Hydrocarbon

Title	**Degradation of polycyclic aromatic hydrocarbons in soil mesocosms by microbial/plant bioaugmentation: Performance and mechanism**
Author Name	Fan-xin Kong, Guang-dong Sun & Zhi-pei Liu
Journal Name	Chemosphere
Year	2018
Volume and Issue	198
Pages	83-91
Abstracts	In order to study the degradation of polycyclic aromatic hydrocarbons (PAHs) in an aged and highly contaminated soil, four bioremediation strategies (indigenous microorganisms, microbial bioaugmentation with a PAH-degrading and bioemulsifier-producing strain, Rhodococcus ruber Em1, plant bioaugmentation with Orychophragmus violaceus and their combination) were compared and the enhanced degradation mechanism was investigated in soil mesocosms. Degradation rates over a period of 175 days showed that Em1 combined with Orychophragmus violaceus promoted a significant enhancement of PAHs degradation. In inoculated microcosms with Rhodococcus ruberEm1, mineralization reached a lower level in the absence than in the presence of plants. Elimination of PAHs was significantly enhanced (increased by 54.45%) in the bioaugmented mesocosms. Quantitative PCR indicated that copy numbers of linA and RHD-like gene (encoding PAH-ring hydroxylating dioxygenase) in the mesocosm with plant were three and five times higher than those in the mesocosm without plant, respectively. Transcript copy numbers of RHD-like gene and 16S rRNA gene of strain Em1 in mesocosm with plant were two and four times higher than those in the mesocosm without plant, respectively. Taken together, the results of this study show that plants or Rhodococcus ruber Em1 enhance total PAHs removal, moreover their effects are necessarily cumulative by combined strains and plants.
Keywords	Polycyclic aromatic hydrocarbons (PAHs); Bioaugmentation; Phytoremediation; Bioemulsifier-producing bacterial strain

Title	Removal of soil polycyclic aromatic hydrocarbons derived from biomass fly ash by plants and organic amendments
Author Name	Zdenek KOSNAR & Pavel TLUSTOS
Journal Name	Plant Soil Environ
Year	2018
Volume and Issue	64, 2
Pages	88-94
Abstracts	Phytoremediation using maize (Zea mays L.) assisted by the compost or vermicompost amendments was the most appropriate strategy for bioremediation of soil contaminated by polycyclic aromatic hydrocarbons (PAHs) derived from biomass fly ash. Higher removal of low molecular weight PAHs than medium and high molecular weight PAHs within the same treatment were observed. The total PAH content in planted soil with compost or vermicompost was decreased in a range between 62.9–64.9%. There were no significant differences ($P < 0.05$) between the compost and vermicompost amendments on the total removal of ash-PAHs. The content of PAH derived by ash did not have adverse effect on maize cultivation and biomass yield. The contribution of PAH reduction by maize roots on the soil total PAH removal was negligible. Therefore, maize significantly boosted the PAH removal in soil. The harvested maize shoots did not represent any environmental risk.
Keywords	carcinogenic compound; combustion residues; contamination; degradation; soil amendments

Title	**Application of biochar to soils may result in plant contamination and human cancer risk due to exposure of polycyclic aromatic hydrocarbons**
Author Name	Jian Wang, Kang Xia, Michael Gatheru Waigi, Yanzheng Gao, Emmanuel Stephen Odinga, Wanting Ling & Juan Liua
Journal Name	Environment International
Volume and Issue	121, 1
Year	2017
Pages	169-177
Abstracts	Biochars are added to soil to improve agronomic yield. This greenhouse- and field-scale study evaluated polycyclic aromatic hydrocarbon (PAH) contamination in 35 commercial and laboratory-produced biochars, and assessed the effects of biochar amendment of soils on PAH accumulation in vegetables and the risk for cancer. The total and bioavailable PAH concentrations in biochars varied from 638 to 12,347 μg/kg and from below the detection limit (BDL) to 2792 μg/kg, respectively. PAH formation in biochars decreased with increasing production temperature (350–650 °C). Root exudates enhanced PAH release from biochars. The total PAH concentrations in eight edible vegetables growing in biochar-amended soil varied according to biochar and vegetables type from BDL to 565 μg/kg. A health risk assessment framework was integrated with the benzo[a]pyrene toxic equivalency quotient and the incremental lifetime cancer risk (ILCR) to estimate the exposure risk for human beings via ingestion of PAH-contaminated vegetables. The total ILCR for adults was above 10−6, which suggests a risk to human health from direct exposure to PAHs in vegetables grown in biochar-amended soil. These results demonstrate that biochar application may lead to contamination of plants with PAHs, which represents a risk to human health. The PAH levels in biochars produced using different conditions and/or feedstocks need to be evaluated and biochars should be pretreated to remove PAHs before their large-scale agronomic application.
Keywords	Biochars; Soil; Polycyclic aromatic hydrocarbons; Vegetable; Incremental lifetime cancer risk; Risk assessment

