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Preliminary Test of Phytoremediation of Hydrocarbon Contaminated Soil Using *Paspalum Vaginatum Sw.*

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Abstract: Phytoremediation is a process which utilizes plants to remove contaminants from the environment. It is the latest alternative to recovery technique. In this research, sand with contaminated petroleum hydrocarbon was remediated. The usefulness of phytoremediation to enhance the degradation of organic contaminants has been extensively researched in recent years. Petroleum is a naturally occurring liquid with widely different composition and complexity. Because of the complexity, diesel was chosen as a model contaminant to represent petroleum hydrocarbon. The plant used in this research is *Paspalum vaginatum Sw.* This plant is a local plant and in *poaceae* family. The preliminary test was conducted to observe whether this plant could survive at what level of diesel contaminant. The experiment was performed in a greenhouse for 28 days. The plants were planted in 8 pots with 3 kg sand and different diesel concentration. The diesel concentrations in this experiment were 5, 10, 15, 20, 25, 30, 35 g diesel/kg sand and another pot with no contaminant as a control. The observation was made three times a week. The plants were also watered using tap water to ensure the plants could grow. After 28 days of observation, the plant species had shown that it could grow and survive in pots with concentrations of 5, 10, 15, 20, 25, 30 g diesel/kg sand. From this preliminary test, *Paspalum vaginatum Sw.* showed its initial ability to treat sand with contaminated petroleum hydrocarbon. As a conclusion, *Paspalum vaginatum Sw.* has the potential in the phytoremediation process of hydrocarbon.

Key words: phytoremediation, petroleum hydrocarbon, diesel, *Paspalum vaginatum Sw.*

INTRODUCTION

Phytoremediation is a process that uses plants to degrade and remove contaminants from the environment. It is a better option of recovery technique. Soil contamination is an important environmental problem. Remediation technologies are required to resolve the problem of soil contaminated with petroleum hydrocarbons, which are compounds used by a variety of industries (Etsuko *et al.,* 2007). Petroleum products are defined as common soil contaminants that are carcinogenic and may contain potentially toxic compounds (Euliss *et al.,* 2008). Diesel oil is a complex mixture of petroleum hydrocarbons containing everything from volatile and low molecular weight alkanes. Diesel oil will spread and seep into the soil when entering the terrestrial environment. Under normal conditions, diesel fuel will be absorbed in the organic rich surface soil and impeding downward migration (Adam and Duncan, 1999). Therefore, diesel was chosen as a model contaminant to represent petroleum hydrocarbon in this study.

Phytoremediation has been shown to be effective for petroleum and assessed in a number of field and greenhouse studies (Ferro *et al,* 1999; Euliss *et al,* 2008). The use of plant-based system to cleanse contaminated waters with organic and inorganic pollutants dates back hundreds of years. It comprises five processes, namely, phytoextraction, phytovolatilization, phytodegradation, rhizodegradation and phytostabilization (Cunningham *et al.*, 1996; Etsuko *et al.,* 2007).

The plant used in this research is *Paspalum vaginatum Sw.* The common name of this plant is biscuit grass. It can be found in coastland, estuarine habitats and wetlands. This is a local grass plant and in *poaceae* family (Anonymous, 2010). Adam and Duncan (2002) reported that grasses are the best to be used in remediation of contaminated soil due to their fibrous root systems with extensive surface area for microbial colonisation. The fibrous root system forms a continuous, dense rhizosphere, which provides ideal conditions for phytoremediation.

This research was carried out to preliminarily determine diesel concentration that *Paspalum vaginatum Sw.* could survive. After determining these concentrations, further work will be done extensively to analyze the concentration in another phytotoxicity test.

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Fig. 1: *Paspalum vaginatum Sw.*

MATERIALS AND METHOD

Propagation of *Paspalum Vaginatum Sw.:*

Paspalum vaginatum Sw. species was propagated from seeds in a greenhouse in Universiti Kebangsaan Malaysia using soil garden in polyethylene bags. Composition of soil garden was 3: 2: 1 which was topsoil: organic: sand.

Preparation of Contaminated Sand:

The sand was sieved with a 4-mm sieve to ensure uniformity and remove coarse fragment. 3 kg of sieved sand was put into each pot. Eight different concentrations of diesel which were 5, 10, 15, 20, 25, 30, 35 g diesel/kg sand including another pot with no contaminant were used.

