

The Effect of Bioremediated Diesel Polluted Soil Ammended with *Eicchorniacrassipes* (Water Hyacinth) on the Germination Parameters of *Amaranthushybridus*L. (Green Amaranth)

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Abstract: The aim of this research is to investigate the effects of bioremediated soil using *Eicchorniacrassipes* (water hyacinth) on the germination parameters such as days to germination of *Amarathushybridus* (green amaranth) and the physico-chemical profile such as total petroleum hydrocarbon (TPH) of the bioremediated soil with water hyacinth. 1kg of soil was polluted with 700ml of diesel oil in perforated plastic containers size (64x21cm) and amended with *E.crassipes* (water hyacinth) at 50,100 and 150g concentrations for 90 days. About 5 seeds of *A.hybridus* were sown on the bioremediated soil for 50 days. Positive (1kg of unpolluted soil) and negative (1kg of 700ml diesel oil polluted soil) controls were used. It was observed that *A. hybridus* seeds in the positive control had the quickest day to germination (7 days). An average of 12, 11, and 9 days to germination was observed in soil treated with *E.crassipes* at 50, 100 and 150 concentrations respectively. For the negative control, day to germination was late (20days). A significant difference was obtained in the root length and plant height and percentage germination between the positive and negative control. However, there was no significant difference between the positive control and the soil treated with *E. crassipes* at the three concentrations. The study had shown that diesel contamination affected germination and growth of *A. hybridus* plant adversely. However, *E.crassipes* can be effectively used to reduce the adverse effect of diesel polluted soil on *A.hybridus* and therefore serve as bioremeditor of diesel oil polluted soil.

Keywords: Bioremediation, *Eicchorniacrassipes* (water hyacinth), *Amarathushybridus* (green amaranth), Positive control, Negative control, Total petroleum hydrocarbon, Diesel oil.

1. Introduction

Since commercial exploration of petroleum started in Nigeria in 1958 Okoh [1], petroleum has continuously grown to be mainstay of the Nigerian economy. However, the exploration and transportation of petroleum and its products such as diesel oil has led to the pollution of agricultural lands and water ways Njoku et al. [2]. Several civil unrests due to environmental degradation due petroleum exploration have also been witnessed in Nigeria Inoniet al. [3]. Therefore, the urgent need of clean-up of petroleum polluted sites becomes paramount.

Bioremediation is the use of either naturally occurring organisms or deliberately introduced micro-organisms to consume and break down environmental pollutants, in order to clean up a polluted site Azubuike et al. [4]. It is a process wherein soil organisms reduce contaminant concentration through degradation, detoxification, stabilization, or transformation Azubuike et al. [4]. It is commonly implemented both *in situ* such as natural attenuation and *ex situ* such as composting. The principle of this technique is to optimize soil parameters that govern the rate of biodegradation such as, soil temperature, moisture, porosity, pH, available nutrients and microbial populations. Generally, bioremediation requires less resource input in diesel oil polluted soil than other techniques, and it is perceived as an environmentally friendly approach. However, bioremediation is often slow and unreliable, and thresholds of toxicity to micro-organisms may preclude its use in some circumstances Lim et al. [5].

Diesel oil is a petroleum distillate fuel used in compression-ignition engines. It is one of the major products of crude oil and it constitutes a major source of pollution to the environment Nwaoguet al. [6]. The increasing use of diesel oil in engines of cars, industrial trucks and generators has led to an increased demand for it Ogbo [7] which causes accidental spillage and pollution of agricultural lands leading to reduced plant growth, soil fertility and microflora population. Diesel oil can enter into the environment through leakage from storage containers and refueling of vehicles. It has been reported to be phytotoxic at relatively low concentrations, contaminates the soil caused a reduction in germination and length of the radicles of *Arachis hypogea*, *Vigna unguiculata*, *Sorghum bicolor* and *Zea mays* Ogbo [7].

Germination is the budding of a seed after it has been planted in soil and remained dormant for a certain period. These seeds eventually grows into young plants through the process of seed germination Tomei et al. [8].

A.hybridus is an erect annual plant with a stem that can be much branched to nearly free branches, it usually grows 30-200cm tall, occasionally to 250cm. The plant has a history of cultivation as a food crop and is still sometimes cultivated on a small scale for its edible leaves and seeds Aboribo [9]. No member of this genus are known to be poisonous, but can bioaccumulate nitrogen when grown on nitrogen rich soils and may cause stomach cancer, blue babies and some other health problems.

This study is significant because most of the time, we believed a diesel polluted soil has been bioremediated based

on the physico-chemical profile of the bioremediated soil, but we never care to check the germination, growth parameters and viability of the crops produced from such soils. Therefore this research aimed at checking the germination parameters of *A. hybridus* produced from *E. crassipes* remediated diesel oil polluted soil.

2. Materials and methods

This study was carried out in the Biological garden of the University of Lagos, Akoka Lagos, Nigeria. Seeds of *A. hybridus* were obtained from an agro allied shop in Bariga, Lagos State. Bioremediated soil with *E. crassipes* and control soil were obtained from a greenhouse experimental soil in the Biological garden of the University.

