Fabrizi, Bilal Mghili, Valeria Conti-Nibali, Kannan Gunasekaran, Teresa Bottari, Monique Mancuso, Giovanna D'Angelo

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Pollution affects even oceanic marine protected areas in Southwestern Atlantic

2024-12-05

Reefs are facing a global decline with sewage pollution emerging as a significant and poorly understood threat. Inadequate wastewater management and disorderly urbanization contributes to water pollution globally. Tropical Southwestern Atlantic comprises a set of oceanic Marine Protected Areas (MPAs) including the Fernando de Noronha Archipelago in Brazil, which has experienced significant population growth without expanding the sewage infrastructure. We mapped and quantified marine pollution in these MPAs, characterizing pollution sources and evaluating their effects on benthic and fish communities in 13 reef sites. We quantified nutrients, metals and metalloid, microplastics, fecal sterols, and Polycyclic Aromatic Hydrocarbons (PAHs) in both water and sediment samples. We also used isotopic tracing on macroalgae to identify the origin of organic matter and characterized benthic and fish communities, and algae biomass at each site. Pollution was more pronounced in the multiple-use area but also affected no-take areas. Effluents from wastewater treatment plants did not meet legislative standards, and reefs in the multiple-use area were enriched in orthophosphate and ammonia compared to those in the no-take area. Nitrogen isotopes in macroalgae revealed sewage-derived nitrogen throughout the multiple-use area. Nutrient enriched sites exhibited higher abundances of fast-growing and opportunistic green macroalgae, and higher biomass of brown macroalgae. The port area, within the multiple-use area, showed high PAHs, coprostanol and metal(loid) concentrations, suggesting untreated sewage and nautical chemical pollution. Microplastics were widespread in sediment and water samples. We documented the pervasive impacts of marine pollution on reef habitats even within marine protected areas in oceanic regions, demonstrating that local pollution control, sewage management and regulating procedures in port areas are critical to protect marine ecosystems. Comparisons with previous studies suggest marine pollution has substantially increased in the Archipelago in the last ten years. This is the first comprehensive assessment of marine pollution in an oceanic environment in Southwestern Atlantic, showing these isolated environments are not immune to pollution impacts.

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Cavalca Bom, Renato Rodrigues Neto, Fabian Sá, Edson A Vieira, Vladmir E Costa, Guilherme O Longo

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Organophosphate pesticide residues in fruits and vegetables in Nigeria: prevalence, environmental impact, and human health implications

2024-12-07

Pesticides have become indispensable in modern agriculture, aiding in crop protection, and ensuring food security. However, their extensive use has raised concerns about environmental contamination and human health risks. This manuscript reviews the prevalence of organophosphate pesticide (OPP) use in Nigerian agriculture and explores methods for detecting pesticide residues in fruits and vegetables. Despite the critical role of pesticides in safeguarding crop yields, the lack of regulatory enforcement and monitoring in Nigeria poses significant challenges. The review underscores the importance of understanding the health implications of pesticide residues in food. While acute and sub-chronic health effects of OPP exposure have been studied, there remains a need for a focused review of the long-term impacts, particularly in the context of limited regulatory oversight. Additionally, the manuscript highlights gaps in knowledge regarding the effects of pesticides on biodiversity, ecosystems, and vulnerable populations such as children, pregnant women, and the elderly. Recommendations include longitudinal studies to assess cumulative and delayed health consequences, systematic reporting of poisoning incidents, and routine analysis of food products to ensure safety. By addressing these gaps, a more comprehensive understanding of the consequences of OPP usage in Nigeria can be achieved, facilitating the development of effective risk management strategies to protect both the environment and public health.

Authors: Celina Ogah, Beatrice Oganah-Ikujenyo, Helen Onyeaka, Evelyn Ojapah, Adedola Adeboye, Tosin Olaniran

Full Source: Environmental science and pollution research international 2024 Dec 7. doi: 10.1007/s11356-024-35591-x.