The diesel fuel was obtained from a local petrol station. It was mixed with acetone as a solvent (Adam and Duncan, 2002). The mixture of diesel and acetone was poured into the sand according to the acetone holding capacity of 157.5 ml. After pouring into the sand, the sand was stirred to become homogeneous. The spiked media was manually stirred 3 times a week and left for about 2 weeks prior the planting to ensure the diesel was aged and the acetone was removed prior to its usage for planting (Wenhao *et al.*,, 2004). The plants were then planted in all pots after all acetone was evaporated. 24 plants with average 10-15 cm high were planted in 8 pots filled with different diesel concentrations. During planting, the plants were also watered to maintain the wetness of the sand and to make sure the plants could grow.

Plant Growth Observation:

This preliminary test was conducted to observe at what level of diesel contaminant this species could survive and grow. The observation was conducted 3 times a week for 28 days. Figure 2 shows day 0 of the pots with different concentrations of diesel contaminant. The observation on the number of withered plants was done within the period. The percentage of withered plant in each concentration was determined by dividing the number of withered plants with the total number of plants in the pot. The observation of plant growth was conducted physically.

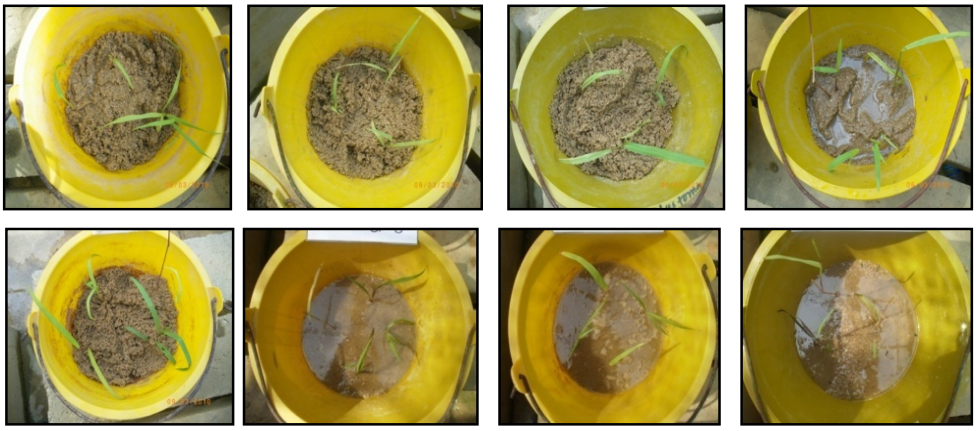

Fig. 2: Different diesel concentrations on day 0.

RESULTS AND DISCUSSION

Physical Growth of *Paspalum Vaginatum Sw.:*

The physical growth observation was conducted daily on the first week of study. In the following week, the observation was conducted weekly. After 7 days of exposure, plants in pots with concentrations of 30 and 35 g diesel/kg sand had turned its colors from green to yellow. The plants with concentration 35 g diesel/kg sand withered after 14 days of exposure and finally dried up 100% after 28 days. While the plants in concentrations of 10, 15, 20 and 25 g diesel/kg sand had begun to wither on day 21.

Based on the physical observation of the plant growth for day 28, Figure 4 illustrates the percentage of withered plant on each pot. On day 28, the result shows 33.3% plant in pots of 10 and 15 g diesel/kg sand were withered and 66.7% plants in pots of 20, 25 and 30 g diesel/kg sand were also withered. The plants with the concentration of 35 g diesel/kg sand was 100% withered while the plant in pot of 5 g diesel/kg sand and no contaminant grew well and survived.

The obtained results are almost similar to the study conducted by Adam and Duncan (1999). From the study, it shows 11 species of grasses could germinate well in concentrations of 0 g/kg and 25 g/kg diesel. In concentration of 50 g/kg diesel, the percentage germination of 11 species was low. Adam and Duncan (2002) reported when the concentration of volatile diesel fuel hydrocarbons surrounding the germinating seed was reduced, germination proceeded at a higher rate. This inhibitory effect on germination may be attributed to the physical constraints induced by the diesel fuel remaining in the soil on the seed. Diesel fuel would cause a film of oil to form around the seed which would act as a physical barrier, preventing or reducing both water and oxygen transfer to the seed. This study is also in agreement with Erute *et al.,* (2009) which concluded that *P. scrobiculatum* could grow successfully in different levels of crude oil (0.0, 2.5, 5.00, 7.5, 10.0, 12.5 and 15.0%) although the shoot length was significantly reduced by the presence of crude oil.

