Soil

1- A critical review on performance indicators for evaluating soil biota and soil health of biochar-amended soils

By:
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Abstract

Amendment of soil with biochar has been widely investigated for soil quality improvement in terms of biotic and abiotic functionalities. The performance of biochar-based amendment varies according to the site characteristics, biochar properties, and soil management targets. There is no existing review that summarizes a broad range of performance indicators to evaluate the health of biochar-amended soil. Based on the latest studies on soil amendment with biochar, this review critically analyzes the soil health indicators that reveal the potential impact of biochar amendment with respect to physicochemical properties, biological properties, and overall soil quality. It is found that soil pH, soil aggregate stability, and soil organic matter are the basic indicators that could influence most of the soil functions, which should be prioritized for measurement. Relevant functional indicators (e.g., erosion rate, crop productivity, and ecotoxicity) should be selected based on the soil management targets of biochar application in agricultural soils. With this review, it is expected that target-oriented performance indicators can be selected in future studies for field-relevant evaluation of soil amendment by biochar under different situations. Therefore, a more cost-effective and purpose-driven assessment protocol for biocharamended soils can be devised by using relevant measurable attributes suggested in this review.

Keywords
Author Keywords

Soil

Soil health indicatorBiochar applicationsSoil quality assessmentGreen and sustainable remediationSoil remediation

Keywords Plus

WATER-USE EFFICIENCYGREENHOUSE-GAS EMISSIONSMETAL-CONTAMINATED SOILMICROBIAL COMMUNITYREFLECTANCE SPECTROSCOPYPYROLYSIS TEMPERATUREPHOSPHORUS DYNAMICSNITROGEN NUTRITIONENZYMATIC-ACTIVITYSTRAW APPLICATION

Soil

2- Global impact of climate change on soil erosion and potential for adaptation through soil conservation

By:
Eekhout, JPC (Eekhout, Joris P. C.) [1] ; de Vente, J (de Vente, Joris) [1]
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Abstract

Climate change is expected to lead to increased soil erosion in many locations worldwide affecting ecosystem services and human well-being. Through a systematic review of 224 modelling studies, we provide a global assessment of the impact of climate change on soil erosion and the adaptation potential through land use change and soil conservation. We account for the robustness of each study based on a statistical analysis of ten methodological aspects and an expert consultation. Results show a global increasing trend in soil erosion towards the end of the 21st century, with the highest increase projected in semi-arid regions. Land use change characterized by agricultural expansion and deforestation aggravate the impact. Reforestation, agricultural land abandonment and soil conservation practices can entirely compensate the impact of climate change on soil erosion. This stresses the need for soil conservation and integrated land use planning. From the obtained weights per study we can conclude that there is a lot of uncertainty in the methods applied, without a clear trend towards more robust studies. Based on the results of the expert consultation, we recommend to use a climate model ensemble of at least five climate models, based on the latest CMIP6 climate scenarios. These data should be downscaled and bias corrected using trend preserving quantile methods. Finally, the post-processed climate data should be applied in a soil erosion model forced by precipitation and runoff. Considering the most robust methodologies of the different aspects of the uncertainty cascade will lead to better spatial evaluation of the impact of climate change on soil erosion and identification of most effective adaptation strategies.

Keywords
Author Keywords
Soil erosionClimate change impactLand use changeSoil conservationUncertaintySystematic review

Soil

Keywords Plus
SUSTAINABLE LAND MANAGEMENTBIAS CORRECTIONSEDIMENT YIELDWATER EROSIONRAINFALL EROSIVITYCARBON EMISSIONSFUTUREMODELBASINRUNOFF

Soil

3- Experimental study of displacement field of layered soils surrounding laterally loaded pile based on transparent soil

By:
Yuan, BX (Yuan, Bingxiang) [1] ; Li, ZH (Li, Zihao) [1] ; Zhao, ZQ (Zhao, Zuqing) [1] ; Ni, H (Ni, Hong) [1] , [2] ; Su, ZL (Su, Zhilei) [1] ; Li, ZJ (Li, Zhijie) [1]

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Abstract

Purpose In the pile-soil interaction system, the disturbed soil directly affects the safety of the laterally loaded pile. The soil displacement field helps to evaluate the range and degree of soil disturbance. This study presents a method of visualiziing the displacement field of the soil around the laterally loaded pile by using transparent soil technology, which overcomes the measurement obstacles caused by the non-transparency of the real soil.
Methods Glass sand and transparent pore solution were mixed to make a saturated transparent soil with two particle sizes (0.1 similar to 0.5 mm and 0.5 similar to 1 mm). Instead of real soil, transparent soil was used to observe the degree of disturbance in the process of interaction with laterally loaded piles. In addition, particle image velocimetry (PIV) was used to capture the displacement of transparent soil particles. The displacement of each particle was integrated into the displacement field by a MATLAB program.
Results When a horizontal force was applied on the top of the pile, the particles in front of the pile were compressed, producing observable movement within a certain area. From the displacement vector diagram, it could be seen that the displacement area of the soil surface in front of the pile increases as the layer thickness of large particle soil increases. The vertical displacement of soil in front of the pile was compacted to form a wedge-shaped area under the horizontal load. The angle between the direction of soil motion and the horizontal plane was positively correlated with the thickness of the soil layer.

Soil

Conclusion Transparent soil and particle image velocimetry can help reveal the displacement trends of the soil around a laterally loaded pile. Based on this, an early warning can be provided when the displacement value and displacement angle of the soil around the laterally loaded pile exceeds the normal range.

Keywords
Author Keywords
Transparent soilLayered soilParticle image velocimetryDisplacement field

Soil

4- The concept and future prospects of soil health

By:
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Abstract

Soil health is the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals and humans, and connects agricultural and soil science to policy, stakeholder needs and sustainable supply-chain management. Historically, soil assessments focused on crop production, but, today, soil health also includes the role of soil in water quality, climate change and human health. However, quantifying soil health is still dominated by chemical indicators, despite growing appreciation of the importance of soil biodiversity, owing to limited functional knowledge and lack of effective methods. In this Perspective, the definition and history of soil health are described and compared with other soil concepts. We outline ecosystem services provided by soils, the indicators used to measure soil functionality and their integration into informative soil-health indices. Scientists should embrace soil health as an overarching principle that contributes to sustainability goals, rather than only a property to measure.

Soil health is essential to crop production but is also key to many ecosystem services. In this Perspective, the definition, impact and quantification of soil health are examined, and the needs in soil-health research are outlined.

Keywords
Keywords Plus

Soil

ECOSYSTEM SERVICESQUALITYCARBONBIODIVERSITYPOLLUTIONSYSTEMSWATERPRODUCTIVITYMICROBIOMEINDICATORS

Soil

5- Soil moisture-atmosphere feedback dominates land carbon uptake variability

By:
Humphrey, V (Humphrey, Vincent) [1] ; Berg, A (Berg, Alexis) [2] ; Ciais, P (Ciais, Philippe) [3] ; Gentine, P (Gentine, Pierre) [4] ; Jung, M (Jung, Martin) [5] ; Reichstein, M (Reichstein, Markus) [5] ; Seneviratne, SI (Seneviratne, Sonia I.) [6] ; Frankenberg, C (Frankenberg, Christian) [1] , [7]
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Abstract

Year-to-year changes in carbon uptake by terrestrial ecosystems have an essential role in determining atmospheric carbon dioxide concentrations(1). It remains uncertain to what extent temperature and water availability can explain these variations at the global scale(2-5). Here we use factorial climate model simulations(6) and show that variability in soil moisture drives 90 per cent of the inter-annual variability in global land carbon uptake, mainly through its impact on photosynthesis. We find that most of this ecosystem response occurs indirectly as soil moisture-atmosphere feedback amplifies temperature and humidity anomalies and enhances the direct effects of soil water stress. The strength of this feedback mechanism explains why coupled climate models indicate that soil moisture has a dominant role(4), which is not readily apparent from land surface model simulations and observational analyses(2,5). These findings highlight the need to account for feedback between soil and atmospheric dryness when estimating the response of the carbon cycle to climatic change globally(5,7), as well as when conducting field-scale investigations of the response of the ecosystem to droughts(8,9). Our results show that most of the global variability in modelled land carbon uptake is driven by temperature and vapour pressure deficit effects that are controlled by soil moisture.

Keywords
Keywords Plus

Soil

SEMIARID ECOSYSTEMSCLIMATE FEEDBACKSUSE EFFICIENCYMODELSURFACECYCLETEMPERATUREDIOXIDEWATERCO2

Soil

6- Genomic basis of geographical adaptation to soil nitrogen in rice

By:
Liu, YQ (Liu, Yongqiang) [1] , [2] ; Wang, HR (Wang, Hongru) [1] ; Jiang, ZM (Jiang, Zhimin) [1] ; Wang, W (Wang, Wei) [1] ; Xu, RN (Xu, Ruineng) [3] , [4] ; Wang, QH (Wang, Qihui) [5] ; Zhang, ZH (Zhang, Zhihua) [1] ; Li, AF (Li, Aifu) [1] , [2] ; Liang, Y (Liang, Yan) [1] ; Ou, SJ (Ou, Shujun) [1] ;
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Abstract

The intensive application of inorganic nitrogen underlies marked increases in crop production, but imposes detrimental effects on ecosystems(1,2): it is therefore crucial for future sustainable agriculture to improve the nitrogen-use efficiency of crop plants. Here we report the genetic basis of nitrogen-use efficiency associated with adaptation to local soils in rice (Oryza sativa L.). Using a panel of diverse rice germplasm collected from different ecogeographical regions, we performed a genome-wide association study on the tillering response to nitrogen-the trait that is most closely correlated with nitrogen-use efficiency in rice-and identified OsTCP19 as a modulator of this tillering response through its transcriptional response to nitrogen and its targeting to the tiller-promoting gene DWARF AND LOW-TILLERING (DLT)(3,4). A 29-bp insertion and/or deletion in the OsTCP19 promoter confers a differential transcriptional response and variation in the tillering response to nitrogen among rice varieties. The allele of OsTCP19 associated with a high tillering response to nitrogen is prevalent in wild rice populations, but has largely been lost in modern cultivars: this loss correlates with increased local soil nitrogen content, which suggests that it might have contributed to geographical adaptation in rice. Introgression of the allele associated with a high tillering response into modern rice cultivars boosts grain yield and nitrogen-use efficiency under low or moderate levels of nitrogen, which demonstrates substantial potential for rice breeding and the amelioration of negative environment effects by reducing the application of nitrogen to crops.