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PHARMACEUTICAL/TOXICOLOGY

Effects of energetic compounds on soil microbial communities and functional genes at a typical ammunition demolition site

2024-12-06

High concentrations of energetic compounds such as 2,4,6-trinitrotoluene (TNT), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) in military-contaminated sites pose a serious threat to human health and ecosystems. Better understanding about their effects on microbial diversity and functional genes in soil of ammunition demolition sites is required. In this study, the information of soil microbial community composition was obtained by macrogenome sequencing, and the impacts of energetic compounds on microbial community structure at the level of functional genes and enzymes based on Nr (Non-Redundant Protein Sequence Database), KEGG (Kyoto Encyclopedia of Genes and Genomes), CAZy (Carbohydrate-Active Enzymes Database) and other databases were discussed. The results showed that soil microbial diversity and functional gene abundance decreased significantly with the increase of the concentrations of energetic compounds. Conversely, the relative abundance of Proteobacteria increased significantly, reaching over 80% in the heavily TNT-contaminated area near explosive-waste water pool. Furthermore, functional gene analysis indicated that Proteobacteria had an advantage in degrading energetic compounds, and thus had the potential to improve the soil quality at ammunition demolition sites. This study provides a scientific basis for the future remediation and management of contaminated soils at ammunition demolition sites, as well as for the selection of efficient degraders of energetic compounds.

Authors: Yongbing Zhu, Sanping Zhao, Shuo Qi, Huijun Zhang, Xinru Zhang, Shangyi Li, Xiaohui Wang, Jing Gu, Tingting Zhang, Hailing Xi, Xiaodong Liu

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OCCUPATIONAL

Bisphenols in Indoor Dust: A Comprehensive Review of Global Distribution, Exposure Risks, Transformation, and Biomonitoring

2024-12-06

Bisphenols (BPs) are pervasive environmental contaminants extensively found in indoor environments worldwide. Despite their ubiquitous presence and potential health risks, there remains a notable gap in the comprehensive reviews focusing on BPs in indoor dust. Existing literature often addresses specific aspects such as exposure pathways, transformation products, or biomonitoring techniques, but lacks a consolidated, in-depth review encompassing all these facets. This review provides a comprehensive overview of the global distribution of BPs, emphasizing their prevalence in diverse indoor settings ranging from households and workplaces to public areas. Variations in BP concentrations across these environments are explored, influenced by factors such as industrial activities, consumer product usage patterns, and geographical location. Exposure assessments highlight ingestion, inhalation, and dermal contact as primary pathways for BP exposure, with ingestion being particularly significant for vulnerable groups such as infants and young children. Studies consistently reveal higher concentrations of BPs in urban indoor dust compared to rural settings, reflecting the impact of urbanization and intensive consumer practices. Moreover, BPs from mobile sources like vehicles contribute significantly to overall human exposure, further complicating exposure assessments. The review also delves into the transformation of BPs within indoor environments, emphasizing the diverse roles of physical, chemical, and biological processes in generating various transformation products (TPs). These TPs can exhibit heightened toxicity compared to their parent compounds, necessitating deeper investigations into their environmental fate and potential health implications. Critical examination of biomonitoring techniques for BPs and their metabolites underscores the importance of non-invasive sampling methods, offering ethical advantages and practicality in assessing human exposure levels. The emerging use of bioindicators, encompassing plants, animals, and

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innovative approaches like spider webs, presents promising avenues for effectively monitoring environmental contamination.

Authors: Vishnu S Moorchilot, Helency Louis, Aiswarya Haridas, P Praveena, S B Arya, Arya S Nair, Usha K Aravind, C T Aravindakumar

Full Source: Chemosphere 2024 Dec 6:143798. doi: 10.1016/j.chemosphere.2024.143798.

Real-world outdoor air exposure effects in a model of the human airway epithelium - A comparison of healthy and asthmatic individuals using a mobile laboratory setting

