UNIVERSITI TEKNOLOGI MARA

HEAVY METALS ACCUMUMULATION IN SELECTED WEED SPECIES UNDER OIL PALM PLANTATION IN CAREY ISLAND, SELANGOR

LINDA BINTI JIREN

Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

Faculty of Plantation and Agrotechnology

January 2017

ABSTRACT

Application of agrochemicals such as pesticides and fertilizers in oil palm plantation is a common practice. Heavy metals are known to be part of the residue component of most pesticides and naturally occurring inorganic as well as organic fertilizers. Some weed species are able to absorb heavy metals from soil in large amount and can be used for phytoremediation. This study determined the demography of weed species under oil palm plantation in West Estate, Carey Island. This study also to evaluate the content of Arsenic (As), Cadmium (Cd), Mercury (Hg), Lead (Pb) and Nickel (Ni) in soil and weed species under oil palm plantation in West Estate, Carey Island. Then, this study assessed the pattern of arsenic uptake and accumulation by *Axonopus compressus, Ageratum conyzoides* and *Borreria latifolia*. The sampling site was conducted in oil palm plantation located in Carey Island, Selangor aged 3, 10 and 17 years old in 2011. A survey census of weed species under the three ages of palm oil was conducted. Weed species were identified, counted and recorded. Random sampling of soil from 0-20 cm depth taken at 12 different points. Soil samples were analyzed for As, Cd, Hg, Pb and Ni, pH, EC, C and soil texture. Identified weed species with soil were collected to analyze for the content of As, Cd, Hg, Pb and Ni. Heavy metal concentrations in plant and soil were measured by Inductively Coupled plasma Optical Emission Spectrometry (ICP-OES). The results showed that under 3 years old oil palm stand, 6 different species belonging to 4 families were recorded while for 10 years old oil palm stand there were 11 different species belonging to 7 families and for 17 years old oil palm stand 9 different species belonging to 5 families were recorded. *Ischaemum muticum Linn* was the dominant species in the 3 years old plot (83.24%) while *Axonopus compressus* was the dominant species under 10 and 17 years old plot (50.14% and 80.27%). As concentration in soil showed a steady increase with age of oil palm indicating potential accumulation with range between 17.58 to 31.65 mg/kg. Arsenic and Pb recorded were significantly different concentrations ($P>0.001$) and so was Hg ($P>0.014$) respectively, while the concentrations of Ni and Cd in soil were not significantly different across different oil palm ages. Under 3 years old oil palm, *Borreria setidens* was able to absorb the highest concentration of As, Cd, Ni, Pb and Hg (6.54, 3.87, 25.82, 29.66 and 0.06 mg/kg). Under 10 years old oil palm stand, *Borreria setidens* absorbed the highest concentration of As (8.52 mg/kg) and Cd (4.59 mg/kg). The highest concentration of Pb was absorbed by *Centotheca lappacea* (Linn.) Desv (59.638 mg/kg) while *Adiantum latifolium* Lam absorbed the highest concentration of Ni (100.877 mg/kg) and Hg (0.07 mg/kg). Under 17 years old oil palm stand, *Borreria latifolia* accumulated the highest concentration of As (26.66 mg/kg) followed by *Borreria setidens* (7.41 mg/kg), *Asystasia gangetica* (3.96 mg/kg) and *Axonopus compressus* (2.84 mg/kg). *Asystasia gangetica* absorbed the highest concentration of Pb (15.87 mg/kg) and Ni (5.38 mg/kg) while Cleome rutidosperma absorbed the highest concentration of Cd. A hydroponic experiment to determine the pattern of As accumulation in *Axonopus compressus, Ageratum conyzoides* and *Borreria latifolia* was carried out. Based on the hydroponic study, *Ageratum conyzoides* showed the highest potential of absorbing As (6666.33 mg/kg) compared to *Axonopus compressus* (1914.33 mg/kg) and *Borreria latifolia* (4654.67 mg/kg) under concentration range 20, 40, 80 and 160 mg/kg.

ACKNOWLEDGEMENT

I wish to thank the Almighty God, because of His grace and favor, I finally completed this thesis. My deepest appreciation goes to my supervisor, Assoc. Prof. Dr. Adzmi bin Yaacob who has helped me from the beginning to the completion of this study. Thank you for all the comments, advice and interest shown during the course of the study.

I would also like to thank my co-supervisor, Prof. Dr. Baki bin Hj Bakar for all the information, help and advice given.-To the soil laboratory staff at UiTM Shah Alam I wish to thank them for their cooperation in preparing the materials and equipment during this study.

I would also like to thank Estate Manager for giving me the permission to conduct this study at West Estate Carey Island. I would also like to thank the soil and plant analytical unit of the Department of Agriculture, Kuala Lumpur for giving me the permission to use their facilities for sample analysis. All the guidance and help has been very useful indeed.

Special thanks you to my parent, siblings and husband, Mohamad Helmi Amri bin Kasmuri for their support, enthusiasm and encouragement to complete this study. To my colleague Mohd Fazri bin Mat Omar, thank you for all the helps and assistance.

Finally thank you to all lecturers, faculty members and individuals who had directly or indirectly help me in completing this study.

TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Weeds can be defined as an unwanted plant when present can lead to competition among major crops for nutrients, water, light and space. Weed growth relies on soil, climate, rainfall, humidity, and seed sources. The ability of weeds to multiply rapidly will depend on its breeding methods such as through wind, stolon, water spread, seeds explosion or by the movement of animals.

Common species of weed found in oil palm plantation including grasses, fern, broadleaves and legume. *Axonopus compresses, Eleusine indica, Imperata cylindrica* and *Ischamum muticum* are examples of grasses whereas *Asystasia intrusa, Cleome rutidosperma, Ageratum conyzodes, Borreria latifolia* and *Eupatoriumm odoratum* are examples of broadleaves (Suk and Yong, 2005). *Croton hirtus, Asystacia commersonii* and *Paspalum commersonii* tend to dominate under young oil palm plantation (Mohamad et al., 2010; Wibawa et al., 2009) while *Asystasia intrusa* and *Mikania cordata* were dominant under mature palm (Chin, 2002). Essandoh et al. (2011) however found that *Chromolaena odorata, Aspillia Africana, Melanther*a *scandens, Panicum maximum, Imperata cylindrica* and *Digitaria horizontalis* dominate both under young and mature oil palm plantation. Weed species from Poaceae and Asteraceae families are also found in oil palm plantation (Essandoh et al., 2011).

The distribution of weed under oil palm plantation is different depending on the age of palm as well as the local climatic condition. Distribution of weed species under oil palm plantation are also affected by factors such as the abundance and distribution of light and shading (Wan Mohamed et al., 1987) as well as the oil palm canopy closure (Hassan, 2001). Weed population tend to decline under older palms as the light transmission is greater under young palms compared to matured palms.

Overpopulated weed poses a major problem in oil palm industry as it grows rapidly out of control creating difficulty for fertilization and disease control. Besides, it also provides breeding ground for pests. Nevertheless, there are also advantages of weed, for instance in helping to minimize soil erosion by reducing the rainfall impact