Soil

Keywords
Keywords Plus
ASSOCIATIONEXPRESSIONYIELDEFFICIENCYRESPONSESREVEALSFAMILYDWARFMAP

7- Unequal weakening of urbanization and soil salinization on vegetation production capacity

By:
Zhuang, QW (Zhuang, Qingwei) [1] ; Shao, ZF (Shao, Zhenfeng) [1] ; Li, DR (Li, Deren) [1] , [2] ; Huang, X (Huang, Xiao) [3] ; Cai, BW (Cai, Bowen) [2] ; Altan, O (Altan, Orhan) [4] ; Wu, SX (Wu, Shixin) [5]

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Abstract

Net Primary Productivity (NPP) has been widely used to estimate the productivity of the farmland ecosystem (FES) and the carbon budget of the terrestrial ecosystem. Changes in the NPP of FES have knock-on effects on food security, sustainable agricultural development, carbon sequestration, and environmental changes. Existing studies mainly focused on the impact of climate change and urbanization on the spatial-temporal pattern of NPP, largely ignoring the roles of soil condition and agricultural management practices (AMPs). At present, the joint impact of "climate-urbanization-soil-AMPs " on the NPP of FES remains unknown. To fill this knowledge gap, we use the NPP dataset retrieved by the vegetation photosynthesis model (VPM), daily meteorological records, field collected soil data, AMPs data collected from the Government Statistical Yearbook, and land cover dataset to study the joint mechanism of "climate-urbanization-soil " that drives spatial-temporal variations of NPP. Taking the northern slope of Tianshan Mountains as the study area, our results indicate that NPP had increased by 3.86 Tg C from 2000 to 2015 (11.93 Tg C in 2000 and 15.79 Tg C in 2015). From the proposed conceptual framework, we found that climate variables (accumulated temperature, precipitation, evapotranspiration) play a major role in driving the growth of NPP (+4.01 Tg C). The AMPs (i.e., mulching filming, drip irrigation, and fertilizer application) make a positive contribution to NPP increase (+0.98 Tg C). We also found that soil salinization (-1.07 Tg C) weakens the growth of NPP more significantly than urbanization (-0.16 Tg C). This study provides new insights on the mechanism of climate change, urbanization, and soil conditions on crops, benefiting stakeholders in designing better management plans for sustainable agriculture, ecosystem cycling, and food security.

Keywords
Author Keywords

Soil

Climate changeUrbanizationSoil salinizationAgricultural management practicesNPPFarmland ecosystem
Keywords Plus
NET PRIMARY PRODUCTIVITYLAND-COVER CHANGECLIMATE-CHANGEURBAN EXPANSIONCARBON DYNAMICSIMPACTSIRRIGATIONCHINANPPAGRICULTURE

Soil

8- How microbes can, and cannot, be used to assess soil health

By:
Fierer, N (Fierer, Noah) [1] ; Wood, SA (Wood, Stephen A.) [2] , [3] ; de Mesquita, CPB (de Mesquita, Clifton P. Bueno) [1]
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Abstract

Healthy soils are critical to the health of ecosystems, economies, and human populations. Thus, it is widely acknowledged that soil health is important to quantify, both for assessment and as a tool to help guide management strategies. What is less clear is how soil health should actually be measured, especially considering that soil health is not exclusively a product of soil physical and chemical characteristics. Given their well-established importance to many aspects of soil health, microbes and microbial processes are often used as metrics of soil health with a range of different microbe-based metrics routinely used across the globe. Unfortunately, it is our opinion that many of these pre-existing microbial measurements are not easy to interpret and may not necessarily provide credible inferences about soil health status. Here we review the microbial indices used to assess or monitor soil health and discuss some of the broader issues associated with their use. We provide recommendations to more effectively guide and improve how microbial information could be used to yield relevant and actionable assessments of soil health.

Keywords
Author Keywords
Soil healthSoil qualitySoil microbiomeMicrobial bio-indicators
Keywords Plus
TEMPORAL VARIABILITYPLANTINDICATORSDIVERSITYBIOGEOGRAPHYDOMINANCECOMMUNITYLINKAGESQUALITYMETHANE

Soil

9- Microplastics in soil: A review on methods, occurrence, sources, and potential risk

By:
Yang, L (Yang, Ling) [1] , [5] ; Zhang, YL (Zhang, Yulan) [1] , [2] ; Kang, SC (Kang, Shichang) [1] , [2] , [5] ; Wang, ZQ (Wang, Zhaoqing) [3] ; Wu, CX (Wu, Chenxi) [4]
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Abstract

Microplastic is an emerging contaminant of concern in soil globally due to its widespread and potential risks on the ecological system. Some basic issues such as the occurrence, source, and potential risks of microplastics in the soil are still open questions. These problems arise due to the lack of systematic and comprehensive analysis of microplastic in soils. Therefore, we comprehensively reviewed the current status of knowledge on microplastics in soil on detection, occurrence, characterization, source, and potential risk. Our review suggests that microplastics are ubiquitous in soil matrices globally. However, the research progress of microplastics in the soil is restricted by inherent technological inconsistencies and difficulties in analyzing particles in complex matrices, and studies on the occurrence and distribution of microplastics in soil environments remain very scarce, especially in Africa, South America, and Oceania. The consistency of the characteristics and composition of the microplastics in the aquatic environment and soil demonstrate they may share sources and exchange microplastics. Wide and varied sources of microplastic are constantly filling the soil, which causes the accumulation of microplastics in the soil. Studies on the effects and potential risks of microplastics in soil ecosystems are also reviewed. Limited research has shown that the combination and interaction of microplastics with contaminants they absorbed may affect soil health and function, and even migration along the food chain. The occurrence and impact of microplastic on the soil depend on the morphology, chemical components, and natural factors. We conclude that large research gaps exist in the quantification and estimation of regional emissions of microplastics in soil, factors affecting the concentration of microplastics, and microplastic disguising as soil carbon storage, which need more effort.

Soil

Keywords
Author Keywords
MicroplasticsSoilAnalytical methodologySourcesRisk
Keywords Plus
WATER TREATMENT PLANTSENVIRONMENTAL-SAMPLESPLASTIC POLLUTIONIDENTIFICATIONQUANTIFICATIONSPRINGTAILTRANSPORTINGESTIONSHANGHAICOMPLEX

Soil

10- **Microbial necromass as the source of soil organic carbon in global ecosystems**

By:
Wang, BR (Wang, Baorong) [1] , [2] , [3] ; An, SS (An, Shaoshan) [1] , [2] ; Liang, C (Liang, Chao) [5] ; Liu, Y (Liu, Yang) [4] ; Kuzyakov, Y (Kuzyakov, Yakov) [6] , [7]
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Abstract

Despite the recognized importance of the contribution of microbial necromass to soil organic carbon (SOC) sequestration, at a global scale, there has been no quantification for cropland, grassland, and forest ecosystems. To address this knowledge gap, the contents of fungal and bacterial necromass were estimated based on glucosamine and muramic acid contents in cropland (986 samples), grassland (278 samples), and forest (452 samples) soils. On an average, microbial necromass C contributed 51%, 47%, and 35% to the SOC in cropland, grassland, and forest soils, respectively, in the first 20 cm of topsoil. The contribution of microbial necromass to SOC increased with soil depth in grasslands (from 47% to 54%) and forests (from 34% to 44%), while it decreased in croplands (from 51% to 24%). The microbial necromass accumulation coefficient (the ratio between necromass and living microbial biomass C) was higher in soil from croplands (41) and grasslands (33) than in forest (20) soils. These results suggest that the turnover of living microbial biomass is faster in grassland and cropland soils than in forest soils, where the latter contains more partially decomposed plant residues. Fungal necromass C (65% of total necromass) had consistently higher contributions to SOC than bacterial necromass C (32-36%) in all soils due to i) a larger living fungal biomass than bacterial biomass, and ii) fungal cell com-pounds being decomposed slowly and, thus able to persist longer in soil. The ratio of fungal:bacterial necromass C increased from 2.4 to 2.9 in the order of croplands < grasslands < forests, because fungi are the principal decomposers of complex substrates dominant in grassland and, especially, in forest soils. The ratios of bacterial: microbial necromass and bacterial:fungal necromass in cropland soils are larger than those in grassland and forest soils. This result indicates that the relative contribution of fungal necromass to total microbial necromass is lowest in cropland among the three land uses. Moreover, fungal and bacterial necromass increased with the total living microbial C and N contents. Lower temperatures and soil pH (e.g., in temperate and boreal ecosystems) stimulate fungal and bacterial necromass accumulation. These findings highlight the fact that shifts in the bacterial:fungal necromass ratio and the microbial necromass contribution to SOC are ecosystem-specific and depend on climate. In conclusion, microbial necromass contributes to approximately half of the SOC in cropland and grassland soils, and only 35% in forest soils; whereas, two-thirds of microbial necromass are of fungal origin.

Keywords

Author Keywords

Amino sugarsCarbon to nitrogen ratioLand-useMicrobial necromassMicrobial necromass accumulationSoil organic carbon formation

Keywords Plus

USE EFFICIENCYAMINO-SUGARSLAND-USELITTER DECOMPOSITIONRESIDUE CONTRIBUTIONBACTERIAL RESIDUESMATTERFUNGALACCUMULATIONTURNOVER

Soil

11- A trade-off between plant and soil carbon storage under elevated CO2

By:
Terrer, C (Terrer, C.) [1] , [2] ; Phillips, RP (Phillips, R. P.) [3] ; Hungate, BA (Hungate, B. A.) [4] , [5] ; Rosende, J (Rosende, J.) [6] ; Pett-Ridge, J (Pett-Ridge, J.) [1] ; Craig, ME (Craig, M. E.) [7] , [8] ; van Groenigen, KJ (van Groenigen, K. J.) [9] ; Keenan, TF (Keenan, T. F.) [10] , [11] ; Sulman, BN (Sulman, B. N.) [7] , [8] ; Stocker, BD (Stocker, B. D.) [12] , [13] ;
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Abstract

Terrestrial ecosystems remove about 30 per cent of the carbon dioxide (CO2) emitted by human activities each year(1), yet the persistence of this carbon sink depends partly on how plant biomass and soil organic carbon (SOC) stocks respond to future increases in atmospheric CO2 (refs.(2,3)). Although plant biomass often increases in elevated CO2 (eCO(2)) experiments(4-6), SOC has been observed to increase, remain unchanged or even decline(7). The mechanisms that drive this variation across experiments remain poorly understood, creating uncertainty in climate projections(8,9). Here we synthesized data from 108 eCO(2) experiments and found that the effect of eCO(2) on SOC stocks is best explained by a negative relationship with plant biomass: when plant biomass is strongly stimulated by eCO(2), SOC storage declines; conversely, when biomass is weakly stimulated, SOC storage increases. This trade-off appears to be related to plant nutrient acquisition, in which plants increase their biomass by mining the soil for nutrients, which decreases SOC storage. We found that, overall, SOC stocks increase with eCO(2) in grasslands (8 +/- 2 per cent) but not in forests (0 +/- 2 per cent), even though plant biomass in grasslands increase less (9 +/- 3 per cent) than in forests (23 +/- 2 per cent). Ecosystem models do not reproduce this trade-off, which implies that projections of SOC may need to be revised.

