

Integrated Phytoremediation Review

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Abstract

Several current publications have been collected to present in this paper. Taiwan local projects have also provided. Integrated phytoremediation can be defined using plant such as hyper accumulating plant as well as energy plant to remove heavy metals. Chelating agents, phytohormones, and calcium peroxide can be employed to enhance phytoremediation. Energy plants can be extract oil from energy plant to provide biogas and biofuel.

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Phytoattenuation of Soil Metal Contamination: The Effects of Plant Growth Regulators (GA₃ and IAA) By Employing Wetland Macrophyte Vetiver and Energy Plant Sunflower

Phytoattenuation, a novel green remediation concept, has been successfully demonstrated while employing vetiver and biostimulator (gibberellic acid GA₃ and indol-3-acetic acid IAA) to gradually mitigate soil Cu levels. The effectiveness of stimulator GA₃ and IAA was in the descending sequence GA₃ > IAA. Biostimulator has been demonstrated plant growth enhancement and been employed for agricultural operation. The on-site tests demonstrated Cu levels were gradually decreasing during ...month monitoring time periods. The soil metal level reduction achieved a satisfactory level which complied with local environmental standards. After more rounds of planting and harvesting, the soil metal concentration expected to be further dropped while on-site operation was executed. Green remediation concepts such as phytoattenuation need to be taken as serious concern while the Earth has faced recent unprecedent damage Japan tsunami, Green house effect, unpredicted weather fluctuation worldwide, and serious endangered species issues.

A novel green soil remediation to mitigate current Kaohsiung unlawful and paramount environmental damage of dig-and-dump soil resource killing regulatory out of date approach.

A Novel Green Soil Remediation to Mitigate Current Kaohsiung Unlawful

Soil and groundwater remediation act has been enacted and executed since year 2000 in Taiwan. It has been ten good years till today where lots of remediation techniques progressively employed to improve Taiwan soil and groundwater resource quality. Regulatory agencies, academia, remediation consulting firms, on-site professional engineers all have contribute the proud ten years in terms of soil and groundwater clean-up contribution. However, some of technologies were un-environmental friendly even detrimental and damage to Taiwan precious soil and groundwater resources. Biostimulators, GA₃ and IAA, have demonstrated effective plant propagation enhancement. Cu descending levels were statistically significant relative to the control. The soil metal level reduction achieved acceptable levels. More rounds of planting and harvesting, the soil metal concentrations expected to be much lessened in real sites. The other metal may have some effect similar to Cu. Green remediation concepts such as phytoattenuation and phytoextraction need to be taken as serious concern.

The Unprecedented Farmland Soil Monitoring Project and Feasible Remediation Approach in Taiwan

Soil and groundwater remediation Act was enacted in year 2000. More than ten years has already passed, Monitoring project has been completed, pollution status has been defined, contaminated sites depollution have been launched, a great progress has been made. This paper majorly to depict the extensive farmland soil quality monitoring which is unprecedent in Taiwan and believe has never been done worldwide.

This project was initiated from February 8th, 2002 to August 8th, 2002. The project tasks including digitalization of cadastre, farmland listing, basic information collecting, field investigation, sampling & analysis planning, field sampling, soil sample analysis, data evaluation, suggestion of contaminated farmland control, and analysis of potential pollution sources and transfer routes.

2,251 soil samples, had been sampled from Chang-Hwa County, Yun-Lin County, Nan-Tao County, and Chia-Yi City, and been analyzed in this project. 44% of these samples concentration exceed the soil pollution control standard, including 492 farmlands (125.65 ha registered) with total contaminated farming area of 108.38 ha in Chang-Hwa, and 6 farmlands (0.39 ha registered)

with total contaminated farming area of 0.39 ha in Nan-Tao County. However, the concentration of samples from Ynu-Lin County and Chia-Yi City do not exceed the soil pollution control standard.

To coordinate with the investigation results of the relative project regarding to water and sediment quality of irrigation channels in Chang-Hwa area, the pollution sources are preliminary concluded to be the irrigation channels surrounding the farmlands in Chang-Hwa area. As to the Nan-Tao County, the abandoned brick furnace plants neighboring the farmland are suspected to be the pollution sources.

