# UNIVERSITI TEKNOLOGI MARA

# *Mucuna bracteata*: AN ASSESSMENT OF ITS CONTRIBUTIONS TO THE FERTILITY OF ACID SULFATE SOIL

**MOHD FAZRI BIN MAT OMAR**

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# ABSTRACT

Incorporation of leguminous cover crop (LCC) during early growth of oil palm plantation in Malaysia is a common practice. The main reason for this practice is to protect soil from erosion and to improve soil properties. This study focus on the assessment of the potential contribution of *Mucuna bracteata* to the fertility of acid sulfate soil. Furthermore, the effect of P fertilization and liming with $CaCO_3$ on N accumulation through fixation by *Mucuna bracteata* was also assessed through pot experiment. The bacteria strain responsible for N fixation by *Mucuna bracteata* in acid sulfate soil was also screened and determined. For field study, soil samples for chemical analysis was drawn at the depth of 0 cm – 15 cm while for physical analysis at 0 cm – 5 cm and 15 cm – 20 cm. Soil samples were analysed for organic matter, total nitrogen, available P, cation exchange capacity, exchangeable Ca, Mg, K, and Na as well as soil bulk density and aggregate stability. *Mucuna bracteata* treatment showed significant increased in organic matter, total nitrogen, cation exchange capacity and available P averaged at 1.59%, 4.34%, 10.58 meq/100 g soil and 2.82 ppm respectively. Bulk density showed decrement of 0.25 g/cm$^3$ while aggregate stability was increased by 9.94%. Determination of responsible bacteria strain which nodulate *Mucuna bracteata* was carried out by isolation using streak plate method while the identification by using polymerase chain reaction and genomic extraction method. Bacteria strain responsible for N fixation was *Rhizobium tropici* strain B28. Factorial Completely Randomized Design (CRD) was used in the study on P fertilization with $CaCO_3$ on N accumulation through fixation by *Mucuna bracteata*. Parameters studied were soil pH, plant biomass, nodule number, soil available P, plant P and leaves N. Combination rate of $CaCO_3$ and P fertilizer at 20g $CaCO_3$ per pot and 7.5 g per pot recorded the best effect in term of soil pH, plant biomass, nodule number, soil available P, plant P and leaves N. Incorporation of *Mucuna bracteata* in oil palm plantation significantly improved soil properties which enhanced soil fertility. Effective rhizobium strain should be inoculated prior to *Mucuna bracteata* planting. P fertilization and liming with $CaCO_3$ should be extensively applied on *Mucuna bracteata* in oil palm plantation.

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# TABLE OF CONTENTS

# CHAPTER ONE
# INTRODUCTION

## 1.1 BACKGROUND OF STUDY

Acid sulfate soils are marginal soils in Malaysia. This type of soil originated from deposition of marine, estuarine and brackish water (Paramanathan and Noordin 1986). Total acid sulfate soils in peninsular Malaysia are estimated around 110,000 hectares with at least 20,000 hectares planted with oil palm (Poon and Bloomfield 1977) as well as rice. Acid sulfate soils contain pyrite a mineral which upon oxidation will produce sulfuric acid which creates problems for crop cultivation (Suswanto et al., 2007). Sulfuric acid produced from oxidation of pyrite also increases the accumulation of Fe, Al, Mn and As which lead to restriction of root growth, inhibition of beneficial microbial population, fixation of P and reduce availability of nitrogen and potassium for uptake by plant (Kisinyo et al., 2005; Coventry et al., 1985).

In Malaysia, oil palm is the most common crop planted on acid sulfate soils (Auxtero and Shamshuddin 1991). Management of acid sulfate soils is important so that the acidity level will not affect oil palm yield. In order to optimize oil palm yield, nutrient management is one of the key area to look into. Nutrient management practices in oil palm plantation include the application of inorganic fertilizer and organic fertilizer. In order to conserve soil health and to avoid underground water pollution, organic fertilizer such as green manure is often used.

Cultivation of legume cover crop is a common agronomic practice in oil palm plantation mainly to protect the soil against erosion. Other benefits of legume cover crop is to conserve soil moisture, increase cycling of nutrients by leaf litter mineralization, fixing atmospheric nitrogen, increase microbial population, reduce leaching loss, reduce rhinoceros beetle population, reduce weed competition, immobilization of Fe and Al by humic acid as well as to improve soil physicochemical properties (Wood 1968; Mainstone 1970; Lau et al., 1981; Yeow et al., 1982; Agamuthu Broughton 1985; Mathews 1998; Hashim et al., 2010). Since the topography of acid