Abdul Hameed M.J. Al-Obaidy

Environmental Research Center, University of Technology Baghdad, Iraq.
10929@uotechnology.edu.iq

Riyad H. Al-Anbari

Building and Constriction Engineering Department, University of Technology, Baghdad, Iraq

Sara M. Hassan

Building and Constriction Engineering Department, University of Technology, Baghdad, Iraq.
Sarah_mustafa_h@yahoo.com

Reducing Total Petroleum Hydrocarbon from Soil Polluted with Iraqi Crude Oil by Phytoremediation Technology

Abstract- *They used anew-green technology phytoremediation to reduce and remove pollutants from the soil. The purpose of the current research study was to survey the effect of soil pollution with a variety of doses of crude oil on the generation and growth of the plants. The study was made for 120 days from March to June in a control condition in the greenhouse and laboratory. Unpolluted soil near the Tigris River was taken and be polluted with varied doses of crude oil. They used alfalfa, Cotton and Grass in this research to reduce pollution. It made a comparison between the results of the three plants species to choose the best plant for total petroleum hydrocarbons removal from the soil. Grass plant gave the greatest result in total petroleum hydrocarbons removal, which gave up to 50.66% for Treatment 4, and cotton came in second place with 49.82% removal rate in treatment 2. Alfalfa came at the end with a removal rate of 31.78% for treatment 2 of the crude oil.*

Keywords- *Phytoremediation, Crude Oil, Soil, TPH.*

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1. Introduction

Duo to industrial and agricultural activities, there is growing in areas of land, surface and ground water affected by pollution. The build-up of toxic contaminants like heavy metals and organic pollutants in soil, surface water and groundwater, affects the natural resources and causes main stress on the environments. Remediation of the polluted sites using conventional rehearses, for example, the 'pump-and-treat' and 'dig-and-dump' methods, is commonly expensive, has limited potential, and is only relevant to small areas. Moreover, these methods are regularly making the soil infertile and unsuitable for agriculture and other usages. Therefore, there is the necessity to apply unconventional, ecologically sound tools, considering the possible end use of the site once.

Phytoremediation is the direct use of living plants for in situ, removal, degradation of pollutants in the soils, sludge, sediments, surface water and groundwater. However, phytoremediation is considered as a low cost, cleanup method, most suitable at sites with shallow, low levels of pollution and suitable for treating an extensive range of environmental pollutants. Furthermore, it is effective with, or in sometimes, in place of mechanical cleaning methods.

The aims of the current research work were to assess the phytoremediation potential of alfalfa, cotton and grass plants toward reducing the pollution of soil with crude oil.

2. Material and Methods

Seeds were germinated and seedlings were grown in plastic PVC pot (25 cm length, 25 cm height) occupied with 7 Kg of sandy clay soil, which was taken from an area near Tigers River. They put pots in the greenhouse and irrigated with tap water twice a week. The experiment was performed from March to June and diurnal temperatures varied between 20-40°C. Each pot have A hole at the bottom was made for the drainage of excessive water from the pots. Sixty pots were ready to seed the selected plant. They divided the pots into five groups for the following treatments:

T1: Unpolluted soil (control) which in tern have tow division seeded and without seeded with the selective plant.

T2: Polluted soil with crude oil (10,000 mg/kg which in tern have tow division seeded and without with the selective plant

T3: Polluted soil with crude oil (30,000 mg/kg which in tern have tow division seeded and without with the selective plant

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2412-0758/University of Technology-Iraq, Baghdad, Iraq

T4: Polluted soil with crude oil (50,000 mg/kg which in tern have tow division seeded and without with the selective plant
T5: Polluted soil with crude oil (75,000 mg/kg which in tern have tow division seeded and without with the selective plant
Three types of plant (Alfalfa (Medicago sativa), American grass (Cynodont Dactylon) and cotton (Gossypium Herbaceum)) were chosen for this study .Each treatment was repeated three times.
Plants were seeded in polluted and unpolluted soil, and the TPH content will be measured. Nevertheless, as we know, natural methods can reduce the TPH content in the studied soil such as a microbial action. It seems that, even if the polluted soil is ignored and abandoned with no treatment effort, TPH reducing occurred after a period of time. The influence of phytoremediation must be separated from the natural processes, which is named "Natural Attenuation". Thus, in the current research work, natural attenuation (NA) was considered for TPHs reducing. In the greenhouse and for five months duration, grass, cotton and alfalfa plant were seeded in soils. Plants were vegetated in the soil with the height of 1-1.5 cm in every single pot and irrigated two times in the week to keep necessary humidity content [1].
Air temperature in the greenhouse was ranged from 25 °C to 35 °C. PVC pans were used for each pot to collect the leachate water, which can be used in the next irrigating to keep away from losing the petroleum crude oil. However, 0.02% of the soil TPH was seeped out from the pot with the extreme water that comes down to the pans [2]. The number of growth vegetates was reported to recognize the germination rate. Plant shoot height was observed and reported. In each month of the research period, they used core sampler (inside D = 10 mm) to collect the soil samples from the 5cm depth. Soil samples were air dried at the laboratory temperature and then passed through 2 mm sieve. Horiba model OCMA–350 was used to test TPH concentration in the soil samples .
It took 5 gm of soil samples in 40 ml clean vial. Then to dry the soil sample 1g of anhydrous sodium sulfate, Na2SO4 was added. After that, 30 ml of the extracting solvent were added. Then an oil extraction from the soil was done by shaking the vial. Then the vial were placed into a vertical position for one some time for soil particles set. They put Whatman filter paper in a glass funnel. Above the filter paper, 2 gm of silica gel was added. Then the solvent was filtered into a clean beaker. Finally, pipette about 6 ml of extract into the OCMA-350 cell to measure TPH concentration.

