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Preliminary Test of Hydrocarbon Exposure on *Salvinia molesta* in Phytoremediation Process

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Abstract
The preliminary test in phytoremediation was necessary to determine the ability of plants to survive in media with different concentrations of contaminant. It was conducted to determine the maximum concentration of contaminant that is harmful to the plant and suppress the plant growth. In this study we observed the ability of an aquatic plant *Salvinia molesta* to resist diesel contaminant in synthetic wastewater of different concentrations (0, 8700, 17400, 26000, 34800, and 43500 mg/L) . The experimental work was performed in a green house in the outdoor condition for an observation period of 2 weeks. Throughout the 2 weeks duration, the results showed that 33% of the aquatic plants withered at the concentration of 8700 mg/L and 100% withered at higher concentration of 43500 mg/L. In addition, the rate of growth was measured through wet and dry weight of the aquatic plant, *Salvinia molesta* to determine the plant biomass. The dry weight (y) was correlated to the wet weight (x) through a growing line of $y = 0.0157\,x + 0.4513$ with R^2

Keywords: *component; Phytoremediation , preliminary test, growth rate, Diesel, Salvinia molesta*

Abstrak
Ujian awal dalam fitopemulihan perlu dilakukan untuk menentukan keupayaan tumbuh-tumbuhan hidup dalam media yang mempunyai kepekatan bahan cemar yang berbeza. Ujian ini dijalankan untuk menentukan jumlah maksimum kepekatan bahan cemar yang akan membahayakan tumbuh-tumbuhan dan menjejaskan pertumbuhannya. Dalam kajian ini, kami memerhatikan keupayaan sejenis tumbuhan akuatik bernama Salvinia molesta hidup dalam air buangan sintetik yang mengandungi kepekatan bahan cemar diesel yang berbeza-beza (0, 8700, 17400, 26000, 34800, 43500 mg/L). Eksperimen ini dilakukan di sebuah rumah hijau di persekitaran luar dan pemerhatian dibuat selama dua minggu. Selepas dua minggu, keputusan menunjukkan tumbuhan akuatik Salvinia molesta telah layu 33.33% pada kepekatan 8700mg/L dan 100% pada takat 43500mg/L. Selain itu, kadar pertumbuhannya ditentukan dengan menimbang berat tumbuhan itu ketika kering dan basa h untuk menentukan biojisimnya. Berat ketika kering(y) berkorelasi dengan berat ketika basah(x) melalui garisan y=0.0157x + 0.4513 dengan R2

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Kata kunci: komponen, fitopemulihan, ujian awal, kadar pertumbuhan, diesel, Salvinia Molest.

Introduction

The petroleum pollutants including diesel are harmful to the environment and humans. The fuel diesel is more dangerous to plants than crude oil

because the percentage of light hydrocarbon components in diesel is higher than in crude oil. Therefore, the treatment of diesel contaminant in water and soil is more important compared to crude oil (Lin Q. et al., 2008). Diesel discharge onto water surface from anthropogenic factors related to urban discharges from industrial activities such as petrochemical factories, detergent, and pesticide (Pietroletti M. et al., 2010). At present, there is an optimal and environmentally friendly way for pollutant treatment through phytoremediation. It is an engineering technology that is successful in cleaning up the environment with effective cost and does not destroy the site. Phytoremediation can be divided into six types depending on the way and the type of contaminant (Table1) (Kavamura V.N. and Esposito E. 2009). It includes phytoextraction, phytostabilization, phytovolatilization, rhizofiltration, and phytostimulation.

Table 1: Types of phytoremediation

Name	Description
Phytoextraction	The ability of plants to remove contaminants through roots and translocation to the shoots
Phytostabilization	Induce adsorption of contaminants onto the plant roots or soil .
Phytovolatilization	The contaminant is absorbed by roots, then volatile from leaves.
Phytodegradation	Contaminants are broken down after they have been taken up by the plant.
Rhizofiltration	Contaminants are taken up by the plant and removed from the site when the plant is harvested
Phytostimulation	Contaminants are removed/digested by bacteria flourishing in the rhizosphere.