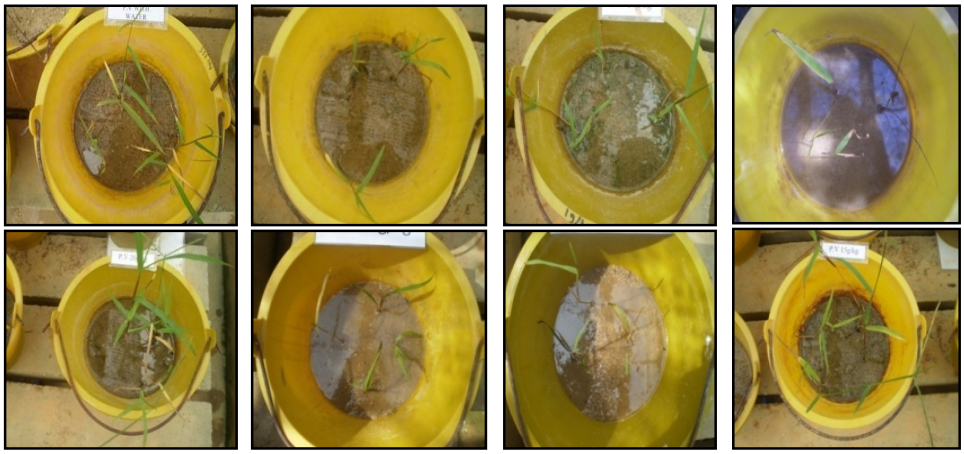

Fig. 3: Growth of *Paspalum vaginatum Sw.* in different diesel concentrations on day 28.

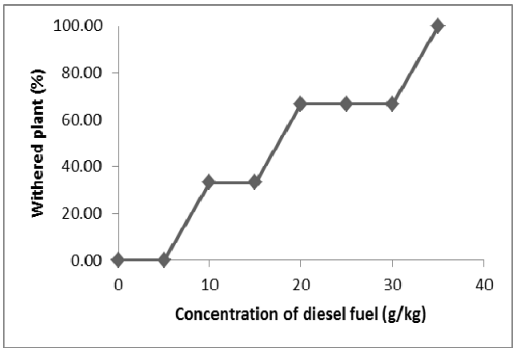

Fig. 4: Withered plant of *Paspalum vaginatum Sw.* on day 28.

Based on the observations, higher concentration of contaminants will affect greater on the withered percentage and cause faster withered condition. Therefore, the next phytotoxicity test of hydrocarbon will be conducted on a range of 0 – 30 g/kg diesel concentration.

Conclusions:

After 28 days of observation, it was found that *P. vaginatum Sw.* could survive and grow successfully in pots of 0, 5, 10, 15, 20, 25 and 30 g diesel/kg sand. Therefore, this plant is a good candidate for remediation of hydrocarbon contaminated soil. Hence, the future phytotoxicity test will be conducted on a range of 0 - 30 g/kg diesel concentration.

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REFERENCES

Adam, G. and H. Duncan, 1999. Effect of diesel fuel on growth of selected plant species. Environmental Geochemistry and Health, 21: 353-357.

Adam, G. and H. Duncan, 2002. Influence of diesel on seed germination. Environmental Pollution, 120: 363-370.

Anonymous, http:// paspalum vaginatum\ecology.asp.htm, Accessed on 7th January 2010.

Cunningham, S.D., T.A. Anderson, P.A. Schwab, F.C. Hsu, 1996. Phytoremediation of soils contaminated with organic pollutants. Advance in Agronomy, 56: 55-114.

Euliss, K., H. Chi-hua, A.P. Schwab, R. Steve, M.K. Banks, 2008. Greenhouse and field assessment of phytoremediation for petroleum contaminants in a riparian zon. Bioresource Technology, 99: 1961-1971.

Erute, M.O., Z. Mary, O. Gloria, 2009. The effect of crude oil on growth of the weed (Paspalum scrobiculatum L.)-phytoremediation potential of the plant. African Journal of Environmental Science and Technology, 3(9): 229-233.

Etsuko, K., M. Tsukasa, T. Masahiko, 2006. Ryegrass enhancement of biodegradation in diesel-contaminated soil. Environmental and Experimental Botany, 55: 110-119.

Etsuko, K., M. Tsukasa, T. Masahiko, 2007. Effect of rhizodegradation in diesel-contaminated soil under different soil conditions. Plant Production Science, 10(1): 105-111.

Ferro, A.M., S.A. Rock, J. Kennedy, J.J. Herrick, D.L. Turner, 1999. Phytoremediation of soils contaminated with wood preservatives: greenhouse and field evaluations. International Journal of Phytochemistry, 1: 289-306.

Wenhao, H.S, B.L. Joey, M.R. Franqoise, R. Chittarajan, C.S. Tang, 2004. Phytoremediation of Petroleum Hydrocarbons in Tropical Coastal Soils I. Selection of Promising Woody Plants. Environmental Science and Pollution Research, 11(4): 260-266.