Soil

12- The International Soil Moisture Network: serving Earth system science for over a decade

By:
Dorigo, W (Dorigo, Wouter) [1] ; Himmelbauer, I (Himmelbauer, Irene) [1] ; Aberer, D (Aberer, Daniel) [1] ; Schremmer, L (Schremmer, Lukas) [1] ; Petrakovic, I (Petrakovic, Ivana) [1] ; Zappa, L (Zappa, Luca) [1] ; Preimesberger, W (Preimesberger, Wolfgang) [1] ; Xaver, A (Xaver, Angelika) [1] ; Annor, F (Annor, Frank) [2] , [3] ; Ardo, J (Ardo, Jonas) [4] ;
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Abstract

In 2009, the International Soil Moisture Network (ISMN) was initiated as a community effort, funded by the European Space Agency, to serve as a centralised data hosting facility for globally available in situ soil moisture measurements (Dorigo et al., 2011b, a). The ISMN brings together in situ soil moisture measurements collected and freely shared by a multitude of organisations, harmonises them in terms of units and sampling rates, applies advanced quality control, and stores them in a database. Users can freely retrieve the data from this database through an online web portal (https://ismn.earth/en/, last access: 28 October 2021). Meanwhile, the ISMN has evolved into the primary in situ soil moisture reference database worldwide, as evidenced by more than 3000 active users and over 1000 scientific publications referencing the data sets provided by the network. As of July 2021, the ISMN now contains the data of 71 networks and 2842 stations located all over the globe, with a time period spanning from 1952 to the present. The number of networks and stations covered by the ISMN is still growing, and approximately 70 % of the data sets contained in the database continue to be updated on a regular or irregular basis. The main scope of this paper is to inform readers about the evolution of the ISMN over the past decade, including a description of network and data set updates and quality control procedures. A comprehensive review of the existing literature making use of ISMN data is also provided in order to identify current limitations in functionality and data usage and to shape priorities for the next decade of operations of this unique community-based data repository.

Soil

Keywords

Keywords Plus

LAND DATA ASSIMILATIONWIRELESS SENSOR NETWORKANTECEDENT WETNESS CONDITIONSSMOS BRIGHTNESS TEMPERATUREIN-SITU MEASUREMENTSCONSECUTIVE DRY DAYSHEIHE RIVER-BASINLEAF-AREA INDEXAMSR-ESPATIAL VARIABILITY

Soil

13- SoilGrids 2.0: producing soil information for the globe with quantified spatial uncertainty

By:
Poggio, L (Poggio, Laura) [1] ; de Sousa, LM (de Sousa, Luis M.) [1] ; Batjes, NH (Batjes, Niels H.) [1] ; Heuvelink, GBM (Heuvelink, Gerard B. M.) [1] ; Kempen, B (Kempen, Bas) [1] ; Ribeiro, E (Ribeiro, Eloi) [1] ; Rossiter, D (Rossiter, David) [1]
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Abstract

SoilGrids produces maps of soil properties for the entire globe at medium spatial resolution (250 m cell size) using state-of-the-art machine learning methods to generate the necessary models. It takes as inputs soil observations from about 240 000 locations worldwide and over 400 global environmental covariates describing vegetation, terrain morphology, climate, geology and hydrology. The aim of this work was the production of global maps of soil properties, with cross-validation, hyper-parameter selection and quantification of spatially explicit uncertainty, as implemented in the SoilGrids version 2.0 product incorporating state-of-the-art practices and adapting them for global digital soil mapping with legacy data. The paper presents the evaluation of the global predictions produced for soil organic carbon content, total nitrogen, coarse fragments, pH (water), cation exchange capacity, bulk density and texture fractions at six standard depths (up to 200 cm). The quantitative evaluation showed metrics in line with previous global, continental and large-region studies. The qualitative evaluation showed that coarse-scale patterns are well reproduced. The spatial uncertainty at global scale highlighted the need for more soil observations, especially in high-latitude regions.

Keywords
Keywords Plus
ORGANIC-CARBON STOCKSPARTICLE-SIZE FRACTIONSMAPSVALIDATIONMODEL

14- Evidence for the plant recruitment of beneficial microbes to suppress soil-borne pathogens

By:
Liu, HW (Liu, Hongwei) [1] , [2] ; Li, JY (Li, Jiayu) [1] ; Carvalhais, LC (Carvalhais, Lilia C.) [3] ; Percy, CD (Percy, Cassandra D.) [4] ; Verma, JP (Prakash Verma, Jay) [5] ; Schenk, PM (Schenk, Peer M.) [2] ; Singh, BK (Singh, Brajesh K.) [1] , [6]
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Abstract

An emerging experimental framework suggests that plants under biotic stress may actively seek help from soil microbes, but empirical evidence underlying such a 'cry for help' strategy is limited.
We used integrated microbial community profiling, pathogen and plant transcriptive gene quantification and culture-based methods to systematically investigate a three-way interaction between the wheat plant, wheat-associated microbiomes and Fusarium pseudograminearum (Fp).
A clear enrichment of a dominant bacterium, Stenotrophomonas rhizophila (SR80), was observed in both the rhizosphere and root endosphere of Fp-infected wheat. SR80 reached 3.7 x 10(7) cells g(-1) in the rhizosphere and accounted for up to 11.4% of the microbes in the root endosphere. Its abundance had a positive linear correlation with the pathogen load at base stems and expression of multiple defence genes in top leaves. Upon re-introduction in soils, SR80 enhanced plant growth, both the below-ground and above-ground, and induced strong disease resistance by boosting plant defence in the above-ground plant parts, but only when the pathogen was present.
Together, the bacterium SR80 seems to have acted as an early warning system for plant defence. This work provides novel evidence for the potential protection of plants against pathogens by an enriched beneficial microbe via modulation of the plant immune system.

Soil

Keywords
Author Keywords
crown rotendophytesFusarium pseudograminearumplant microbiomeStenotrophomonas rhizophilawheat
Keywords Plus
STENOTROPHOMONAS-MALTOPHILIARHIZOSPHERE MICROBIOMEIMMUNE-RESPONSESROOTSRESISTANCEPCREVOLUTIONAMPLIFYFOOD

Soil

15- Soil heavy metal pollution and food safety in China: Effects, sources and removing technology

By:
Qin, GW (Qin, Guowei) [1] ; Niu, ZD (Niu, Zhaodong) [2] ; Yu, JD (Yu, Jiangdong) [3] , [4] ; Li, ZH (Li, Zhuohan) [4] ; Ma, JY (Ma, Jiaoyang) [5] ; Xiang, P (Xiang, Ping) [5]
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Abstract

Soil plays a fundamental role in food safety and the adverse effects of contaminants like heavy metal (loid)s on crop quality have threatened human health. Therefore, it is important to focus on the food safety and agricultural soil pollution by heavy metals, especially for China where the demand for food production is increasing. This review comprehensively introduced the current status of agricultural soil pollution by heavy metals in China, analyzed the main sources of contaminants, including the applications of pesticides and fertilizers, atmospheric deposition related to vehicle emissions and coal combustion, sewage irrigation and mining. Food safety and agricultural soil pollution by heavy metals, the removal technologies for soil remediation such as soil amendments, phytoremediation and foliar sprays were also introduced. The review can provide significant insights for policymakers, environmental engineers, and agro-technicians regarding soil contamination control and management strategies and technologies.

Keywords
Author Keywords
Agricultural soilHeavy metalsFood safetySoil remediationPhytoextraction
Keywords Plus
HEALTH-RISK ASSESSMENTAGRICULTURAL SOILSWASTE-WATERRICE GRAINCADMIUMLEADCDCONTAMINATIONACCUMULATIONPHYTOREMEDIATION

Soil

16- Cover cropping enhances soil microbial biomass and affects microbial community structure: A meta-analysis

By:

Muhammad, I (Muhammad, Ihsan) [1] , [2] ; Wang, J (Wang, Jun) [1] , [2] ; Sainju, UM (Sainju, Upendra M.) [3] ; Zhang, SH (Zhang, Shaohong) [2] ; Zhao, FZ (Zhao, Fazhu) [1] , [2] ; Khan, A (Khan, Ahmad) [4] (provided by Clarivate)

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Abstract

Cover crops have been increasingly grown for improving soil health and crop production and minimizing environmental impact compared to no cover crop. Systematic documentation of cover cropping effects on soil microbial abundance and community structure, however, is scarce. A meta-analysis including data from 81 available studies was conducted to elucidate the effect of "cover crop" versus "no cover crop" on soil microbial community abundance and structure. Microbial biomass C and N (MBC and MBN) and total phospholipid-derived fatty acids (PLFA) were taken as proxies for soil microbial abundance, and total fungi, total bacteria, gram-positive and -negative bacteria, actinomycete, and arbuscular mycorrhizal fungi (AMF) for microbial community structure. Compared to no cover crop, cover crop overall enhanced PLFA, MBC, and MBN by 24, 40, and 51%, respectively. Soil total bacteria and total fungi, and the groups in them increased by 7-31% with cove crop compared to no cover crop. Fungi were affected more by cover crop than bacteria as indicated by the greater fungi/bacteria ratio. In depth categorical meta-analyses revealed that the legume and nonlegume cover crop mixture reduced MBC, PLFA, and actinomycete compared to legume or nonlegume cover crop alone. Legume cover crop enhanced actinomycete in comparison to nonlegume or the cover crop mixture. Incorporation of cover crop residue into the soil increased PLFA, total bacteria, AMF root colonization, and spore density, but decreased gram-positive and -negative bacteria and AMF compared to residue placed at the surface or removed from the soil. Microbial parameters due to cover crop compared to no cover crop were related to soil properties and annual precipitation. Medium-textured soils showed greater response of cover crop on PLFA, total bacteria and fungi, and actinomycete than fine- or coarse-textured soils. We conclude that cover crops enhance soil microbial community biomass and affected community structure compared to no cover crop and the

responses of microbial parameters to cover crop varied with soil and climatic conditions. Cover crops can enhance biological soil health by enhancing microbial community abundance compared to no cover crop.

