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CONTENTS

Plant Selection in Oil Hydrocarbon Degradation Process in the Soil

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Oil-hydrocarbon has been used as a fuel energy in transportation. The presence of hydrocarbon compound in soil may change structure and function of soil. It may result in reducing soil productivity. In order to remediate soil productivity, it is necessary to select plants that able to degrade oil in the soil. There were two study parts: first study is to determine the interaction between soil bacteria and plant in reducing oil in the polluted soil. This study has four treatments, there are (a) sterilized soil containing oil hydrocarbon, (b) non-sterilized soil containing oil hydrocarbon, and (c) *Impatiens* sp. was grown in sterilized soil containing oil-hydrocarbon, and (d) non-sterilized soil containing oil-hydrocarbon (4.76%). These first experiment were incubated for 52 days. While in second study, four plants of Asteraceae (*Tagetes* sp., *Chrysanthemum* sp., *Gerbera* sp. and *Zinnia* sp.) were planted in the contaminated non sterilized-soil to find out which species has the highest ability in degrading oil. Every two weeks, 5 gr of soil from all treatments were sampled and extracted using Soxhlet extraction method. These oil extraction were analysed using GC-MS. Soil pH, humidity and temperature were controlled daily during experiment period. Plant morphology was observed during cultivation. Result study shows that there is an interaction between soil bacteria and plants in degrading oil in the contaminated soil. Also, *Chrysanthemum* sp. was able to reduce oil concentration in the soil. It can be suggested that those exotic plants can be grown in oil-contaminated urban area.

Keywords: bioremediation, oil, Asteraceae

INTRODUCTION

Hydrocarbon is an organic substances which may pollute the environment due to human activities. These substances originated from geothermal activities such as natural gases and raw oil and it can be produced from raw oil and human activities such as transportation, forest fire and combustion of gases, oil and fossil.

Hydrocarbon pollution source mostly occurred in city due to high transportation. Motor cycles and cars need oil renewal which is done in service agents . They collect, discard and deposit used-oil to the sanitary land without any treatment. There is no solution yet now to reduce soil pollution due to used-oil deposit. It may create high soil pollution, because oil has a characteristic as a persistent and low degradable. These substances are classified as dangerous chemical which may reduce soil productivity. Beside that there is an aromatic hydrocarbon which is more dangerous than aliphatic and cyclic hydrocarbon. In order to remediate the polluted soil, bioremediation is chosen because it is environmental-friendly and low cost.

Before remediation process is applied in the field, plant selection is studied to find which plant has an ability in oil degradation in the oil-polluted soil. First of all, interaction between plant and soil bacteria was studied. Then further study is plant selectivity among Asteraceae group. This group of plant is chosen because it is not consumed by people but this plant is used as an exotic plant. So it is not dangerous if this plant accumulate oil hydrocarbon.

METHOD

Before starting this experiment, sterilized soil was prepared by wet heating the soil using autoclave up to 121°C for 15 minutes, so the soil microorganism have killed. These Andosol soil

...s collected from Kebun Botani FPMIPA UPI, containing organic matter (6.09%). While the plants for experiment were collected from Parongpong Lembang.

There were two study parts: first part, *Impatiens* sp was grown in two treatments using sterilized soil containing oil-hydrocarbon (4.76%), non-sterilized soil containing oil (4.76%) for 56 days. Second part, four plants of Asteraceae (*Tagetes* sp., *Chrysanthemum* sp., *Gerbera* sp. and *Zinnia* sp.) were tested to find out which plant has the highest ability in degrading oil in the contaminated non sterilized-soil. Those plants were grown in 1 kg of soil using the plastic container (diameter 16 cm). These experiments were carried out in the green house. During this experiment plant morphology including leaves, stem and roots were observed. Environmental factors including soil pH, temperature and humidity were controlled daily. Every two weeks, 5 gr of soil from all treatments were sampled and extracted using Soxhlet extraction method (Deuel, 1997 in Rossiana, *et al.* 2002) for 90-120 minutes. N-hexane solution was used as a solute of oil. These oil extraction were analysed using GC-MS. Chemical analysis was conducted at Chemical laboratory FPMIPA UPI.

