BIOSURFACTANT AS AN ADDITIVE FOR THE PROMOTION OF DIESEL-CONTAMINATED SOIL PHYTOREMEDIATION

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INTRODUCTION

Fig.1: Petroleum hydrocarbons contaminated site

One of the most common pollutants found in contaminated soil sites is petroleum hydrocarbons. Due to their toxic effects on human health and the environment, it's crucial to pay attention to soil pollution

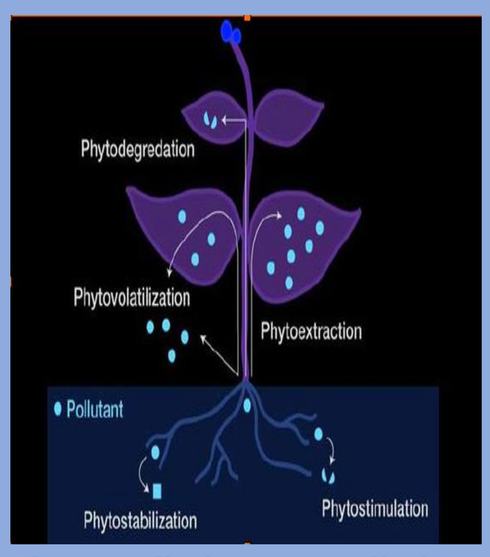

Fig.2: Soil phytoremediation principles

Phytoremediation is a process that can be accelerated by combining certain petroleum-resistant plant species with biological additives. Leguminous plants are particularly effective because of their nitrogen-fixing ability, which can reduce competition for limited soil nitrogen in petroleum-contaminated sites, thus supporting soil remediation efforts. One promising approach involves using biosurfactants as process promoters. Biosurfactants makes hydrocarbons more bioavailable for microbial breakdown

METHODS

Fig.3: Phytoremediation experiment using biosurfactant

Selected plant species (Melilotus albus, Medicago sativa and Lotus corniculatus) were cultivated in soil with varying levels of diesel pollution (control, 4000 mg kg^{-1}, 6000 mg kg^{-1}) for 90 days in a growth chamber. Biosurfactant HydroBreak PLUS at a rate of 1 ml kg^{-1} was introduced to the soil to examine its effectiveness in diesel phytoremediation with various legume species. To assess the diesel decomposition rates, the residual concentration of diesel in the soil was analysed by gas chromatography.

Fig.4: Gas chromatograph “SHIMADZU GC-2010 Plus”

Laboratory equipment used for the experiment:
Scales "SHIMADZU ATX84";
Shaker "EKROS PE-6410"; Centrifuge "Hettich BENCHTOP UNIVERSAL 320";
Gas chromatograph "SHIMADZU GC-2010 Plus".

RESULTS & DISCUSSION

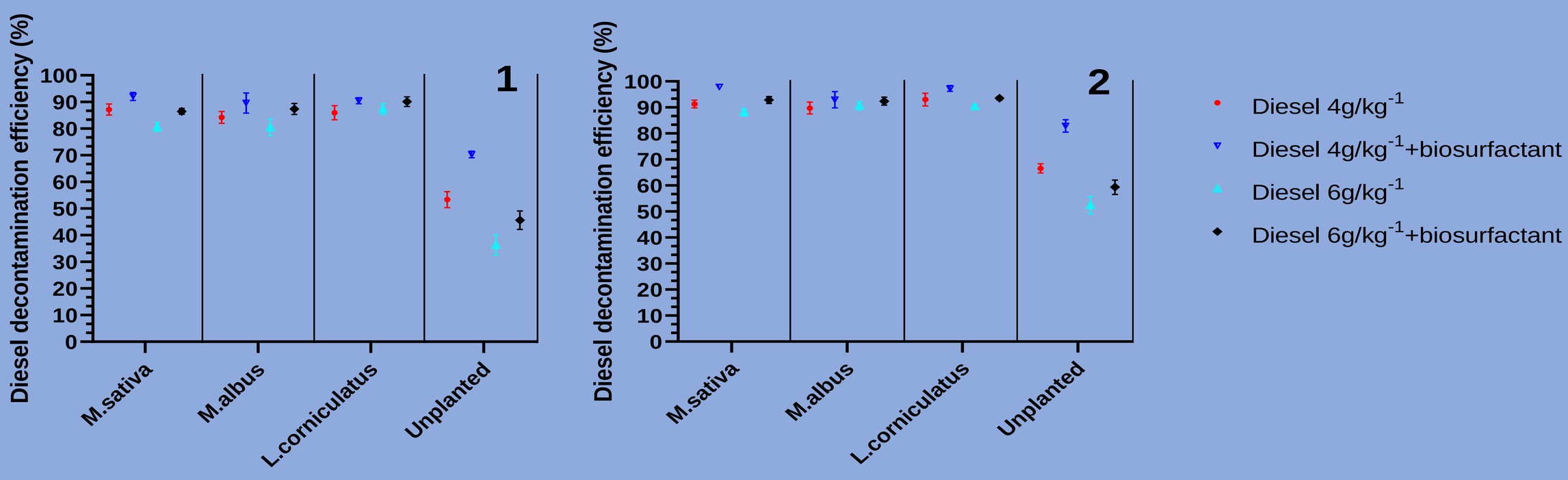

Fig.5: Diesel decontamination efficiency (%) after 45 (1) and 90 days (2) from the diesel-amended soil and diesel and biosurfactant-amended soil planted with *M. Sativa*, *M. albus*, *L. corniculatus* and unplanted soil.

At 4000 mg kg-1 diesel soil concentration, biosurfactant had a higher stimulatory effect than at 6000 mg kg^{-1}. After 45 days, diesel removal rates increased by 16% in unplanted and 4% in planted treatments in the 4000 mg kg^{-1} diesel+BS treatment with biosurfactant. In the 6000 mg kg^{-1} diesel+BS treatment, the diesel removal rates were 9% and 6% higher in unplanted and planted treatments, respectively. After 90 days, similar results were observed for the 4000 mg kg^{-1} diesel+BS treatment, while for the 6000 mg kg^{-1} diesel+BS treatment, the diesel removal rates were 6% and 3% higher in unplanted and planted treatments, respectively.

CONCLUSIONS

The results show that a biosurfactant additive can enhance legume plants' tolerance to diesel pollution while also improving the efficiency of contaminant removal. The effectiveness of the biosurfactant in removing diesel is contaminant concentration-dependent, as it decreases when the dosage of diesel exceeds certain levels. This suggests that optimal phytoremediation outcomes could be achieved using this amendment at minimal levels of soil contamination with petroleum hydrocarbons.