Keywords

Author Keywords

Soil organic carbonSoil microbialBacteriaFungi

Keywords Plus

ARBUSCULAR MYCORRHIZAL FUNGIORGANIC-MATTERCROPSCARBONTILLAGENITROGENDIVERSITYEMISSIONSQUALITYRATIOS

Soil

17- Face stability of shield tunnels considering a kinematically admissible velocity field of soil arching

By:
Li, W (Li, Wei) [1] , [2] ; Zhang, CP (Zhang, Chengping) [1] , [2] ; Zhang, DL (Zhang, Dingli) [1] , [2] ; Ye, ZJ (Ye, Zijian) [1] , [2] ; Tan, ZB (Tan, Zhibiao) [1] , [2]

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Abstract

Existing mechanism of simulating soil movement at tunnel face is generally based on the translational or rotational velocity field, which is, to some extent, different from the real soil movement in the arching zone. Numerical simulations are carried out first to investigate the characteristics of the velocity distribution at tunnel face and above tunnel vault. Then a new kinematically admissible velocity field is proposed to improve the description of the soil movement according to the results of the numerical simulation. Based on the proposed velocity field, an improved failure mechanism is constructed adopting the spatial discretization technique, which takes into account soil arching effect and plastic deformation within soil mass. Finally, the critical face pressure and the proposed mechanism are compared with the results of the numerical simulation, existing analytical studies and experimental tests to verify the accuracy and improvement of the presented method. The proposed mechanism can serve as an alternative approach for the face stability analysis. (C) 2022 Institute of Rock and Soil Mechanics, Chinese Academy of Sciences. Production and hosting by Elsevier B.V.

Keywords
Author Keywords
Tunnel face stabilityVelocity fieldFailure patternImproved failure mechanismCritical face pressure
Keywords Plus
SHALLOW CIRCULAR TUNNELSUPPER-BOUND SOLUTIONSDRIVENPREDICTION2D

Soil

18- Effects of silicon on heavy metal uptake at the soil-plant interphase: A review

By:
Khan, I (Khan, Imran) [1] ; Awan, SA (Awan, Samrah Afzal) [1] ; Rizwan, M (Rizwan, Muhammad) [2] ; Ali, S (Ali, Shafaqat) [2] , [3] ; Hassan, MJ (Hassan, Muhammad Jawad) [1] ; Brestic, M (Brestic, Marian) [4] ; Zhang, XQ (Zhang, Xinquan) [1] ; Huang, LK (Huang, Linkai) [1]
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Abstract

Silicon (Si) is the second richest element in the soil and surface of earth crust with a variety of positive roles in soils and plants. Different soil factors influence the Si bioavailability in soil-plant system. The Si involves in the mitigation of various biotic (insect pests and pathogenic diseases) and abiotic stresses (salt, drought, heat, and heavy metals etc.) in plants by improving plant tolerance mechanism at various levels. However, Si-mediated restrictions in heavy metals uptake and translocation from soil to plants and within plants require deep understandings. Recently, Si-based improvements in plant defense system, cell damage repair, cell homeostasis, and regulation of metabolism under heavy metal stress are getting more attention. However, limited knowledge is available on the molecular mechanisms by which Si can reduce the toxicity of heavy metals, their uptake and transfer from soil to plant roots. Thus, this review is focused the following facets in greater detail to provide better understandings about the role of Si at molecular level; (i) how Si improves tolerance in plants to variable environmental conditions, (ii) how biological factors affect Si pools in the soil (iii) how soil properties impact the release and capability of Si to decrease the bioavailability of heavy metals in soil and their accumulation in plant roots; (iv) how Si influences the plant root system with respect to heavy metals uptake or sequestration, root Fe/ Mn plaque, root cell wall and compartment; (v) how Si makes complexes with heavy metals and restricts their translocation/transfer in root cell and influences the plant hormonal regulation; (vi) the competition of uptake between Si and heavy metals such as arsenic, aluminum, and cadmium due to similar membrane transporters, and (vii) how Si-mediated regulation of gene expression involves in the uptake, transportation and accumulation of heavy metals by plants and their possible detoxification mechanisms. Furthermore, future research work with respect to mitigation of heavy metal toxicity in plants is also discussed.

Keywords
Author Keywords
SiliconHeavy metalsSoilToxicitySequestration
Keywords Plus
SUPPRESSED CADMIUM UPTAKERICE AQUAPORIN LSI1BACTERIAL COMMUNITYROOT MORPHOLOGYPOWDERY MILDEWHEALTH-RISKSIRON PLAQUEISOTOPE FRACTIONATIONVEGETABLE CONSUMPTIONLITTER DECOMPOSITION

Soil

19- Halo-tolerant plant growth promoting rhizobacteria for improving productivity and remediation of saline soils

By:
Arora, NK (Arora, Naveen Kumar) [1] ; Fatima, T (Fatima, Tahmish) [2] ; Mishra, J (Mishra, Jitendra) [3] ; Mishra, I (Mishra, Isha) [2] ; Verma, S (Verma, Sushma) [2] ; Verma, R (Verma, Renu) [2] ; Verma, M (Verma, Maya) [4] ; Bhattacharya, A (Bhattacharya, Ankita) [1] ; Verma, P (Verma, Priyanka) [1] ; Mishra, P (Mishra, Priya) [1] ;
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Abstract

Background: The collective impact of climate change and soil salinity is continuously increasing the degraded lands across the globe, bringing agricultural productivity and food security under stress. The high concentration of salts in saline soils impose osmotic, ionic, oxidative and water stress in plants. Biological solutions can be the most reliable and sustainable approach to ensure food security and limit the use of agro-chemicals.
Aim of Review: Halo-tolerant plant growth promoting rhizobacteria (HT-PGPR) are emerging as efficient biological tools to mitigate the toxic effects of high salt concentrations and improve the growth of plants, simultaneously remediating the degraded saline soils. The review explains the role of HT-PGPR in mitigating the salinity stress in plants through diverse mechanisms and concurrently leading to improvement of soil quality.
Key Scientific Concepts of Review: HT-PGPR are involved in alleviating the salinity stress in plants through a number of mechanisms evoking multipronged physiological, biochemical and molecular responses. These include changes in expression of defense-related proteins, exopolysaccharides synthesis, activation of antioxidant machinery, accumulation of osmolytes, maintaining the Na+ kinetics and improving the levels of phytohormones and nutrient uptake in plants. The modification of signaling by HT-PGPR inoculation under stress conditions elicits induced systemic resistance in plants which further prepares them against salinity stress. The role of microbial-mechanisms in remediating the saline soil through structural and compositional improvements is also important. Development of novel bioinoculants for

saline soils based on the concepts presented in the review can be a sustainable approach in improving productivity of affected agro-ecosystems and simultaneously remediating them.

Keywords

Author Keywords

SalinityPlant growth promoting rhizobacteriaRemediationSustainable agricultureExopolysaccharides

Keywords Plus

SALT TOLERANCEACC-DEAMINASESTRESS TOLERANCEGENE-EXPRESSIONSECONDARY METABOLITESUSE EFFICIENCYBACTERIADROUGHTINOCULATIONWHEAT

Soil

20- Land use and climate change impacts on global soil erosion by water (2015-2070)

By:

Borrelli, P (Borrelli, Pasquale) [1] , [2] ; Robinson, DA (Robinson, David A.) [3] ; Panagos, P (Panagos, Panos) [4] ; Lugato, E (Lugato, Emanuele) [4] ; Yang, JE (Yang, Jae E.) [2] ; Alewell, C (Alewell, Christine) [1] ; Wuepper, D (Wuepper, David) [5] ; Montanarella, L (Montanarella, Luca) [4] ; Ballabio, C (Ballabio, Cristiano) [4]

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Abstract

Soil erosion is a major global soil degradation threat to land, freshwater, and oceans. Wind and water are the major drivers, with water erosion over land being the focus of this work; excluding gullying and river bank erosion. Improving knowledge of the probable future rates of soil erosion, accelerated by human activity, is important both for policy makers engaged in land use decision-making and for earth-system modelers seeking to reduce uncertainty on global predictions. Here we predict future rates of erosion by modeling change in potential global soil erosion by water using three alternative (2.6, 4.5, and 8.5) Shared Socioeconomic Pathway and Representative Concentration Pathway (SSP-RCP) scenarios. Global predictions rely on a high spatial resolution Revised Universal Soil Loss Equation (RUSLE)-based semiempirical modeling approach (GloSEM). The baseline model (2015) predicts global potential soil erosion rates of 43(-7)(+9.2) Pg yr(-1) , with current conservation agriculture (CA) practices estimated to reduce this by similar to 5%. Our future scenarios suggest that socioeconomic developments impacting land use will either decrease (SSP1-RCP2.6-10%) or increase (SSP2-RCP4.5 +2%, SSPS-RCP8.5 +10%) water erosion by 2070. Climate projections, for all global dynamics scenarios, indicate a trend, moving toward a more vigorous hydrological cycle, which could increase global water erosion (+30 to +66%). Accepting some degrees of uncertainty, our findings provide insights into how possible future socioeconomic development will affect soil erosion by water using a globally consistent approach. This preliminary

evidence seeks to inform efforts such as those of the United Nations to assess global soil erosion and inform decision makers developing national strategies for soil conservation.

