UNIVERSITI PUTRA MALAYSIA

PHYSICAL AND CHEMICAL PROPERTIES FOR OIL PALM CULTIVATION BASED ON SMALLHOLDER LANDIN FOUR DIFFERENT TYPE OF SOILS

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SERDANG SELANGOR
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PHYSICAL AND CHEMICAL PROPERTIES FOR OIL PALM CULTIVATION BASED ON SMALLHOLDER LAND IN FOUR DIFFERENT TYPE OF SOILS

By

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A project report PRT 4999 (Final Year Project) submitted to the Faculty of Agriculture, Universiti Putra Malaysia, as a requirement for the award of the first degree in Bachelor Science of Agriculture

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Specially dedicated to.....

Beloved family, friends and lectures,

Thank you for your love and support.

CERTIFICATION

This project entitled 'Physical and Chemical Properties for Oil Palm Cultivation Based on Smallholder Land in Four Different Type of Soils' is prepared by Mohd Firdaus Bin Ahmad and submitted to the Faculty of Agriculture in partial fulfilment of the requirement of PRT 4999 for the award of the degree of a Bachelor of Agriculture Science.

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LIST OF ABBREVIATIONS

ml	mililiter
g	gram
Kg	Kilograme
AAS	Atomic Absroption Spectrometer
Al	Aluminium
Mg	Magnesium
Ca	Calcium
P	Phosphorus
N	Nitrogem
K	Potassium
CEC	Cation Exchange Capacity
EC	Exchangeable Bases
EFB	Empty fruit bunch

ABSTRACT

Oil palm is an important commodity (industrial crop) in Malaysia because it contributes high revenue to Malaysia economy. In 2012, small holder participation were about 15.1% (767,688 ha) from 5.07 million hectare total area planted with oil palm. The suitability of land for oil palm cultivation consists of topography, drainage, physical and chemical properties. These characteristics influence the palm oil yield. Thus, study on land suitability and fertility for oil palm plantations in smallholder is important. Difficulties of smallholder to get the information about the classification and guidance in oil palm plantation ofteninflunce smallholder capability to survive and grow in oil palm industry. Thus, the objectives of this study is: i) to determine the physical and chemical properties of oil palm land of smallholder and, ii) to identify productivity level between different soils (alluvium, mineral, BRIS and acid sulphate soil) in term of economics impact relation with oil palm and land suitability. In this study, soil samples were collected from four locations. Each of the smallholders have land size of (<2.5ha). The selected areas were at Hulu Langat (Selangor) and ParitBotak(Johor). For alluvium, mineral and acid sulphate soils, the sample were taken in Johor and for BRIS soil; the sample were taken in Selangor. Soil samples were collect at two different depths which are 0-15 cm for top soil and 15 – 45 cm for effective depth to uptake nutrient because oil palm have fibrous root. The samples were collected using a an auger in which 12 sample were taken randomly for each plot. Hence, a total of 48 soil samples were collected for determination of physical and chemical properties. Soil analyse includes pH, CEC, exchangeable bases, N, P, K, soil structure, soil texture, colour and soil moisture.

Atomic Absorption Spectrometer (AAS) were used to quantify macro nutrient content (N, P, K, Ca and Mg).The fertility of the soils and land suitability known to affect oil palm. From this study,Alluvium soil contains highest clay (34%) , high in CEC (12.39 $cmol_c/kg$), high in available P (5.25 ppm) and soil pH (5.12) that suitable for Oil palm cultivation. Meanwhile, BRIS and acid sulfate soil can be categorized as a problematic area for oil palm cultivation. Acid sulfate soil more acidic and contain a jarosite not suitable for crop. Besides, BRIS soil not fertile because less in water holding capacity and the soil is more sandy. Organic fertilizer such as manure, compose and mulching are recommend also in problematic soil. This can help to improve soil structure, soil CEC, increase water holding capacity and promote microorganism activity. It can also help in reducing water loss through evapotranspiration and cooling the soil surface to retain the moisture.