In this study, an aquatic plant *Salvinia molesta* was used. It is found in tropical and temperate regions. It is a native plant in Malaysia (Figure 1). *Salvinia molesta* is an aquatic fern species with high growth rate and has the ability to accumulate contaminants. It is a free floating fern; with hairy horizontal stems that float just below the water surface, and appears at each node, a pair of floating or emergent leaves (Jacono C.C., 2003). Its growth is rapid and irregular (Richard A. and Ramey V., 2007). It can spread rapidly and prolifically into a monoculture; which can shade out underwater natives, leaving large bottom areas which are bare (Pradoa C. et al., 2009).

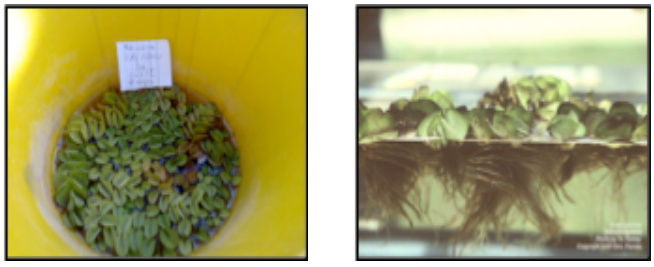

Figure 1: The aquatic plant *Salvinia molesta*

A preliminary test was done to investigate the maximum contaminant concentration of diesel that the aquatic plant can degrade. It is a way to determine the suitable contaminant concentration that the plant can degrade and still survive; which is to be adopted in the next stage of phytotoxicity test. Additionally, wet and dry weight was also recorded to determine plant biomass. The objective of this study is to investigate the maximum concentration of contaminant that will cause the death of the aquatic plant *Salvinia molesta* and to determine the plant biomass.

Materials and method

The healthy nine aquatic plants of *Salvinia molesta* were put into yellow pails containing 3 L synthetic wastewater prepared by mixing water with the diesel in different concentrations of 8700 , 17400 , 26000 , 34800 , and 43500 mg/L. A yellow pail without the diesel acted as a control. Physical observations for 2 weeks were done to observe the ability of the plant to resist the hydrocarbon contaminant. The number of withered plants was recorded and the percentage of withered plants was calculated using Eq. 1 below:

$$\%Withered\ plant = \frac{No\ of\ withe}{No\ of\ tota} \quad (1)$$

The growth rate of *Salvinia molesta* was measured by determining its dry and wet weight for 72 days. The healthy plants were taken from the container as shown in Figure 2. They were firstly dried by using tissues and later weighted with electronic balance to record their wet weight. Then, the plants were dried in an oven at 70˚ C for 3 days to determine their dry weight.

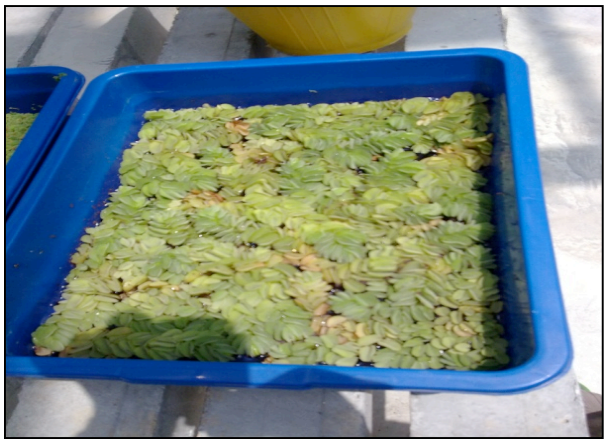

Figure 2: Collection of *Salvinia molestan*

Result and discussion

At the end of 14 days, there was a minimum percentage of withered plant occurring at 8700 mg/L concentration of diesel and for the concentration 43500 mg/L all the aquatic plant died as shown in Figure 3.

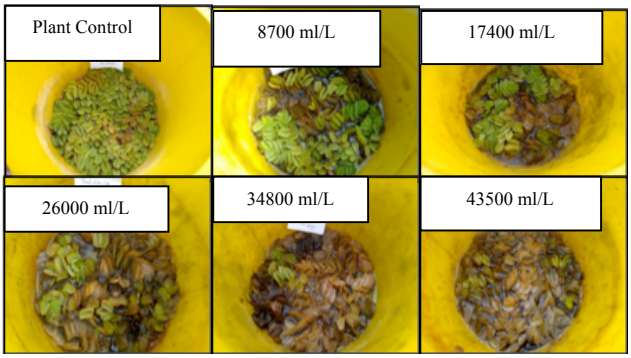

Figure 3: The 14 days observation of withered plant

Based on the results in Figure 4 after 14 days of the diesel exposure to the aquatic fern the minimum percentage of withered plant was 33.33% for concentration of 8700 mgl/L; all the plants withered at 43500 mg/L concentration. A study on diesel biodegradation by aquatic plants of *Azolla pinnata* as well as *Pistia stratiotes* and *Salvinia molesta* (Cohen M. F. et al., 2002) showed that at a concentration of 0.005% diesel (v/v) all species can survive but at concentration of 0.1-0.2 % , *Azolla pinnata* died but other species could still survive.