The results show that the soil of the investigation area in Chang-Hwa County is the most polluted. Base on the Geostatistics study and the distribution of the irrigation channels; the area neighboring the investigated farmland in this project is suspected being polluted. For the farmlands exceeding soil control standard, Geostatistics method is suggested to coordinate with the information of the irrigation system to clarify the contaminated area so as to be the basis of land control and remediation work. As to the farmlands, not being investigated in this project but with high pollution potential according to the Geostatistics study, detail investigations are suggested. Regarding to soil pollution remediation, it is suggested to coordinate with the effluent control and irrigation channel remediation to achieve an all-out success.

A Study on Integrated Phytoremediation Measures for Enhancing Energy Crop's Performance in Treating Heavy Metal-polluted Soil

The purpose of this research is to verify a set of integrated measures for the phytoremediation of soil polluted by heavy metals. With the addition of chelant, phytohormones and calcium peroxide into the soil, we then grow energy-related crops, i.e. sunflowers, on it to absorb the heavy metals into the plant's body, reducing its content level and consequently achieving the goal of phytoremediation. In this research, we used a pot experiment to investigate the optimal operational parameters for phytoremediation by adding chelant (EDTA, EDDS), phytohormone (GA_3 , IAA), and calcium peroxide into soil polluted by copper, zinc and lead. The experiment's results indicate that EDDS is suitable for soil polluted by copper or zinc, while EDTA is the best one for removing lead from the soil. While both IAA and GA_3 can increase the biomass of plants, GA_3 performs better. Therefore, our conclusions regarding the optimal operational parameters for phytoremediation are as follows: The combination of GA_3 +EDDS+ CaO_2 is the best formula to remove copper and zinc, while GA_3 +EDTA+ CaO_2 is the most suitable one for eliminating lead from the soil. Compared with the conventional methods of phytoremediation, these integrated measures can actually spur the growth of plants and improve the efficiency of their absorption of heavy metals.

The Improvement of Phytomediation on the Treatment Effectiveness of Heavy Metals with Energy Sunflower Plants with Calcium Peroxide and Phytohormones

Phytomediation is an environmentally friendly green rehabilitation technology that is often incorporated with an application to improve calcium peroxide and phytohormones required for the growth of agricultural plants with the expectation to improve the effectiveness of plant rehabilitation. This study mainly consists of two parts: (1) water culture experiment and (2) pot culture experiment. In the water culture experiment, we attempt to understand the influence of the addition of calcium peroxide, phytohormones (IAA and GA_3) and a chelating agent on the growth of sunflower plants. From the growth, we are then able to know the effectiveness of the addition of phytohormones. However, in the pot culture experiment, when hormones and the chelating agent EDTA are introduced to different plant groups at the same time, if the nutrition in the water required by plants is not available, the addition of the hormone cannot negate the toxicity caused by EDTA. In terms of calcium peroxide, due to quick release of oxygen in water, this study fails to apply calcium peroxide to the water culture experiment.

When the pot culture experiment is used to examine the influence of hormones at different concentration levels on the growth of sunflowers, GA_3 10-8M is reported to have the optimal effectiveness, followed by IAA 10-8M; IAA 10-12M has the lowest effectiveness. According to an accumulation analysis of heavy metals at different levels, GA_3 concentrates in leaves to transport nutrition in soil to leaves. This result in an excellent TF value of 2.329G of GA_3 than 1.845 of the control group indicating that the addition of the hormone and chelating agent to GA_3 increases the TF value and the chelating agent is beneficial to the sunflower plant. If we examine phytoattenuation ability, the one-month experiment was divided into three stages for ten days each. The concentration level of heavy metals in the soil at each stage dropped continuously while that of the control group decreased from 31.63 mg/kg to 23.96 mg/kg, GA_3 from 32.09 mg/kg to 23.04 mg/kg and EDTA from 30.65 mg/kg to 25.93 mg/kg indicating the quickest growth period of the sunflowers from the formation of the bud to blossom. During the stage, the quick upward transportation of nutrition results in quick accumulation of heavy metals; the accumulated speed of heavy metals is found higher than that of directly planted plants. This study shows an improvement in the effectiveness of the addition of hormones on plant extraction and when rehabilitation is incorporated with sunflowers with the beginning bud formation, better treatment effectiveness can be reached.