RESULTS AND DISCUSSION

Physical and chemical parameter (pH, humidity and temperature) of soil were relatively constant. The average soil pH, humidity and temperature in the green house were respectively 6,81; 30.16%; and 24.11°C.

Oil degradation in the all treatments increased every two weeks (Table 1). With the non sterilized-soil, oil degradation was higher compared to other treatments. This can be explained that root plant of *Impatiens* sp. is suitable for soil microorganism growth. As Alexander (1977) said that root web of plant is related to the microorganism growth. High population of soil microorganism may break down oil hydrocarbon in the soil. In this case, plant passively play a role in oil degradation. Various bacteria and fungus have an ability to metabolize and break down hydrocarbon into simple substances (Stoner, 1994; Atlas & Cerniglia, 1995; and Mellor, *et al.* 1996). GC-MS analysis showed that there were thousands of oil hydrocarbon derivates detected from soil samples.

The morphology of *Impatiens* sp. which grown on oil contaminated soil has changed after 28 days. Leaves color changing occurred due to chlorosis. Oil substances appeared in the transparent stem of *Impatiens* sp. It showed that oil from contaminated soil was transported as well as other mineral. However these plants may grow for 5 weeks. It said that this plant has broad range of tolerance to environmental factors mainly soil characteristics.

Table 1 The percentage of oil degradation by *Impatiens* sp. within 2 weeks interval time

Treatment	0 day	14 days	28 days	42 days	56 days
Non sterilized-soil and plant	0	31.12±10.05	42.39±4.46	48.55±7.76	57.16±6.25
Non sterilized-soil	0	28.87±7.75	37.28±7.82	41.97±7.14	43.02±7.47
Sterilized-soil and plant	0	9.35±14.19	33.15±12.67	36.72±7.05	40.43±6.90
Sterilized-soil	0	15.72±13.37	18.24±11.78	37.63±7.66	39.31±8.04

Chromatogram results showed the number of oil substances present in the four treated soil. The number oil substances in the soil after treatment was less than that before treatment. It indicated that soil bacteria and plant may play a role in degrading oil substances.

The plantation of Asteraceae group in oil hydrocarbon spiked sediment may enhance oil degradation. The percentage of oil degradation was observed every 2 weeks (Table 2). Among these plants, *Chrysanthemum* sp. was able to decrease oil hydrocarbon faster than other plants (up to 76.98%). Priyanto and Prayitno (2001) said

that *Chrysanthemum* sp. is a hyperaccumulator of organic substance including oil hydrocarbon Meanwhile *Tagetes* sp. and *Zinnia* sp. were not significant different compared to control in oil degradation. *Tagetes* sp. was not able to grow more than 42 days. The morphology of this plant showed abnormal growth. There was a black spot on young leaves and it followed by undevelopment of flower. Due to delayed growth, this plan t can not survive longer. *Tagetes* sp. roots produces a chemical substance which has a characteristic as a anti microba (Dolorresa, 1999). Therefore no soil bacteria may grow to degrade oil in the soil. As a result, oil in that soil was absorbed by *Tagetes* sp. and accumulated in that plant. That oil may influence that plant to grow. These characteristics indicated that oil influences to the plant growth (Reddin and Prendeville, 1981 in Kustianti, 1998).

Table 2 The percentage of oil degradation by 4 different plants within 2 weeks interval time

Plant	0 day	14 days	28 days	42 days	56 days
Control	0	28.32±8.53	38.43±8.16	44.22±5.06	45.32±5.50
Chrysanthemum sp.	0	46.91±9.92	59.34±8.24	72.36±2.25	76.98±2.19
Tagetes sp.	0	22.22±10.80	35.24±10.43	44.39±11.19	death
Zinnia sp	0	31.12±14.05	35.99±14.03	45.74±13.35	50.02±12.22
Gerbera sp.	0	50.19±6.88	59.09±7.22	62.54±6.11	67.32±6.70

During cultivation in oil spiked soil, those plants showed an abnormal growth. It was characterized by the presence of black spot on the young leaves, chlorosis leaves and anomaly roots.

CONCLUSIONS

Impatiens sp may decrease the content of the oil-hydrocarbon in the contaminated soil. Also, *Chrysanthemum* sp. was able to reduce oil concentration in the soil. It can be suggested that those exotic plants can be grown in oil-contaminated urban area.

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