ABSTRAK

Kelapa sawit merupakan tanaman industri yang penting di Malaysia kerana ianya menyumbang pendapatan yang tinggi kepada ekonomi Negara. Pada tahun 2012, penyertaan pekebun kecil dalam industry sawit adalah berjumlah 15.1% (767,688 ha) daripada 5.07 juta hektar jumlah keseluruhan tanaman kelapa sawit. Kesesuaian tanah bagi penanaman kelapa sawit terdiri daripada topografi, saliran, sifat fizikal dan sifat kimia tanah. Ciri-ciri ini mempengaruhi hasil minyak sawit. Oleh itu, kajian kesesuaian dan kesuburan tanah bagi tanaman kelapa sawit oleh pekebun kecil adalah penting. Kekangan pekebun kecil untuk memperolehi maklumat mengenai klasifikasi tanah serta bimbingan dan tunjuk ajar mempengaruhi dalam penanaman kelapa sawit untuk terus hidup dan berkembang dalam industry minyak sawit. Oleh itu, objektif kajian ini adalah: i) untuk menentukan sifat-sifat fizikal dan kimia tanah kelapa sawit pekebun kecil dan, ii) untuk mengenal pasti tahap produktiviti antara tanah yang berbeza (aluvium, mineral, bris dan asid sulfat tanah) dari segi ekonomi berhubung kesan dengan kelapa sawit dan kesesuaian tanah. Dalam kajian ini, sampel tanah diambil dari empa lokasi. Setiap daripada pekebun kecil mempunyai saiz tanah (<2.5ha). Kawasan-kawasan yang dipilih adalah di Hulu Langat (Selangor) dan Parit Botak (Johor). Untuk tanah aluvium, mineral dan asid sulfat, sampel tanah diambil di Negeri Johor dan untuk tanah BRIS, sampel diambil di Negeri Selangor. Sampel tanah diambil pada dua kedalaman yang berbeza iaitu pada 0-15 cm untuk tanah lapisan atas dan 15 - 45 cm untuk kedalaman berkesan bagi pengambilan nutrient kerana kelapa sawit mempunyai system akar serabut. Sampel diambil menggunakan auger dimana 12 sampel diambil secara rawak. Oleh itu, sebanyak 48 sampel tanah diambil bagi menentukan sifat-sifat fizikal dan kimia. Analisis

tanaht ermasuk pH, CEC, exchangeable bases, N, P, K, struktur tanah, tekstur tanah, warna dan kelembapan tanah. Spektrometer Penyerapan Atom (AAS) digunakan untuk menilai kandungan nutrient makro (N, P, K, Ca dan Mg). Kesuburan dan kesesuaian tanah akan member kesan kepada kelapa sawit. Daripada kajian ini, Kesuburan tanah dan kesesuaian tanah diketahui mempengaruhi kelapa sawit. Dari kajian ini, tanah aluvium mengandungi tanah liat tertinggi (34%), tinggi dalam CEC (12.39 cmolc / kg), tinggi dalam kandungan P (5.25 ppm) dan pH tanah (5.12) yang sesuai untuk penanaman kelapa sawit. Sementara itu, tanah BRIS dan tanah asid sulfat boleh dikategorikan sebagai kawasan bermasalah untuk penanaman kelapa sawit. Tanah asid sulfat lebih berasid dan mengandungi jarosite yang tidak sesuai untuk tanaman. Selain itu, tanah bris tidak subur kerana kurang sifat pegangan air dan tanah adalah lebih berpasir. Baja organik seperti kompos, sisa tanaman dan sungkupan boleh dilakukan pada tanah yang bermasalah. Ini boleh membantu untuk memperbaiki struktur tanah, CEC tanah, meningkatkan keupayaan pegangan air dan menggalakkan aktiviti mikroorganisma. Ia juga boleh membantu dalam mengurangkan kehilangan air melalui penyejatan dengan mengekalkan kelembapan di atas permukaan tanah.

CHAPTER 1

1.0 INTRODUCTION

Oil palm (*Elaeis guineensis,Jacq*) is a perennial crop that originated from west Africa. It was brought into Malaysia in 1911 and 1912 and grown as an ornamental plant in Rantau Panjang, Selangor. The first commercial oil palm was plant in Malaysia for production in 1938 with more than 30,000 hectare planted with oil palm. The good price of crude palm oil market and more stable than rubber attracted and causes some rubber growers to switch to oil palm plantations. In 2003, total oil palm area reached 3.8 million hectares compared to 1990 only 2 million hectares.

Oil palm is one of the healthiest oil in the world (Wahid et al., 2004;Noh et al., 2012). Oil palm is a perennial crop that commonly grown in humid and tropics area. It has an economic lifespan of 25-30 years (Hartley 1977). Up until now, the world's largest source of vegetable oil is palm oil. About 50 million tan or 36% of the palm oil uses in fat production and total edible oil (Yoshizaki et al., 2012).

In Malaysia it is also known as the golden crop because it largely contributes high income to Malaysian economy. The palm oil industry in Malaysia is one of the major industries in the country and Malaysia is one of the main suppliers that supply more than 17 million tan to the

world (MPOB, 2011). PEMANDU (2010) states that the palm oil industry is the fourth highest contributor of the Malaysian income gross which contribute RM 52.7 billion in 2010.

Hence in 2012, oil palm commodities contributed revenue of more than RM80 billion. High income was mainly through from the sale of crude palm oil and downstream products. Malaysian palm oil industry faces competition from other producers with low production costs as Indonesia. The cost of production in Indonesia is only USD 100-120/tan oil (RM 380-460/tan oil) (Chandra, 2000). The oil palm industry also faces competition from other oils and fats where the production costs are much lower.

Soil is defined as natural medium that is needed for land plants growth. The word "Soil" can be translated into several meanings according to different people and condition. Soil is very important because it support plant that provide food supply for human and livestock, drugs for medicine, raw material for industrial purposes, fiber and other important roles it plays that can solve human problems. Soil covers the surface of the earth as a continuum.