Keywords
Author Keywords
land degradationagricultural sustainabilitypolicy scenarios
Keywords Plus
RAINFALL EROSIVITYAPPLICABILITYEUROPERATES

Soil

21- Tamm Review: Influence of forest management activities on soil organic carbon stocks: A knowledge synthesis

By:

Mayer, M (Mayer, Mathias) [1] , [2] ; Prescott, CE (Prescott, Cindy E.) [3] ; Abaker, WEA (Abaker, Wafa E. A.) [4] ; Augusto, L (Augusto, Laurent) [5] ; Cecillon, L (Cecillon, Lauric) [6] , [7] ; Ferreira, GWD (Ferreira, Gabriel W. D.) [8] ; James, J (James, Jason) [9] ; Jandl, R (Jandl, Robert) [10] ; Katzensteiner, K (Katzensteiner, Klaus) [1] ; Laclau, JP (Laclau, Jean-Paul) [11] , [12] ;

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Abstract

Almost half of the total organic carbon (C) in terrestrial ecosystems is stored in forest soils. By altering rates of input or release of C from soils, forest management activities can influence soil C stocks in forests. In this review, we synthesize current evidence regarding the influences of 13 common forest management practices on forest soil C stocks. Afforestation of former croplands generally increases soil C stocks, whereas on former grasslands and peatlands, soil C stocks are unchanged or even reduced following afforestation. The conversion of primary forests to secondary forests generally reduces soil C stocks, particularly if the land is converted to an agricultural land-use prior to reforestation. Harvesting, particularly clear-cut harvesting, generally results in a reduction in soil C stocks, particularly in the forest floor and upper mineral soil. Removal of residues by harvesting whole-trees and stumps negatively affects soil C stocks. Soil disturbance from site preparation decreases soil C stocks, particularly in the organic top soil, however improved growth of tree seedlings may outweigh soil C losses over a rotation. Nitrogen (N) addition has an overall positive effect on soil C stocks across a wide range of forest ecosystems. Likewise, higher stocks and faster accumulation of soil C occur under tree species with N-fixing associates. Stocks and accumulation rates of soil C also differ under different tree species, with coniferous species accumulating more C in the forest floor and broadleaved species tending to store more C in the mineral soil. There is some evidence that increased tree species diversity could positively affect soil C stocks in temperate and subtropical forests, but tree species identity, particularly N-fixing species, seems to have a stronger impact on soil C stocks than tree species diversity. Management of stand density and thinning have small effects on forest soil C stocks. In forests with high populations of ungulate herbivores, reduction in herbivory levels can increase soil C stocks. Removal of plant biomass for fodder and fuel is

related to a reduction in the soil C stocks. Fire management practices such as prescribed burning reduce soil C stocks, but less so than wildfires which are more intense. For each practice, we identify existing gaps in knowledge and suggest research to address the gaps.

Keywords

Keywords Plus

NITROGEN-FIXING TREESMIXED-SPECIES PLANTATIONSLAND-USE CHANGEMECHANICAL SITE PREPARATIONPLANT LITTER DECOMPOSITIONFIRE SURROGATE TREATMENTSGLOBAL CLIMATE-CHANGEOLD-GROWTH FORESTSCONTROL ROOT-ROTBOREAL FOREST

Soil

22- Centrifuge experiment on the penetration test for evaluating undrained strength of deep-sea surface soils

By:

Guo, XS (Guo, Xingsen) [1] , [2] , [3] ; Nian, TK (Nian, Tingkai) [2] ; Zhao, W (Zhao, Wei) [2] ; Gu, ZD (Gu, Zhongde) [2] ; Liu, CP (Liu, Chunpeng) [2] ; Liu, XL (Liu, Xiaolei) [1] ; Jia, YG (Jia, Yonggang) [1]

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Abstract

Rapid advances in deep-sea mining engineering have created an urgent need for the accurate evaluation of the undrained strength of marine soils, especially surface soils. Significant achievements have been made using full-flow penetration penetrometers to evaluate marine soil strength in the deep penetration; however, a method considering the effect of ambient water on the surface penetration needs to be established urgently. In this study, penetrometers with multiple probes were developed and used to conduct centrifuge experiments on South China Sea soil and kaolin clay. First, the forces on the probes throughout the penetration process were systematically analyzed and quantified. Second, the spatial influence zone was determined by capturing the resistance changes and sample crack development, and the penetration depth for a sample to reach a stable failure mode was given. Third, the vane shear strength was used to invert the penetration resistance factor of the ball and determine the range of the penetration resistance factor values. Furthermore, a methodology to determine the penetration resistance factors for surface marine soils was established. Finally, the effect of the water cavity above various probes in the surface penetration was used to formulate an internal mechanism for variations in the penetration resistance factor.

Keywords

Author Keywords

Soil

Static penetrometerCentrifuge experimentDeep-sea surface soilUndrained shear strengthPenetration resistance factorWater cavity

Keywords Plus

SHEAR-STRENGTHPENETROMETERSTABILITYRESISTANCESLOPEFLOOR

Soil

23- Heavy Metals and Pesticides Toxicity in Agricultural Soil and Plants: Ecological Risks and Human Health Implications

By:
Alengebawy, A (Alengebawy, Ahmed) [1] ; Abdelkhalek, ST (Abdelkhalek, Sara Taha) [2] , [3] ; Qureshi, SR (Qureshi, Sundas Rana) [2] ; Wang, MQ (Wang, Man-Qun) [2]
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Abstract

Environmental problems have always received immense attention from scientists. Toxicants pollution is a critical environmental concern that has posed serious threats to human health and agricultural production. Heavy metals and pesticides are top of the list of environmental toxicants endangering nature. This review focuses on the toxic effect of heavy metals (cadmium (Cd), lead (Pb), copper (Cu), and zinc (Zn)) and pesticides (insecticides, herbicides, and fungicides) adversely influencing the agricultural ecosystem (plant and soil) and human health. Furthermore, heavy metals accumulation and pesticide residues in soils and plants have been discussed in detail. In addition, the characteristics of contaminated soil and plant physiological parameters have been reviewed. Moreover, human diseases caused by exposure to heavy metals and pesticides were also reported. The bioaccumulation, mechanism of action, and transmission pathways of both heavy metals and pesticides are emphasized. In addition, the bioavailability in soil and plant uptake of these contaminants has also been considered. Meanwhile, the synergistic and antagonistic interactions between heavy metals and pesticides and their combined toxic effects have been discussed. Previous relevant studies are included to cover all aspects of this review. The information in this review provides deep insights into the understanding of environmental toxicants and their hazardous effects.

Keywords
Author Keywords

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Soil

heavy metal pollutionpesticide riskstoxic effectagroecosystemhealth implications
Keywords Plus
SOURCE APPORTIONMENTLEAD TOXICITYORGANOCHLORINE PESTICIDESCARDIOVASCULAR-DISEASEOCCUPATIONAL-EXPOSURENITROGENASE ACTIVITYMICROBIAL DIVERSITYPARKINSONS-DISEASEENZYMATIC-ACTIVITYCADMIUM TOXICITY

24- Roles of biochar-derived dissolved organic matter in soil amendment and environmental remediation: A critical review

By:
Sun, YQ (Sun, Yuqing) [1] ; Xiong, XN (Xiong, Xinni) [1] ; He, MJ (He, Mingjing) [1] ; Xu, ZB (Xu, Zibo) [1] ; Hou, DY (Hou, Deyi) [2] ; Zhang, WH (Zhang, Weihua) [3] ; Ok, YS (Ok, Yong Sik) [4] , [5] ; Rinklebe, J (Rinklebe, Jorg) [6] , [7] ; Wang, LL (Wang, Linling) [8] ; Tsang, DCW (Tsang, Daniel C. W.) [1]
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Abstract

Biochar is an emerging, cost-effective, and renewable carbonaceous material with abundant functional groups and tuneable mesoporous structure, showing a promising performance in fertility improvement, nutrient retention, microbial activity enhancement, and contaminant immobilization, etc. Dissolved organic matter (DOM) from biochar, which can be readily mobilized during soil application, is a key component for the soil matrix, microbial community, and the fate of contaminants. Comprehensive assessments of both positive and negative effects of biochar-derived DOM present critical environmental implications. This paper is the first of its kind to critically review the compositions and structures of biochar-derived DOM as well as its multiple roles in soil application. The effects of biochar-derived DOM on stabilization or migration/mobilization of contaminants/nutrients, as well as stimulation or inhibition of microbial activity and plant growth, depend on the nature of biochar-derived DOM, pollutant properties, soil characteristics, and environmental conditions including weather and hydrological conditions. The long-term stability of biochar-derived DOM is vital during soil application and involves various interactions such as physical disintegration, infiltration, sorption, and biotic/abiotic oxidation. Further studies of biochar-derived DOM are necessary for us to understand the fate of DOM and minimize the ecological and environmental risks (e.g., toxicity, competitive sorption, blockage effect, and solubilization) of biochar application.

Soil

Keywords
Author Keywords
Dissolved organic matterGreen and sustainable remediationSoil quality and healthMetal/metalloid immobilizationBiomass waste management
Keywords Plus
CARBON SURFACE-CHEMISTRYBLACK CARBONPYROLYSIS TEMPERATUREMICROBIAL COMMUNITYACTIVATED CARBONSWATEROXIDATIONRELEASEPLANTFLUORESCENCE

Soil

25- Forest soil nutrient stocks along altitudinal range of Uttarakhand Himalayas: An aid to Nature Based Climate Solutions

By:
Kumar, A (Kumar, Amit) [1] ; Kumar, M (Kumar, Munesh) [2] ; Pandey, R (Pandey, Rajiv) [3] ; Yu, ZG (Yu ZhiGuo) [1] ; Cabral-Pinto, M (Cabral-Pinto, Marina) [4]
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Abstract

Understating of forest functioning is crucial for ensuring the sustainable flow of forest ecosystem services. Climate regulation service of a forest ecosystem can be ensured through emission reduction by increasing carbon sequestration in forests. However, understanding about the functioning of forests for carbon sequestration is constrained due to lack of information on nutrient stocks and stoichiometry of soils of forests of India. Present study focuses to examine the stoichiometry of major nutrients; nitrogen (N), phosphorus (P), carbon (C) of forest soil to understand the dynamics of the forests of Uttarakhand, India. The study also attempted to supplement the information about the soil carbon sequestration potential of important tree species of the forest. Soil samples were collected randomly for the evaluation of physico-chemical characteristics and stoichiometry of forest soil at four altitudinal ranges i.e., <1000, 1000-1500, 1500-2000, and >2000 m a.s.l in the Himalayan region of Uttarakhand, India. The analysis shows that total nitrogen, total phosphorous, and soil organic carbon contents in forest soil were 0.35 +/- 0.11%, 0.10 +/- 0.04% and 3.36 +/- 0.84%, respectively, which increases with altitude. The stoichiometric ratios viz., C:N:P, N:P, C:N, and C:P, and N:P were reported of 51.6:5.4:1, 4.30 +/- 2.39, 9.60 +/- 1.48, and 41.94 +/- 23.35, respectively which were invariant with altitude. The low C:N ratio may be attributed to either increase in the nitrous oxide (N_2O) emissions with an increase in nitrogen, or low in carbon stock leading to decrease in carbon dioxide (CO_2) and methane (CH_4) emissions. Moreover, the soil C sequestration potential in the forest tree species follow the order of Abies pindrow > Cedrus deodara > Quercus leucotrichophora > Pinus roxburghii. The information of the study would facilitate for broadening the understanding about the soil properties and stoichiometry of forest ecosystem and would provide an aid to forest management besides contributing to the mitigations strategies of the forests.