Title	**Presence, distribution and risk assessment of polycyclic aromatic hydrocarbons in rice-wheat continuous cropping soils close to five industrial parks of Suzhou, China**
Author Name	Yong Li, Ling Long, Jing Ge, Li-xuan Yang, Jin-jin Cheng, Ling-xiang Sun, Changying Lu & Xiang-yang Yu
Journal Name	Chemosphere
Year	2017
Volume and Issue	184
Abstracts	Polycyclic aromatic hydrocarbons (PAHs) accumulated in agricultural soils are likely to threaten human health and ecosystem though the food chain, therefore, it is worth to pay more attention to soil contamination by PAHs. In this study, the presence, distribution and risk assessment of 16 priority PAHs in rice-wheat continuous cropping soils close to industrial parks of Suzhou were firstly investigated. The concentrations of the total PAHs ranged from 125.99 ng/g to 796.65 ng/g with an average of 352.94 ng/g. Phenanthrene (PHE), fluoranthene (FLT), benzo [a] anthracene (BaA) and pyrene (PYR) were the major PAHs in those soil samples. The highest level of PAHs was detected in the soils around Chemical plant and Steelworks, followed by Printed wire board, Electroplate Factory and Paper mill. The composition of PAHs in the soils around Chemical plant was dominated by 3-ring PAHs, however, the predominant compounds were 4, 5-ring PAHs in the soils around other four factories. Meanwhile, the concentration of the total PAHs in the soils close to the factories showed a higher level of PAHs in November (during rice harvest) than that in June (during wheat harvest). Different with other rings of PAHs, 3-ring PAHs in the soils around Chemical plant and Steelworks had a higher concentration in June. The results of principal component analysis and isomeric ratio analysis suggested that PAHs in the studied areas mainly originated from biomass, coal and petroleum combustion. The risk assessment indicated that higher carcinogenic risk was found in those sites closer to the industrial park.
Keywords	Polycyclic aromatic hydrocarbons; Agricultural soils; Distribution; Principal component analysis; Risk assessment

Title	**Remediation approaches for polycyclic aromatic hydrocarbons (PAHs) contaminated soils: Technological constraints, emerging trends and future directions**
Author Name	Saranya Kuppusamy, Palanisami Thavamani, Kadiyala Venkateswarlu, Yong Bok Lee, Ravi Naidu & Mallavarapu Megharaj
Journal Name	Chemosphere
Year	2017
Volume and Issue	168
Pages	944-968
Abstracts	For more than a decade, the primary focus of environmental experts has been to adopt risk-based management approaches to cleanup PAH polluted sites that pose potentially destructive ecological consequences. This focus had led to the development of several physical, chemical, thermal and biological technologies that are widely implementable. Established remedial options available for treating PAH contaminated soils are incineration, thermal conduction, solvent extraction/soil washing, chemical oxidation, bioaugmentation, biostimulation, phytoremediation, composting/biopiles and bioreactors. Integrating physico-chemical and biological technologies is also widely practiced for better cleanup of PAH contaminated soils. Electrokinetic remediation, vermiremediation and biocatalyst assisted remediation are still at the development stage. Though several treatment methods to remediate PAH polluted soils currently exist, a comprehensive overview of all the available remediation technologies to date is necessary so that the right technology for field-level success is chosen. The objective of this review is to provide a critical overview in this respect, focusing only on the treatment options available for field soils and ignoring the spiked ones. The authors also propose the development of novel multifunctional green and sustainable systems like mixed cell culture system, biosurfactant flushing, transgenic approaches and nanoremediation in order to overcome the existing soil- contaminant- and microbial-associated technological limitations in tackling high molecular weight PAHs. The ultimate objective is to ensure the successful remediation of long-term PAH contaminated soils.
Keywords	PAHs; Long-term contaminated soils; Treatment technologies; Biodegradation; Field-scale remediation; Future strategies

Title	**Hydrocarbon degradation potential and plant growth-promoting activity of culturable endophytic bacteria of Lotus corniculatus and Oenothera biennis from a long-term polluted site**
Author Name	Pawlik M, Cania B, Thijs S, Vangronsveld J, Piotrowska-Seget Z
Journal Name	Environmental Science and Pollution Research
Year	2017
Volume and Issue	24(24)
Pages	19640-19652
Abstracts	Many endophytic bacteria exert beneficial effects on their host, but still little is known about the bacteria associated with plants growing in areas heavily polluted by hydrocarbons. The aim of the study was characterization of culturable hydrocarbon-degrading endophytic bacteria associated with Lotus corniculatus L. and Oenothera biennis L. collected in long-term petroleum hydrocarbon-polluted site using culture-dependent and molecular approaches. A total of 26 hydrocarbon-degrading endophytes from these plants were isolated. Phylogenetic analyses classified the isolates into the phyla Proteobacteria and Actinobacteria. The majority of strains belonged to the genera Rhizobium, Pseudomonas, Stenotrophomonas, and Rhodococcus. More than 90% of the isolates could grow on medium with diesel oil, approximately 20% could use n-hexadecane as a sole carbon and energy source. PCR analysis revealed that 40% of the isolates possessed the P450 gene encoding for cytochrome P450-type alkane hydroxylase (CYP153). In in vitro tests, all endophytic strains demonstrated a wide range of plant growth-promoting traits such as production of indole-3-acetic acid, hydrogen cyanide, siderophores, and phosphate solubilization. More than 40% of the bacteria carried the gene encoding for the 1-aminocyclopropane-1-carboxylic acid deaminase (acdS). Our study shows that the diversity of endophytic bacterial communities in tested plants was different. The results revealed also that the investigated plants were colonized by endophytic bacteria possessing plant growth-promoting features and a clear potential to degrade hydrocarbons. The properties of isolated endophytes indicate that they have the high potential to improve phytoremediation of petroleum hydrocarbon-polluted soils.
Keywords	Plant-bacteria interactions; Endophytic bacteria; Petroleum hydrocarbons; Plant growth-promoting mechanisms; Lotus corniculatus L.; Oenothera biennis L.