



The Use of Bermuda grass Clippings in the Phytoremediation of Crude Oil Polluted Soil

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Received: 18.08.2025 | Accepted: 31.08.2025 | Published: 22.09.2025

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DOI: [10.5281/zenodo.17253109](https://doi.org/10.5281/zenodo.17253109)

Abstract

This study demonstrates the efficacy of Bermuda grass clippings as a low-cost phytoremediation amendment for crude oil-polluted soil. In fourteen days, grass clippings significantly enhanced microbial activity with fungi count from $(5.8 \times 10^2 \text{ to } 6.5 \times 10^2)$ with parameters $(6.5 \pm 0.5 \text{ to } 12.2 \pm 0.7)$ $(3 \pm 1 \text{ to } 10.2 \pm 0.7)$ $(1.5 \pm 0.1 \text{ to } 3.1 \pm 0.2)$ of shoot, leaves and stem facilitating hydrocarbon degradation. The amendment stimulated the proliferation of indigenous fungi *Aspergillus flavus* and *Aspergillus niger* which played a crucial role in pollutant degradation. Our findings highlight the potential of Bermuda grass clippings as a rapid, cost-effective, and sustainable remediation strategy, offering a promising solution for environmental restoration in oil-polluted regions.

Keywords: Bermuda, Grass, Clippings, Phytoremediation, Crude-Oil, Polluted Soil.

Original Research Articles

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INTRODUCTION

Crude oil pollution poses significant environmental risks, particularly in oil-producing areas, disrupting soil structure, fertility, and microbial balance, and ultimately impacting agricultural productivity and ecosystem health (Tang & Angela, 2019). The Niger Delta region in Nigeria exemplifies severe environmental damage from oil spills, with lasting impacts on water, biodiversity, and human health (Dasetima-Altraide and Ogbonna, 2021).

Crude oil activities lead to soil acidification, heavy metal buildup, and elevated total petroleum hydrocarbons (TPH) levels, compromising soil health and agricultural productivity (Gibson & Paraes, 2021). Petroleum hydrocarbons also cause soil hydrophobicity and nutrient depletion, altering its texture, reducing water retention, and decreasing permeability (Kiamarsi et al., 2021).

Phytoremediation harnesses plants' ability to absorb, concentrate, and detoxify contaminants. Plants like *Cyperus esculentus* and *Phyllanthus amarus* have successfully reduced TPH and PAH levels in polluted soil (Dasetima-Altraide and Ogbonna 2021). By stimulating microbial activity and secreting enzymes, plants facilitate pollutant degradation, offering a promising approach for environmental remediation (Chukwuma et al., 2018).

Phytoremediation is a rapidly growing technology that's considered one of the best methods for cleaning up contaminated sites. It's cost-effective, visually appealing, and offers long-term solutions, making it an attractive option for environmental remediation (Clause 2004).

This plant-based technology uses natural or genetically engineered plants to tackle environmental issues, including heavy metal pollution caused by industrial activities (Yan et al 2020). As a green and sustainable approach, phytoremediation provides an environmentally friendly way to restore polluted areas (Yoon et al 2006)

By exploring the role of grass clippings in enhancing microbial activity and pollutant degradation, this study seeks to contribute to the development of eco-friendly and cost-effective phytoremediation strategies, enhancing our understanding of the role of grass clippings in pollutant degradation and promoting sustainable environmental management.

Materials and Methods

Sample Collection

Soil samples and Bermuda grass clippings were gathered from ESUT's agricultural farm, an area without prior crude oil contamination. The soil was then sieved to ensure



uniformity, air-dried, and stored in sealed bags to prevent any external contamination. While the crude oil was gotten from Indoroma petrochemical Limited Rives State Nigeria.

Crude Oil Contamination Procedure

The soil was contaminated with crude oil by adding a measured amount of crude oil to achieve a concentration of 5% by weight (weight of crude oil/weight of soil), a level simulating moderate pollution in laboratory studies as referenced in Kiamarsi et al. (2021). The crude oil was thoroughly mixed into the soil using a mechanical stirrer to ensure uniform distribution.

Environmental Treatment Set up and Treatment Application

The modified method of the experiment consisted of three groups: uncontaminated soil, soil contaminated with crude oil only, and soil contaminated with crude oil treated with cut grass, with maize planted in each group to assess the impact

by measuring plant growth parameters such as leaf count, shoot height, and stem thickness (Rita et al 2023; Chinwe 2025).