Keywords
Author Keywords
C:N:P ratioC:P ratioCarbon sequestrationMitigationStoichiometric ratio
Keywords Plus
N-P STOICHIOMETRYTEMPERATE FORESTSORGANIC-CARBONLOESS PLATEAULEAF-LITTERHYDROELECTRIC RESERVOIRSMICROBIAL BIOMASSCNP STOICHIOMETRYNITROGENDECOMPOSITION

Soil

26- Evaluation of 18 satellite- and model-based soil moisture products using in situ measurements from 826 sensors

By:
Beck, HE (Beck, Hylke E.) [1] ; Pan, M (Pan, Ming) [1] ; Miralles, DG (Miralles, Diego G.) [2] ; Reichle, RH (Reichle, Rolf H.) [3] ; Dorigo, WA (Dorigo, Wouter A.) [4] ; Hahn, S (Hahn, Sebastian) [4] ; Sheffield, J (Sheffield, Justin) [5] ; Karthikeyan, L (Karthikeyan, Lanka) [6] ; Balsamo, G (Balsamo, Gianpaolo) [7] ; Parinussa, RM (Parinussa, Robert M.) [8] ;
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Article

Abstract

Information about the spatiotemporal variability of soil moisture is critical for many purposes, including monitoring of hydrologic extremes, irrigation scheduling, and prediction of agricultural yields. We evaluated the temporal dynamics of 18 state-of-the-art (quasi-)global near-surface soil moisture products, including six based on satellite retrievals, six based on models without satellite data assimilation (referred to hereafter as "open-loop" models), and six based on models that assimilate satellite soil moisture or brightness temperature data. Seven of the products are introduced for the first time in this study: one multi-sensor merged satellite product called MeMo (Merged soil Moisture) and six estimates from the HBV (Hydrologiska Byrans Vattenbalansavdelning) model with three precipitation inputs (ERA5, IMERG, and MSWEP) with and without assimilation of SMAPL3E satellite retrievals, respectively. As reference, we used in situ soil moisture measurements between 2015 and 2019 at 5 cm depth from 826 sensors, located primarily in the USA and Europe. The 3-hourly Pearson correlation (R) was chosen as the primary performance metric. We found that application of the Soil Wetness Index (SWI) smoothing filter resulted in improved performance for all satellite products. The best-to-worst performance ranking of the four single-sensor satellite products was SMAPL3E(SWI), SMOSSWI, AMSR2(SWI), and ASCAT(SWI), with the L-band-based SMAPL3ESWI (median R of 0.72) outperforming the others at 50% of the sites. Among the two multi-sensor satellite products (MeMo and ESA-CCISWI), MeMo performed better on average (median R of 0.72 versus 0.67), probably due to the inclusion of SMAPL3ESWI. The best-to-worst performance ranking of the six openloop models was HBV-MSWEP, HBV-ERA5, ERA5-Land, HBV-IMERG, VIC-PGF, and GLDAS-Noah. This ranking largely reflects the quality of the precipitation forcing. HBV-MSWEP (median R of 0.78) performed best not just among the open-loop models but among all products. The calibration of HBV improved the median R by C0 :12 on average compared to random parameters, highlighting the importance of model calibration. The best-to-worst performance ranking of the six models with satellite data assimilation was HBV-MSWEP+SMAPL3E, HBV-ERA5+SMAPL3E, GLEAM, SMAPL4, HBV-IMERG+SMAPL3E, and ERA5. The assimilation of SMAPL3E retrievals into HBV-IMERG improved the median R by C0:06, suggesting that data assimilation yields significant benefits at the global scale.

Keywords

Keywords Plus

GLOBAL-SCALE EVALUATIONHEIHE RIVER-BASINDATA ASSIMILATIONAMSR-ERADIOFREQUENCY INTERFERENCEAGRICULTURAL SITESCLIMATE-CHANGENEAR-SURFACE4 DECADESSMOS

Soil

27- Calcite in combination with olive pulp biochar reduces Ni mobility in soil and its distribution in chili plant

By:
Turan, V (Turan, Veysel) [1]
(provided by Clarivate)

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Abstract

The presence of Ni above the permissible limit in agriculture soils poses negative effects on soil health, crop quality, and crop productivity. Surprisingly, the usage of various organic and inorganic amendments can reduce Ni mobility in the soil and its distribution in the crops. A pot experiment was conducted to elucidate the effects of olive pulp biochar (BR), calcite (CAL), and wheat straw (WS), as sole amendments and their mixtures of 50:50 ratio, added to Ni polluted soil on Ni mobility in the soil, Ni immobilization index (Ni - IMi), soil enzymatic activities, Ni distribution in parts of chili plant, Ni translocation factor and bioaccumulation factor in fruit, plant growth parameters and oxidative stress encountered by the plants. Outcomes of this pot experiment revealed that amendments raised soil pH, improved soil enzymatic activities, values of Ni - IMi, while significantly reduced bioavailable Ni fraction in the post-harvest soil. However, the highest activities of acid phosphatase, urease, catalase, and dehydrogenase by 50, 70, 239, and 111%, respectively, improvement in Ni - IMi up to 60% while 60% reduction in the bioavailable Ni fraction was observed in BR + CAL treatment, compared to control was noted. Among all amendments, the top most reduction in Ni concentrations in shoots, roots, fruit, Translocation Factor (TF), and Bioaccumulation Factor (BAF) values of fruit by 72%, 36%, 86%, 72%, and 86%, in BR + CAL treatment, compared to control. Moreover, the plants growing on BR + CAL amended Ni contaminated soil showed the topmost improvement in plant phonological parameters while encountered the least oxidative stress. Such findings refer to the prospective usage of BR + CAL at 50:50 ratio than BR, CAL, WS alone, and BR +

WS as well as WS + CAL for reducing Ni mobility in the soil, improving Ni - IMi, soil enzymatic activities, plant phonological and oxidative stress while reducing Ni distribution in plant parts. Novelty statement In this experiment, it was hypothesized that amending Ni polluted soil with olive pulp biochar (BR), CAL, and WS as alone soil amendments and their combinations at 50:50 ratios can reduce Ni bioavailability in soil, Ni distribution in chili plant and oxidative stress encountered by the plants. Moreover, these amendments may improve, soil enzymatic activities, Ni immobilization index, plant phenological traits. Therefore, it was aimed to undertake useful scientific planning and research, to restore and rehabilitate the dwellings, biological resources and to minimize the sufferings of the peoples in nutrient-poor Ni contaminated soils, by improving soil health and chili productivity.

Keywords
Author Keywords
Olive pulp biocharcalciteimmobilization indexsoil enzymesoxidative stress
Keywords Plus
ZEA-MAYS L.NUTRITIONAL QUALITYHEAVY-METALSNICKEL IMMOBILIZATIONSUPEROXIDE-DISMUTASECONTAMINATED SOILWASTE-WATERBIOAVAILABILITYPEROXIDASECADMIUM

Soil

28- An overview on biochar production, its implications, and mechanisms of biochar-induced amelioration of soil and plant characteristics

By:
Haider, FU (Haider, Fasih Ullah) [1] , [2] ; Coulter, JA (Coulter, Jeffrey A.) [3] ; Cai, LQ (Cai, Liqun) [1] , [2] ; Hussain, S (Hussain, Saddam) [4] ; Cheema, SA (Cheema, Sardar Alam) [4] ; Wu, J (Wu, Jun) [1] ; Zhang, RZ (Zhang, Renzhi) [1] , [3]
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Abstract

The degradation of soil fertility and quality due to rapid industrialization and human activities has stimulated interest in the rehabilitation of low-fertility soils to sustainably improve crop yield. In this regard, biochar has emerged as an effective multi-beneficial additive that can be used as a medium for the amelioration of soil properties and plant growth. The current review highlights the methods and conditions for biochar production and the effects of pyrolysis temperature, feedstock type, and retention time on the physicochemical properties of biochar. We also discuss the impact of biochar as a soil amendment with respect to enhancing soil physical (e.g., surface area, porosity, ion exchange, and water-holding capacity) and chemical (e.g., pH, nutrient exchange, functional groups, and carbon sequestration) properties, improving the soil microbiome for increased plant nutrient uptake and growth, reducing greenhouse gas emissions, minimizing infectious diseases in plants, and facilitating the remediation of heavy metal-contaminated soils. The possible mechanisms for biochar-induced amelioration of soil and plant characteristics are also described, and we consider the challenges associated with biochar utilization. The findings discussed in this review support the feasibility of expending the application of biochar to improve degraded soils in industrial and saline-alkali regions, thereby increasing the usable amount of cultivated soil. Future research should include long-term field experiments and studies on biochar production and environmental risk management to optimize biochar performance for specific soil remediation purposes.