2024-12-07

We developed a mobile laboratory allowing field exposure of lung tissue models to ambient air at localities with various pollution sources (Background, Industrial, Traffic, Urban) in different seasons (summer/fall/winter). In samples originating from healthy and asthmatic individuals, we assessed the parameters of toxicity, lipid peroxidation and immune response; we further performed comprehensive monitoring of air pollutants at sampling sites. We measured lactate dehydrogenase (LDH) and adenylate kinase (AK) production and transepithelial electrical resistance (TEER), analyzed 15-F2t-isoprostane (IsoP) and a panel of 20 cytokines/chemokines/growth factors. In the ambient air, we detected particulate matter (PM), and other relevant chemicals (benzene, benzo[a]pyrene (BaP), NO_x). In the Traffic locality, we found very high concentrations of ultrafine particles and NO_x and observed low TEER values in the exposed samples, indicating significant traffic-related toxicity of the ambient air. In the Urban locality, sampled in winter, we observed high PM and BaP levels. We found lower AK levels in samples from healthy individuals exposed in this locality than in the asthmatic samples. In the samples from the Industrial locality, sampled in summer, we detected higher concentrations of TNF α , MIP-1 α , Eotaxin, GRO α , GM-CSF, IL-6 and IL-7 than in the Urban locality samples. We hypothesize that pollen or other plant-related components of the ambient air were responsible for this response. In conclusion, our data proved the feasibility of our mobile laboratory for field measurements of the biological response of lung tissue models exposed to ambient air, reflecting not only the levels of toxic compounds, but also season-specific parameters.

Authors: Pavel Rossner, Helena Libalova, Tereza Cervena, Michal Sima, Zuzana Simova, Kristyna Vrbova, Antonin Ambroz, Zuzana Novakova,

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Associations of long-term nitrogen dioxide exposure with a wide spectrum of diseases: a prospective cohort study of 0.5 million Chinese adults

2024-12

Background: Little evidence is available on the long-term health effects of nitrogen dioxide (NO₂) in low-income and middle-income populations. We investigated the associations of long-term NO₂ exposure with the incidence of a wide spectrum of disease outcomes, based on data from the China Kadoorie Biobank.

Methods: This prospective cohort study involved 512 724 Chinese adults aged 30-79 years recruited from ten areas of China during 2004-08. Time-varying Cox regression models yielded adjusted hazard ratios (HRs) for the associations of long-term NO₂ exposure with aggregated disease incidence endpoints classified by 14 ICD-10 chapters, and incidences of 12 specific diseases selected from three key ICD-10 chapters (cardiovascular, respiratory, and musculoskeletal diseases) found to be robustly associated with NO₂ in the analyses of aggregated endpoints. All models were stratified by age-at-risk (in 1-year scale), study area, and sex, and were adjusted for education, household income, smoking status, alcohol intake, cooking fuel type, heating fuel type, self-reported health status, BMI, physical activity level, temperature, and relative humidity.

Findings: The analysis of 512 709 participants (mean baseline age 52.0 years [SD 10.7]; 59.0% female and 41.0% male) included approximately 6.5 million person-years of follow-up. Between 5285 and 144 852 incident events were recorded for each of the 14 aggregated endpoints. Each 10 µg/m³ higher annual average NO₂ exposure was associated with higher risks of chapter-specific endpoints, especially cardiovascular (n=144 852; HR 1.04 [95% CI 1.02-1.05]), respiratory (n=73 232; 1.03 [1.01-1.05]), musculoskeletal (n=54 409; 1.11 [1.09-1.14]), and mental and behavioural (n=5361; 1.12 [1.05-1.21]) disorders. Further in-depth analyses on specific diseases found significant positive supra-linear associations with hypertensive disease (1.08 [1.05-1.11]), lower respiratory tract infection (1.03 [1.01-1.06]), arthrosis (1.15 [1.09-1.21]), intervertebral disc disorders (1.13 [1.09-1.17]), and spondylopathies (1.05 [1.01-1.10]), and linear associations with ischaemic heart disease (1.03 [1.00-1.05]), ischaemic stroke (1.08 [1.06-1.11]), and asthma (1.15 [1.04-1.27]), whereas

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intracerebral haemorrhage (1.00 [0.95-1.06]), other cerebrovascular disease (0.98 [0.96-1.01]), acute upper respiratory infection (1.03 [0.96-1.09]), and chronic lower respiratory disease (0.98 [0.95-1.02]) showed no significant association. NO₂ exposure showed robust null association with external causes (n=32 907; 0.98 [0.95-1.02]) as a negative control.

Interpretation: In China, long-term NO₂ exposure was associated with a range of diseases, particularly cardiovascular, respiratory, and musculoskeletal diseases. These associations underscore the pressing need to implement the recently tightened WHO air quality guidelines.

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