Media Preparation

Potato Dextrose Agar Preparation

Potato Dextrose Agar was prepared according to the manufacturer's instructions, sterilized by autoclaving at 121°C for 15 minutes, and then poured into sterile Petri dishes for culturing fungi.

Identification of Indigenous Fungi in the Contaminated Soil
The fungi were identified by examining their cultural and morphological features, such as mycelia, spores, and fruiting bodies. A lacto phenol cotton blue wet mount was used to prepare samples, which were then observed under a microscope at 40x magnification. The observed structures were matched to known fungal characteristics using a reference atlas (Catherine 2015).

Results

Table 1 Measurements of Growth Phase of Amended Soil and Control in Fourteen Days

Samples	Days	Shot	Leaves	Stem
Control (Uncontaminated soil)	Day0	0.0	0.0	0.0
	Day7	5.3 ± 1.0	2±1	1.5 ±0.9
	Day14	9.7 ±0.7	7 ±1	1.8±0.7
Soil + Crude Oil (No grass)	Day0	0.0	0.0	0.0
	Day7	0.0	0.0	0.0
	Day14	0.0	0.0	0.0
Soil + Crude Oil + grass	Day0	0.0	0.0	0.0
	Day7	6.5±0.5	3±1	1.5±0.1
	Day14	12.2±0.7	10.2±0.7	3.1 ±0.2

Table 2 (4.3) Enumeration of Hydrocarbon Fungal counts in Amended Soil with Grass Fourteen days

Treatment Group	Day1	Day3	Day5
Control	4.5×10 ²	5.7 ×10 ²	6.0×10 ²
Crude Oil Only	5.4 ×10 ²	5.0 ×10 ²	4.5×10 ²
Crude Oil + Grass	5.8 ×10 ²	7.0 ×10 ²	6.5×10 ²

Table 3 Cultural and Microscopic Identification of Fungi from Grass Treatment

Cultural Characteristics	Microscopy	Suspected Organism
Consist of Dense Felt Yellow Conidiophores	Unbranched conidiophores, round vesicles with biseriate sterigmata, and globose, greenish-yellow conidia.	<i>Asperigilus flavus</i>
Consist of black colonies, rough conidiophores with rapid growth	Rough-walled conidiophores, globose vesicles with phialides, and dark brown to black conidia.	<i>Aspergillus niger</i>

DISCUSSION

Table 1 illustrates that crude oil-contaminated soil

treated with (specify the treatment) exhibited the highest growth rate, whereas uncontaminated soil showed minimal growth, and untreated polluted soil had no growth over 14 days. This finding is consistent with Kiamarsi et al (2021) study, which demonstrated that organic amendments like vetiver grass significantly improved plant biomass production in oil-polluted soils. This study's results are consistent with earlier findings by Uwazie 2020 , which demonstrated the effectiveness of lemon grass in remediating crude oil-contaminated soil. Furthermore, the research by Oshiotse et al. 2020 on heavy metal uptake by *Pteridium aquilinum* plants supports the current study's conclusions, highlighting the potential of certain plant species for environmental remediation.

Table 2 reveals that the combination of crude oil and grass chippings resulted in the highest fungal count, suggesting that the grass chippings enhanced microbial proliferation by supplying necessary nutrients. This is consistent with Sumathi and Manian's 2023 study, which highlighted the role of microorganisms in degrading crude oil in soil amended with grass. This align with the study of Chinwe 2025 which found *Aspergillus flavus* multiplied from 2.10 to 5.12 cfu in a contaminated soil using grass and sawdust.

Table 3 reveals that *A. niger* and *A. flavus* were more prevalent in soil amended with grass chippings compared to untreated polluted soil and control. This finding is consistent with previous studies, including Rita et al. 2023 who identified *A. flavus* in spent engine oil-contaminated soil. This is align with the research of Chinwe 2025, who isolated *A. flavus* from crude oil-contaminated soil.

This study shows that grass clippings can rapidly restore hydrocarbon-polluted soil within fourteen days, offering a low-cost and locally available remediation solution

CONCLUSION

This research demonstrated that Bermuda grass chippings can be effectively used as a low-cost phytoremediation amendment in consortium with indigenous fung in the soil. The amendment improved soil physical structure, enhanced microbial diversity, and facilitated early plant growth in fourteen days. The grass provided organic matter that served both as a nutrient source and a physical medium for microbial colonisation, accelerating the degradation of hydrocarbons.

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