Soil

Keywords
Author Keywords
carbon sequestrationcrop yieldpyrolysissoil amendmentsoil fertilitysoil remediation
Keywords Plus
DIFFERENT PYROLYSIS TEMPERATURESGREENHOUSE-GAS EMISSIONSBLACK CARBONMICROBIAL COM

Soil

29- Insights into variations on dissolved organic matter of bauxite residue during soil-formation processes following 2-year column simulation

By:
Xue, SG (Xue, Shengguo) [1] ; Liu, Z (Liu, Zheng) [1] ; Fan, JR (Fan, Jiarong) [1] ; Xue, R (Xue, Rui) [2] ; Guo, Y (Guo, Ying) [1] ; Chen, W (Chen, Wei) [1] ; Hartley, W (Hartley, William) [3] ; Zhu, F (Zhu, Feng) [1]
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Abstract

Bauxite residue, an industrial alkaline solid waste, has a low organic carbon content which hinders plant growth. Dissolved organic matter (DOM) drives many biogeochemical processes including carbon storage and soil formation in soils. Input of exogenous organic materials may provide organic carbon and accelerate soil formation processes in bauxite residue. However, the potential effects of ameliorants on the quantity and quality of DOM in bauxite residue are still poorly understood. Here, the integration of ultraviolet-visible (UV-Vis) spectra, fluorescence spectra, and parallel factor (PARAFAC) analysis were used to investigate the vertical characteristics of DOM in bauxite residue treated by PV (the combined addition of 2% phosphogypsum and 4% vermicompost, w/ w) and BS (6% w/w including 4% bagasse and 2% bran) with 2-year column experiments. The content of DOM in untreated residues ranged from 0.064 to 0.096 g/kg, whilst higher contents of DOM were observed in PV (0.13 g/ kg) and BS (0.26 g/kg) treatment. Meanwhile, with the increase of residue depth, the aromaticity and hydrophobic components of DOM in residue decreased, which indicated that the degree of humification of the treated residues in the upper layer was higher than that in the lower layer. Compared with BR, BS and PV treatment accumulated the related content of fulvic acid-like substance from 36.14% to 71.33% and 74.86%, respectively. The incorporation of vermicompost and biosolids increased the content of humic-like substances, whilst decreasing the content of protein-like substances in the surface layer, which may be due to the

enrichment of the microbial community. During soil formation processes, the application of organic amendments reduced both salinity and alkalinity, enhanced microbial community diversity, and changed the quantity and quality of DOM in bauxite residue. These findings improve our understanding of the dynamics of DOM and response of DOM to soil formation processes in bauxite residue.

Keywords

Author Keywords

Bauxite residueSoil formation processesDissolved organic matterSpectroscopyPARAFAC

Keywords Plus

PARALLEL FACTOR-ANALYSISFLUORESCENCE SPECTROSCOPYMICROBIAL PROPERTIESPARAFAC COMPONENTSMOLECULAR-WEIGHTEXCITATIONQUALITYCARBONALKALINITYAMENDMENT

Soil

30- How biochar works, and when it doesn't: A review of mechanisms controlling soil and plant responses to biochar

By:
Joseph, S (Joseph, Stephen) [1] , [2] , [3] , [4] , [5] , [6] ; Cowie, AL (Cowie, Annette L.) [4] , [7] ; Van Zwieten, L (Van Zwieten, Lukas) [8] , [9] ; Bolan, N (Bolan, Nanthi) [9] , [10] , [11] ; Budai, A (Budai, Alice) [12] ; Buss, W (Buss, Wolfram) [13] ; Cayuela, ML (Cayuela, Maria Luz) [14] ; Graber, ER (Graber, Ellen R.) [15] ; Ippolito, JA (Ippolito, James A.) [16] ; Kuzyakov, Y (Kuzyakov, Yakov) [17] , [18] , [19] ;
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Review

Abstract

We synthesized 20 years of research to explain the interrelated processes that determine soil and plant responses to biochar. The properties of biochar and its effects within agricultural ecosystems largely depend on feedstock and pyrolysis conditions. We describe three stages of reactions of biochar in soil: dissolution (1-3 weeks); reactive surface development (1-6 months); and aging (beyond 6 months). As biochar ages, it is incorporated into soil aggregates, protecting the biochar carbon and promoting the stabilization of rhizodeposits and microbial products. Biochar carbon persists in soil for hundreds to thousands of years. By increasing pH, porosity, and water availability, biochars can create favorable conditions for root development and microbial functions. Biochars can catalyze biotic and abiotic reactions, particularly in the rhizosphere, that increase nutrient supply and uptake by plants, reduce phytotoxins, stimulate plant development, and increase resilience to disease and environmental stressors. Meta-analyses found that, on average, biochars increase P availability by a factor of 4.6; decrease plant tissue concentration of heavy metals by 17%-39%; build soil organic carbon through negative priming by 3.8% (range -21% to +20%); and reduce non-CO2 greenhouse gas emissions from soil by 12%-50%. Meta-analyses show average crop yield increases of 10%-42% with biochar addition, with greatest increases in low-nutrient P-sorbing acidic soils (common in the tropics), and in sandy soils in drylands due to increase in nutrient retention and water holding capacity. Studies report a wide range of plant responses to biochars due to the diversity of biochars and contexts in which biochars have been applied. Crop yields increase strongly if site-specific soil constraints and nutrient and water limitations are mitigated by appropriate biochar formulations. Biochars can be tailored to address site constraints through feedstock selection, by modifying pyrolysis conditions, through pre- or post-production treatments, or co-application with organic or mineral fertilizers. We demonstrate how, when used wisely, biochar mitigates climate change and supports food security and the circular economy.

Keywords

Author Keywords

carbon sequestrationGHG mitigationheavy metalspriming effectresiliencerhizosphere processessoil carbon

Keywords Plus

PYROGENIC ORGANIC-MATTERPOLYCYCLIC AROMATIC-HYDROCARBONSGREENHOUSE-GAS EMISSIONSBLACK CARBONPYROLYSIS TEMPERATUREHEAVY-METALSSEWAGE-SLUDGEMICROBIAL BIOMASSENHANCED BIOCHARN2O EMISSIONS

Soil

31- Mechanical and microstructural properties of recycling granite residual soil reinforced with glass fiber and liquid-modified polyvinyl alcohol polymer

By:
Yuan, BX (Yuan, Bingxiang) [1] ; Li, ZH (Li, Zihao) [1] ; Chen, YM (Chen, Yiming) [1] ; Ni, H (Ni, Hong) [2] ; Zhao, ZQ (Zhao, Zuqing) [1] ; Chen, WJ (Chen, Weijie) [1] ; Zhao, J (Zhao, Jin) [1]
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Abstract

Glass fiber and liquid-modified polyvinyl alcohol polymer (SH Polymer) are used to reinforce granite residual soil. In this paper, scanning electron microscopy (SEM) tests and drop-weight tests were used to study the microscopic interaction mechanism and impact resistance of granite residual soil specimens reinforced by glass fiber and SH Polymer. Combined with the equivalent confining pressure theory, Mohr-Coulomb intensity lines were used to quantitatively analyze the reinforcement effect of glass fiber. The SEM results showed that the granite residual soil solidified by a 3.5 % SH polymer had a tighter bond between the flake clay particles. In addition, with the incorporation of glass fiber, these flake clay particles were cemented on the glass fiber along the long axis, forming a cementing system of flake clay particles and glass fiber. When the glass fiber content was 3.0 %, the impact resistance of the specimen reached its maximum, 32.16 kN. Using the equivalent confining pressure theory, the reinforcement effect of glass fiber on soil could be quantified by Delta sigma 3.

Keywords
Author Keywords
Granite residual soilReinforcement of glass fiberMicrostructureImpact resistanceLiquid-modified polyvinyl alcohol polymer
Keywords Plus

Soil

WET-MIX SHOTCRETEIMPACT RESISTANCESTRENGTH BEHAVIORSHEAR-STRENGTHSISAL FIBERCEMENTLIME

Soil

32- Global soil pollution by toxic elements: Current status and future perspectives on the risk assessment and remediation strategies-A review

By:
Khan, S (Khan, Shamshad) [1] ; Naushad, M (Naushad, Mu) [2] , [3] , [4] ; Lima, EC (Lima, Eder C.) [5] ; Zhang, SX (Zhang, Shengxin) [1] ; Shaheen, SM (Shaheen, Sabry M.) [6] , [7] , [8] ; Rinklebe, J (Rinklebe, Joerg) [6] , [9]
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Review

Abstract

The aim of this article is to review and present the state of the arte about the status of toxic elements (TEs) in soils and assess the potential risk using single and total complex pollution indices in a global scale. We compiled, integrated, and analyzed soil TE pollution data over almost a decade through key maps, which have not been reviewed up to date. All the in-situ and ex-situ remediation treatments have been also reviewed, illustrated, and compared, for the first time. The future perspectives have been discussed and summarized. This review demonstrates that the cornerstone maps and integrated information provide reliable geographical coordinates and inclusive information on TEs pollution, particularly in China. In-situ treatment approaches for TEs polluted soils are more cost-effective and applicable than ex-situ treatment trials. Selecting a feasible remediation strategy should to take the extent of contamination, treatment objectives, site characteristics, cost-efficiency, and public suitability into account. The summarized findings in this review may help to develop innovative and applicable methods for assessing the global soil pollution by TEs. Also, these findings may help to develop innovative, applicable, and feasibly economic methods for sustainable management of TEs contaminated soils to mitigate the environmental and human health risk.

Keywords
Author Keywords

Soil

Hazardous metalsPollution indicesRemediation strategiesSustainable engineeringContaminated soils

Keywords Plus

HEAVY-METAL POLLUTIONSEQUENTIAL EXTRACTION PROCEDURECONTAMINATED SOILSSERPENTINE SOILSTIO2 NANOPARTICLESURBAN SOILSENRICHMENT FACTORSSOLID SPECIATIONULTRAMAFIC SOILSMARINE-SEDIMENTS

Soil

33- Environmental and health risk assessment of potentially toxic trace elements in soils near uranium (U) mines: A global meta-analysis

By:

Chen, L (Chen, Li) [1] , [2] ; Wang, JZ (Wang, Jingzhe) [3] , [4] , [5] ; Beiyuan, J (Beiyuan, Jingzi) [6] ; Guo, XT (Guo, Xuetao) [7] ; Wu, H (Wu, Hao) [8] ; Fang, LC (Fang, Linchuan) [1] , [2]

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Review

Abstract

Soil pollution by potentially toxic trace elements (PTEs) near uranium (U) mines arouses a growing interest worldwide. However, nearly all studies have focused on a single site or only a few sites, which may not fully represent the soil pollution status at the global scale. In this study, data of U, Cd, Cr, Pb, Cu, Zn, As, Mn, and Ni contents in U mine-associated soils were collected and screened from published articles (2006-2021). Assessments of pollution levels, distributions, ecological, and human health risks of the nine PTEs were analysed. The results revealed that the average contents of the U, Cd, Cr, Pb, Cu, Zn, As, Mn, and Ni were 39.88-, 55.33-, 0.88-, 3.81-, 3.12-, 3.07-, 9.26-, 1.83-, and 1.17-fold greater than those in the upper continental crust, respectively. The pollution assessment showed that most of the studied soils were heavily polluted by U and Cd. Among them, the U mine-associated soils in France, Portugal, and Bulgaria exhibited significantly higher pollution levels of U and Cd when compared to other regions. The average potential ecological risk value for all PTEs was 3358.83, which indicated the presence of remarkably high risks. Among the PTEs, Cd and U contributed more to the potential ecological risk than the other elements. The health risk assessment showed that oral ingestion was the main exposure route for soil PTEs; and the hazard index (HI) values for children were higher than those for adult males and females. For adult males and females, all hazard index values for the noncarcinogenic risks were below the safe level of 1.00. For children, none of the HI values exceeded the safe level, with the exception of U (HI = 3.56) and As (HI = 1.83), but Cu presented unacceptable carcinogenic risks. This study provides a comprehensive analysis that demonstrates the urgent necessity for treating PTE pollution in U mine-associated soils worldwide.