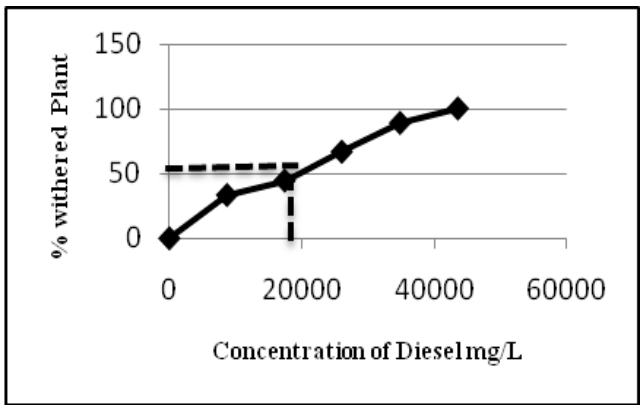

Figure 4: Concentration of Diesel and % of withered plants

In Figure 4, 50% of the plants withered at a diesel concentration of 19000 mg/L, half of the plants were

died in concentration 19000 mg/L after 14 day. Therefore, in future phytotoxicity studies the concentration of diesel of less than 19000 mg/L will be considered to ensure the plants ability for degradation.

In Figure 5, both wet and dry weight of *Salvinia molesta* increased throughout 72 days, whereby at the end of 72days, both wet and dry weight achieved the same value indicating they might come to the end of their life.

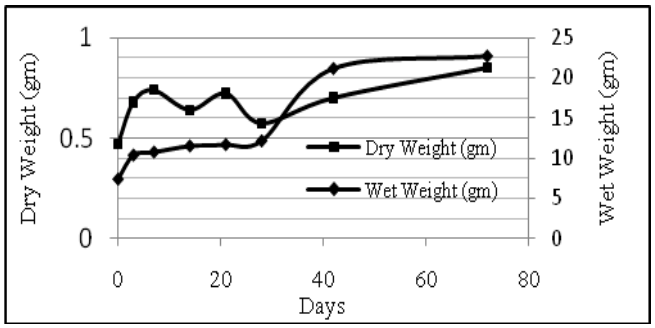

Figure 5: The wet and dry weight of *Salvinia molesta*

Figure 6 shows the correlation between the wet and dry weight of *Salvinia molesta*. The correlation data was not good due to insufficient observation time and the difficulty of tracking the plant growth.

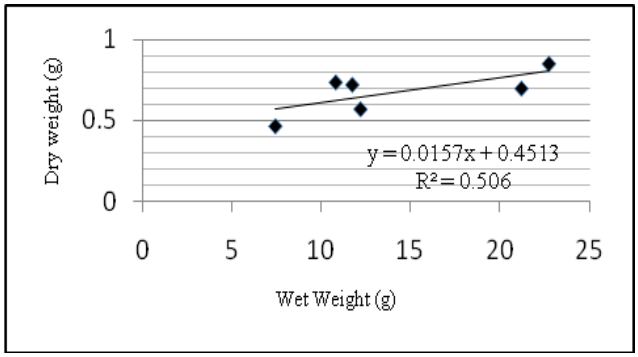

Figure 6: The relationship between wet and dry weight for *Salvinia molesta*

Conclusion

Laboratory culture of preliminary experiments was conducted to assess the ability of the aquatic plant *Salvinia molesta* to survive with different concentrations to diesel exposure. The results clearly showed that whenever the concentration increased, the withering of plant also increased. In this experiment, the concentration of diesel must not exceed 19000 mg/L in the phytotoxicity test; the next stage of phytoremediation processes; because 50% of withered plants means that the plant cannot survive and the diesel concentration was too high for the species. The relationship between wet weight (x) and dry weight (y) explains the correlated equation of $y = 0.0157\ x + 0.4513$ (R^2. The biomass of *Salvinia molesta* increased progressively as time goes by.

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