World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:10, No:05, 2016

Rhizoremediation of Contaminated Soils in Sub-Saharan Africa: Experimental Insights of Microbe Growth and Effects of Paspalum Spp. for Degrading Hydrocarbons in Soils

Authors : David Adade-Boateng, Benard Fei Baffoe, Colin A. Booth, Michael A. Fullen

Abstract : Remediation of diesel fuel, oil and grease in contaminated soils obtained from a mine site in Ghana are explored using rhizoremediation technology with different levels of nutrient amendments (i.e. N (nitrogen) in Compost (0.2, 0.5 and 0.8%), Urea (0.2, 0.5 and 0.8%) and Topsoil (0.2, 0.5 and 0.8%)) for a native species. A Ghanaian native grass species, Paspalum spp. from the Poaceae family, indicative across Sub-Saharan Africa, was selected following the development of essential and desirable growth criteria. Vegetative parts of the species were subjected to ten treatments in a Randomized Complete Block Design (RCBD) in three replicates. The plant-associated microbial community was examined in Paspalum spp. An assessment of the influence of Paspalum spp on the abundance and activity of micro-organisms in the rhizosphere revealed a build-up of microbial communities over a three month period. This was assessed using the MPN method, which showed rhizospheric samples from the treatments were significantly different ($P < 0.05$). Multiple comparisons showed how microbial populations built-up in the rhizosphere for the different treatments. Treatments G (0.2% compost), H (0.5% compost) and I (0.8% compost) performed significantly better done other treatments, while treatments D (0.2% topsoil) and F (0.8% topsoil) were insignificant. Furthermore, treatment A (0.2% urea), B (0.5% urea), C (0.8% urea) and E (0.5% topsoil) also performed the same. Residual diesel and oil concentrations (as total petroleum hydrocarbons, TPH and oil and grease) were measured using infra-red spectroscopy and gravimetric methods, respectively. The presence of single species successfully enhanced the removal of hydrocarbons from soil. Paspalum spp. subjected to compost levels (0.5% and 0.8%) and topsoil levels (0.5% and 0.8%) showed significantly lower residual hydrocarbon concentrations compared to those treated with Urea. A strong relationship ($p<0.001$) between the abundance of hydrocarbon degrading micro-organisms in the rhizosphere and hydrocarbon biodegradation was demonstrated for rhizospheric samples with treatment G (0.2% compost), H (0.5% compost) and I (0.8% compost) ($P < 0.001$). The same level of amendment with 0.8% compost (N-level) can improve the application effectiveness. These findings have wide-reaching implications for the environmental management of soils contaminated by hydrocarbons in Sub-Saharan Africa. However, it is necessary to further investigate the in situ rhizoremediation potential of Paspalum spp. at the field scale.

Keywords : rhizoremediation, microbial population, rhizospheric sample, treatments
Conference Title : ICEBESE 2016 : International Conference on Environmental, Biological, Ecological Sciences and Engineering
Conference Location : Amsterdam, Netherlands
Conference Dates : May 12-13, 2016