Soil

Keywords

Author Keywords

U mine-associated soilsPotentially toxic trace elementsPollution assessmentEcological riskHealth riskA global scale

Keywords Plus

ECOLOGICAL RISKHEAVY-METALSPOLLUTION CHARACTERISTICSAREAREMEDIATIONIMPACTPLANTDUST

Soil

34- Ecological risk assessment of soil and water loss by thermal enhanced methane recovery: Numerical study using two-phase flow simulation

By:
Xue, Y (Xue, Yi) [1] ; Liu, J (Liu, Jia) [1] ; Liang, X (Liang, Xin) [1] ; Wang, SH (Wang, Songhe) [1] ; Ma, ZY (Ma, Zongyuan) [1]
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Abstract

Thermal enhanced methane recover y inevitably aggravates the soi l and water loss, causing severe harm to the sustainability of groundwater environment and the surrounding ecosystem. Therefore, quantitative analysis of the effect of thermal enhanced methane recover y on groundwater loss and ecological risk of coalbed methane development zone is necessary. In this study, a coupling model of gas drainage and groundwater loss is estab-lished. The model considers the dynamic gas diffusion of coal matrix, the two-phase flow of water and gas, and the influence of temperature on such flow. Based on this model , characteristics of groundwater loss of coal seam reservoir caused by enhanced methane recover y are analyzed, and the ecological risk assessment of methane recovery zone is realized. Results indicate that during heat injection, the permeability of the coal seam increases with distance from the borehole due to the competition between two-phase flow and temperature. High tem-perature develops the permeability, gas production, and water production of the reservoir. The change rules of water and gas productions are similar with initial increases and subsequent declines. The influence of coal gas diffusion on groundwater loss has a certain time lag. In the early stage, the dynamic attenuation of gas dif f usion is not apparent. In the later stage, the supplement rate of gas from matrix to fracture decreases. The initial saturation has a significant influence on the water production rate in the early stage. A large Langmuir volume constant not only strengthens the peak value of gas drainage rate but also the gas drainage rate itsel f in the later declining period. Large scale coalbed methane development wi l l face ecological risks such as water environment pollution, habitat destruction and soi l degradation, which is the key aspect of ecological environment man-agement and risk prevention.

Soil

Keywords
Author Keywords
Enhanced methane recoveryHeat injectionGroundwater lossPermeability evolutionNumerical investigation
Keywords Plus: GAS

Soil

35- Arbuscular mycorrhizal fungi and pistachio husk biochar combination reduces Ni distribution in mungbean plant and improves plant antioxidants and soil enzymes

By:
Turan, V (Turan, Veysel) [1]
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Abstract

Soil pollution with nickel (Ni) casts detrimental effects on the quality of crops. Low-cost amendments can restrict Ni mobility in soil and its uptake by the plants. In this pot experiment, the effects of pistachio husk biochar (PHB) and arbuscular mycorrhizal fungi (AMF) on the distribution of Ni in mung bean and its bioavailability in Ni-spiked soil were evaluated. Plant parameters like Ni plant height, root dry weight, shoot dry weight, grain yield, chlorophyll contents, oxidative stress, Ni distribution in the roots, shoot, and grain, as well as the nutritional potential of grains, were measured on plants grown on Ni-contaminated soil amended or not (control) with AMF, zeolite (ZE), PHB, ZE + AMF, and PHB + AMF. Moreover, DTPA (diethylenetriamine pentaacetate)-extractable Ni in the soil, microbial biomass carbon (MBC), total glomalin (TG), extractable glomalin (EG), mycorrhizal root colonization (MRC), and the activities of soil enzymes (i.e. urease, acid phosphatase, and catalase) were also assessed after the plant harvest. With few exceptions, all treatments had significant effects on plant and soil parameters. The PHB + AMF treatment showed the topmost significant increment in plant physical parameters while reducing the Ni distribution in plant parts and oxidative injury. Based on these findings, it is proposed that PHB + AMF treatment can reduce Ni distribution and oxidative stress in mung bean plants and improve the biochemical compounds in grain.

Keywords

Soil

Keywords Plus
NUTRITIONAL QUALITYNICKEL IMMOBILIZATIONSUPEROXIDE-DISMUTASEL.RESPONSESPROTEINASCORBATEGLOMALINSTRESSLEAD

Soil

36- Appropriate human intervention stimulates the development of microbial communities and soil formation at a long-term weathered bauxite residue disposal area

By:
Ke, WS (Ke, Wenshun) [1] ; Zhang, XC (Zhang, Xianchao) [1] ; Zhu, F (Zhu, Feng) [1] ; Wu, H (Wu, Hao) [1] ; Zhang, YF (Zhang, Yifan) [1] ; Shi, Y (Shi, Yan) [1] ; Hartley, W (Hartley, William) [2] ; Xue, SG (Xue, Shengguo) [1]
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Abstract

Bauxite residue discharged to disposal areas, which could generate environmental pollution issues. Long-term natural restoration may improve the physicochemical properties of the residues, in turn supporting vegetation establishment, and effectively managing pollution. Nevertheless, the effects of short-term human intervention on soil formation in the weathered disposal areas are still relatively unknown. Thus, residue samples with different depths from different regions including no vegetation, sparse vegetation, complete vegetation coverage, and complete vegetation coverage following sewage sludge treatment were selected to analyze microbial community using Illumina high-throughput sequencing technology and evaluate soil formation process. Long-term weathering changed pH, the fraction of water-stable aggregates and nutrient concentrations, whilst promoting Proteobacteria, Chloroflexi, Acidobacteria and Planctomycete populations. Sewage sludge addition enhanced aggregate stability and significantly changed microbial community diversity. Sewage sludge application enriched the relative abundances of Proteobacteria and Bacteroidetes, whilst decreasing the relative abundance of Acidobacteria, which may be due to variation in environmental factors. Canonical correspondence analysis revealed that pH and EC were the main factors affecting microbial structure, followed by organic carbon content and aggregate stability. The results enhance the understanding of soil formation in bauxite residue and reveal the potential benefit of human intervention in ecological reconstruction at disposal areas.

Keywords
Author Keywords

Soil

Bauxite residueNatural restorationHuman interventionMicrobial community diversitySoil formation

Soil

37- Three-Dimensional Frequency-Domain Green's Functions of a Finite Fluid-Saturated Soil Layer Underlain by Rigid Bedrock to Interior Loadings

By:
Zhang, SP (Zhang, Shiping) [1] , [2] , [3] ; Pak, RYS (Pak, Ronald Y. S.) [4] ; Zhang, JH (Zhang, Junhui) [1] , [2] , [3]

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Abstract

This paper presents the three-dimensional frequency-domain Green's functions of a saturated poroelastic soil layer with incompressible constituents resting on rigid base due to interior time-harmonic point-, ring-, and disc-loadings with uniform distribution being composed of three effective stress source components and one pore fluid pressure source. The set of Green's functions can provide complete fundamental solutions for relevant boundary-value problem studies by the method of boundary integral equations. In developing these solutions, the dynamic property of the porous medium is described by Boer's poroelastic model. Four independent wave equations with definite physical meaning are obtained by introducing four scalar displacement potentials to uncouple the equations of motion of the layer and then resolved by the Fourier-Hankel integral transformations. By imposing the boundary and load interfacial conditions of the layer, the Green's function solutions of all field variables corresponding to the point-, ring-, and disc-loadings are derived. The obtained solutions are then validated by comparing with the existing special solutions and the finite-element model (FEM) calculation results. Numerical examples with disc loading cases are also performed to examine the effects of the permeability and the thickness of the poroelastic layer on its dynamic characteristic.

Keywords
Author Keywords
Green's functionFluid-filled poroelastic stratumBoer's poroelastic modelDisplacement potentials
Keywords Plus

Soil

POROELASTIC HALF-SPACETIME-HARMONIC RESPONSEDYNAMIC-RESPONSEFUNDAMENTAL-SOLUTIONSPOINT-SOURCEPROPAGATIONMECHANICSFORCEMODELWAVES

Soil

38- Effects of long-term grazing exclusion on plant and soil properties vary with position in dune systems in the Horqin Sandy Land

By:

Miao, RH (Miao, Renhui) [1] ; Liu, YZ (Liu, Yinzhan) [1] ; Wu, LQ (Wu, Liqi) [1] ; Wang, D (Wang, Dong) [1] ; Liu, YC (Liu, Yanchun) [1] ; Miao, Y (Miao, Yuan) [1] ; Yang, ZL (Yang, Zhongling) [1] ; Guo, MX (Guo, Meixia) [2] ; Ma, J (Ma, Jun) [3]

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Article

Abstract

Grazing exclusion is an important policy currently being employed by the Chinese government to recover degraded grasslands. Despite many field experiments, controversy still exists concerning the effects of grazing exclusion on the restoration of sand dune ecosystems. In order to examine the response of plant and soil parameters to grazing exclusion, a 32-year field experiment was conducted in active dune systems in the Horqin Sandy Land. The results showed that the dominant species changed significantly at the windward and leeward sides of dunes, and at interdune lowlands after long-term grazing exclusion. Plant density, cover, species richness, and soil organic carbon and total nitrogen (N) significantly increased across all topographic locations in areas with grazing exclusion. The effects of grazing exclusion on plant and soil parameters varied as a function of position in the dune system. In general, the recovery of plant and soil parameters occurred more rapidly at the windward side than at the leeward side when grazers were excluded. Soil organic carbon and total N were positively correlated with plant community density, cover, and species richness in active and stabilized sand dune systems. In addition, grazing exclusion strengthened the relationship between soil and plant parameters. The results showed that the effects of grazing exclusion on plant and soil properties were strongly dependent on dune position. These findings

should prompt those responsible to assess the recovery of sand dune systems by synthesizing the effects of multiple positions within a dune system.

Keywords

Author Keywords

Active sand duneDesertificationEcological restorationInterdune lowlandSpecies diversityWindwardLeeward

Keywords Plus

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