1kg of soil was polluted with 700ml of diesel oil and remediated with *E. crassipes* at different concentrations (50,100 and 150g) for 90 days. 5 seeds of *A. hybridus* were sown on the remediated soil, positive control soil and negative control soil for 50 days. The positive control soil was made up of 1kg of unpolluted soil, while the negative control was made up of 1kg of polluted soil with no remediation according to Wyzkowskiet al. [10]. The set up was monitored for the following parameters; Days to germination, percentage germination (%), root length (cm) and plant height (cm). Days to germination was determined by observing the number of days for first germination, percentage germination was by counting the number of germinated seeds and dividing it by total seeds sown,

multiplied by one hundred, root length and plant height was by using a transparent meter rule (cm). Total petroleum hydrocarbon residue (TPH) in the germinated plant was also obtained using gas chromatography and mass spectrophotometer (GC-MS) technique following Eckerts and Sims [11].

The effect of bioremediated soil using *E. crassipes* on the days to germination, percentage germination, root length and plant height of *A. hybridus* was determined by comparing all the data obtained. Statistical analyses of the data obtained were done using Statistical Package for Social Science (10.0) computer program using a 2 way ANOVA with significance levels at $p=0.05$.

3. Results and Discussion

The results indicated a significant difference in Total Petroleum Hydrocarbon residue (TPH) between the positive control and negative control at $p > 0.05$. There was no TPH in the positive control compared to 50 mg/kg in the negative control. However, there was no significant difference in (TPH) between bioremediated soil with 50, 100 and 150 g of *E. crassipes* and the Positive control at $p < 0.05$. This might be due to the ability of *E. crassipes* to breakdown petroleum hydrocarbon in the diesel polluted soil. This is similar to the findings of Siddiqui and Adams [12] who observed a less TPH in petrol polluted soil remediated with *E. crassipes*.

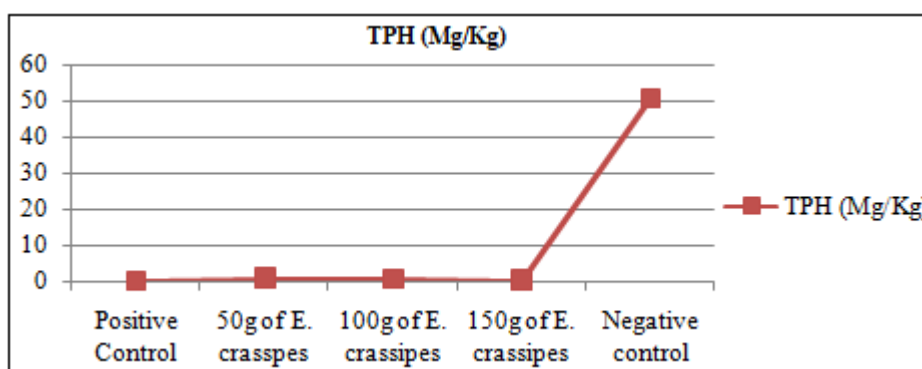


Figure 1: Total Petroleum Hydrocarbon residue in *A. hybridus* at three different concentrations after 50 days (Seven weeks)

The study indicated a significant delay in days to germination between the positive and negative control. The positive control germinated in 7 days, while the negative control took up to 20 days. This may be due to the prevention of proper functioning of microbes as a result of the inhibition of aeration by high concentration of diesel oil. This is similar to a research made by Kapulnik [13]. Amakiri and Onofeghara [14], reported that oil acts as potent on contact herbicides on seeds forming a film on the seed. However, there was no significant difference in days to germination between the positive control and the bioremediated soil with *E. crassipes* at the three concentrations. Though a more similar results was obtained

between positive control and the 150g of *E. crassipes*. A less percentage germination was obtained in the negative control while higher percentage germination was obtained in the positive control and the bioremediated soil. For the root length and plant height, the results indicated a significant difference between the positive and negative control at $p < 0.05$. However, there is no significant difference at days to germination, percentage germination, root length and plant height between the positive control and the bioremediated soil with *E. crassipes* at the three concentrations. This might be due to the effectiveness of *E. crassipes* in decomposing hydrocarbon polluted soil.

Table 2: Germination parameters of *A. hybridus* grown with polluted (Negative control), unpolluted (Positive control) and bioremediated soil at three different concentrations of *E. crassipes*, after 50 days (Seven weeks).

Sample	Days to germination	% Germination	Plant height (cm)	Root length (cm)
Positive Control	7	80±0.33	25±0.49	6.9±0.50
NegativeControl	20	20±0.33	8±0.25	1.21±0.79
50g of <i>E.crassipes</i>	12	74±1.45	23.4±0.15	6.0±0.13
100g of <i>E.crassipes</i>	11	80±0.00	24.2±0.15	6.3±0.12
150g of <i>E.crassipes</i>	9	80±1.20	24.9±0.67	6.6±0.27

4. Conclusion

The findings of this study indicated that diesel oil polluted soil affects the germination day, percentage germination, root length and height of *A. hybridus* and also led to accumulation of petroleum hydrocarbon in the test plant tissue. However, *E. crassipes* has been indicated as effective biostimulant which stimulate the hydrocarbon breakdown on a diesel polluted soil. The *E. crassipes* led to the breakdown of the hydrocarbon present in the polluted soil and thereby reducing the total petroleum hydrocarbon residue on the soil polluted with diesel oil. Therefore this study suggests the use of higher concentration of both powdered and fresh *E. crassipes* to check its effectiveness in hydrocarbon breakdown. Studies should also be conducted on soil polluted with other hydrocarbons such as kerosene, petrol, engine oil and bitumen to check the effectiveness of *E. crassipes* on hydrocarbon breakdown.

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