UNIVERSITI PUTRA MALAYSIA

EFFECTS OF PHENOL ON THE GROWTH OF *Vigna angularis*

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PENGESAHAN

Dengan ini adalah disahkan bahawa projek yang bertajuk "Effects of Phenol on the Growth of *Vigna angularis*" telah disiapkan serta dikemukakan kepada Jabatan Mikrobiologi oleh SITI ROSLINA BINTI MUSTAPHA (164862) sebagai syarat untuk kursus BMY 4999 projek.

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ABSTRACT

Rapid industrialisation since the recent past years has led to the increasing number of pollutions from industrial wastes, with phenol as one of the organic pollutant produced. Phytoremediation is one of the effective techniques available to clean up pollutant *in situ* by using plants as the main agent to absorb pollutants from targeted sites. *Vigna angularis*, which is a legume from Fabaceae family, is an annual plant that can be found mainly in East Asia and Himalaya countries such as Japan, and Malaysia. In this study, an experiment was conducted to investigate effects phenol had on *V. angularis*, and the plant's ability to absorb phenol contain in 4 L distilled water. Plants were exposed to different concentrations of phenol of 0.04, 0.05, 0.2, 0.3, and 0.4 g/L for 8 days and phenol remaining in the water was also being measured daily by using 4-aminoantipyrene assay method. The observations on changes on morphology of plants were made and followed by determination of rate of phenol degradation by plants. Changes on plants such as yellowing of leaves, changes of colour of roots from white to brown, and stems became droopy were recorded. The results obtained showed that *V. angularis* was able to tolerate variations of phenol concentrations, and can uptake 100% of phenol in the water for all concentrations with different rate of degaradations, except for in 0.4 g/L phenol.

ABSTRAK

Pembangunan yang pesat sejak beberapa tahun kebelakangan telah menyebabkan peningkatan kadar pencemaran yang berpunca daripada sisa industri, dengan fenol sebagai salah satu ejen pencemaran organik yang terhasil. Fitopemulihan merupakan salah satu kaedah efektif yang digunakan untuk membersihkan kawasan pencemaran secara *in situ* dengan menggunakan pokok sebagai ejen utama untuk menyerap ejen pencemaran daripada tempat pencemaran. *Vigna angularis* merupakan sejenis legume daripada Famili Fabaceae dan boleh dijumpai kebanyakannya di kawasan Timur Asia dan Negara Himalaya seperti Jepun dan Malaysia. Dalam projek ini, satu eksperimen telah dijalankan untuk menyiasat kesan fenol terhadap *V. angularis* dan kebolehan pokok untuk menyerap fenol di dalam 4 L air suling. Pokok didedahkan kepada fenol dengan kepekatan yang berbeza-beza iaitu 0.04, 0.05, 0.2, 0.3, dan 0.4 g/L selama 8 hari dan baki fenol yang tinggal di dalam air juga telah diukur dengan menggunakan kaedah 4-aminoantipirina asai. Pemerhatian ke atas perubahan dalam morfologi pokok telah dibuat dan diteruskan dengan penentuan kadar degradasi fenol oleh pokok. Perubahan ke atas pokok seperti kekuningan pada daun, perubahan warna akar daripada putih kepada coklat, dan juga batang pokok menjadi layu telah dicatatkan. Keputusan yang diperoleh menunjukkan *V. angularis* boleh bertolak ansur di dalam kepekatan fenol yang pelbagai, dan boleh mengambil sehingga 100% fenol di dalam air untuk semua kepekatan dengan kadar degradasi fenol yang berlainanan, kecuali di dalam 0.4 g/L fenol.

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LIST OF ABBREVATION

%	Percentage
4-AAP	4-aminoantipyrene
℃	Degree Celsius
et al.	And others
g	Gram
ml	Milimeter
nm	Nanometre
mg	Miligram
sp.	Species
var.	Variety
NH_4C	Ammonium chloride
$K_3Fe(CN)_6$	Potassium ferric cyanide
µl	Micro liter
L	Litre
rpm	Revolutions per minute

CHAPTER 1

INTRODUCTION

The emergence of many industrial sectors has lead to the increasing numbers of pollutions in the world. The high level of heavy metal toxics and organic contaminants that contaminate the air, soil and water has resulted in decreased quality of health in human and at the same time affected the ecosystem (Singh et al., 2014). Recent analysis by The Global Alliance on Health and Pollution (GAHP) also showed that pollution kills more than 8.4 million people each year.

Phenol is an aromatic organic compound and one of the contributors to the pollution issues. A report submitted to the government of Negeri Sembilan dated back in 1961 and 1979 (Abdullah and Nainggolan, 1991) showed that Linggi River was highly polluted by phenol and by WHO standards, can be classified as "heavily-polluted requiring extensive treatment. The anthropogenic sources of phenols are mainly originated from the domestic sewage and industrial effluents which include from the chemicals, petrol, pharmaceutical and textile industries, pulp mills, and pesticides (Michalowicz and Duda, 2007; Whitely and Bailey, 2000; Kumaran and Paruchuri, 1997).

Phytoremediation is a technology that utilises plants to remove or transform toxic chemicals present on soils, sediments, ground water, surface water, and even the atmosphere to clean up or reduce pollutions level (Susarla et al., 2002). Phytoremediation which is cost-effective as comparison to other technologies to clean up pollution may offer the only effective way to restore hundreds of thousands of square miles of land and water that have been polluted by industrial activities.

This project was focused on the effects of phenol on the growth of *Vigna angularis* in order to observe plant's tolerance towards phenol. The project was also intended to analyse the amount of phenol remaining in the water and relate it to the rate of degradation by the plants. The future application of the data obtained is to test the suitability of using *V. angularis* as a phytoremediator agent to reduce the level of phenol pollutions in the environment.

Objectives

The objectives of this project are:

1. To determine the effects of phenol on the growth of *Vigna angularis*.
2. To assess *Vigna angularis* as a potential phytoremediator.

Hypotheses

1. Different concentrations of phenol affect growth and morphological characteristics of *Vigna angularis.*
2. *Vigna angularis* has potential as a phytoremediator.

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