3. Results and Discussion

Table 1 illustrates the removal rate efficiency for the whole four months of the study. It will illustrate which plant has given the best performance in removing and eliminating crude oil from the soil. Alfalfa gave lower removal rate in a comparative with other planted soil. Cotton and grass had the best removal rate of T2 for the whole five months, which recorded 49.82% and 47.85% respectively. Grass has big progressed after four months of the experiment being recorded the greatest removal rate in T3 and T4. While cotton has the greatest removal rate after four months for T5 (Figure 1).

Table 1: Efficiency of crude oil removal for four months

Plant type	Crude oil content mg/kg*10^3	Efficiency for five months %
Alfalfa	T2	31.8
Cotton	T2	49.8
Grass	T2	47.8
Without plant	T2	34.9
Alfalfa	T3	27.2
Cotton	T3	49.7
Grass	T3	49.9
Without plant	T3	46.17
Alfalfa	T4	32.2
Cotton	T4	46.9
Grass	T4	50.66
Without plant	T4	29
Alfalfa	T5	8.42
Cotton	T5	39.4
Grass	T5	25.86
Without plant	T5	37.27

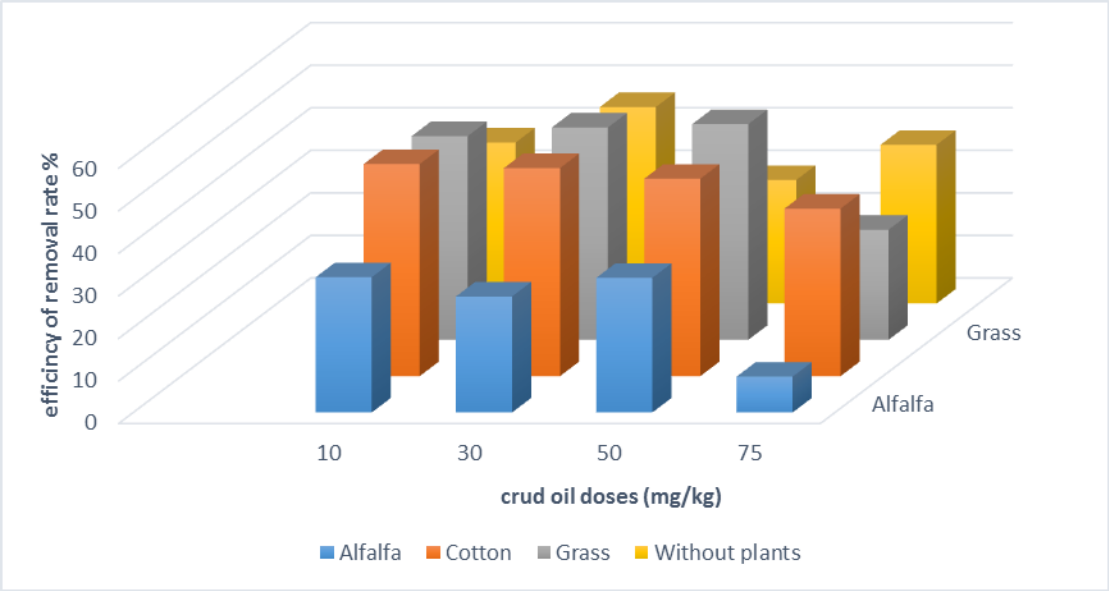

Figure 1: Removal rats for four months

Figure 1 shows the efficiency of the removal rate of the TPH concentration by the phytoremediation method. All bioremediation methods have affected the content of TPH fractions after 75 days of investigation. At the end of the investigation, the TPH content in soil was released as the greatest significant mechanism of phytoremediation was based on the motivation of soil microorganism. They may expect that higher root biomass, as got for some examined, means a larger rhizosphere for microbial population and it was associated with a higher degradation of hydrocarbons in the soil [3]. Thus, the increased of the pollutant degradations in the rhizosphere might result from a combined action of plants and rhizosphere microorganisms. Root exudates were exhibited to increase soil desorption of pollutants, improving bioavailability and subsequent biodegradation potential [4]. Plant exudates with plant age may affect the population and activity of the hydrocarbon degrading microorganisms in the rhizosphere; effect the efficiency rate of phytoremediation.

Natural attenuation is the simplest method among bioremediation tools; they are able to improve it through the association with other biological strategies to reduce cleaning-up times. This experimentation has shown that the vegetation with alfalfa, cotton and grass species led to higher removal rates of hydrocarbon from the soil. These conclusions support the impression of plant influence to pollutant dissipation through enrichment of microbial number and/or activity in the rhizosphere [5].

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