According to (Soil Survey Staff, 2003), soil can be considered as natural body that consist of organic matter and mineral (solids component), liquid and gases that occurs on the land surface, that can occupies space, and is characterized by one or both of horizon, or layers that are distinguishable from the initial material as a result of soil formation factor which are transfer, addition, losses, and transformation of energy and matter or the ability to support rooted plants in a natural environment

The availability of land for oil palm expansion is limited, particularly in Peninsular Malaysia where land prices are high. Sarawak still have a lot of land that can be developed, but faces problem in terms of customary land development (Native Customary Right, 2007).

Over 4.8 million hectare of land is planted in oil palm which more than 60% of total agricultural land were planted in Malaysia. The suitability of land for oil palm cultivation consist of topographic, drainage, physical properties of soil such as texture and structure and chemical properties such as charge properties of minerals, base saturation, salinity and micro nutrient excess in soil and plant that can cause crop poisoning. This can inhibit plant growth, thus reduce yield of average crop.

Table 1.0 Total Oil Palm Planted in 2012 Compare to 2007

Sector	Area (hectare)		%	
	2012	2007	2012	2007
Private Estate	3,076,990	2,598,859	60.7	60.31
FELDA	696,069	676,977	13.7	15.73
FELCRA	157,361	163,891	3.1	3.81
RISDA (Including Espek)	75,634	81,486	1.5	1.89
State Plantation	303,187	313,545	5.9	7.28
Small Holder	767,688	470,155	15.1	10.92
Total	5,070,000	4,304,913	100	100

Source: Idris and Esnan, (2012)

The suitability of an area for oil palm cultivation also depends on the height and steepness factor. Oil palm is not suitable for planting in areas above 300 m elevation above sea level because of low temperature can effect of plant growth and can delay or disrupt production. Oil palm can be planted on the slope below the 12^0 and not more than 20^o because the higher the slope, cultivation cost increase. Texture, structure, soil depth and rock content affect the physical properties of palm growth. Land with sandy soil or high clay content are not suitable for oil palm cultivation. Most of oil palm roots grow between 0.3-0.6m from the surface ground.

Palm trees need soil that is free of physical barriers not less than 60 cm from the soil surface to form the perfect rooting. Physical barriers less than 60 cm from the soil surface is to prevent the growth of oil palm roots. Layers of rock or other hard layer thickness more than 25 cm with a volume of 50% or 75% of the volume of rock layers can inhibit root growth.

Chemical properties of the soil that should be considered to determine the suitability of land for oil palm consist of charge properties of minerals, base saturation, salinity and micro nutrient poisoning. Base saturation of the soil shows the current and measures the amount of clay soil surface occupied by cations such as calcium (Ca), magnesium (Mg), potassium (K) and sodium (Na). Base saturation often low much of the surface of the clay filled by aluminum (Al^{3+}) and hydrogen (H^{+}).

Oil palm growth in variety of soils in Malaysia gives good yield based on the topographic factors ($<20^{0}$) and only 42% from 33 million hectares of land in Malaysian suitable for agriculture including the cultivation of oil palm. Oil palm revenue is influenced by the type of soil and field conditions. Field conditions and soil type will determine with management techniques including of planting, construction of drains, roads, soil management and fertilization. Thus, area accessibility can influence good management practice in oil palm sector.

Suitability of the land and management of the oil palm greatly influence rooting system. Oil palm has a root system that called an adventitious root. Normally, active root available in range 5cm – 35cm from the land surface. Oil palm is very sensitive to the changes in the soil environment and requires adequate fertilization. Problematic soil in Malaysia include of acid

sulphate soils, peat soil, laterite soil, BRIS and coral areas, low fertility and limited crop planting suitability. By improving their fertility, land can be used for agricultural activity, at least for oil palm cultivation

1.1 PROBLEM STATEMENT

Oil palm is composed of two species of the Arecaceae, or palm family used for commercial agriculture in the production of palm oil. African palm is *Elaeis guineensis*, native to western Africa between Angola and Gambia, while the American oil palm is *Elaeis oleifera*, native to Central America and South America.

The competition for land with other industry requires a study to classify suitability of land in relation to crop patterns. Soil containing nutrients at balanced rate should be paramount in oil palm cultivation. Less knowledge of smallholders also makes them take for granted the status of land in plantation development.

Sometimes the small holder oil palm plantation have problem related to the nutrient deficiency that can be a serious threat to their oil palm. Besides that, soil can be too acidic or the drainage of the soil is excessive that it is not suitable for planting oil palm. Some of the small holders might also face nutrient imbalance due to wrong usage and dosage of fertilizers at the wrong time.

Total area of 4,691,160 hectares of oil palm plantations in Malaysia in 2009 compared to only 642,000 hectares recorded in 1975. Currently, Sabah is the largest area of oil palm plantations in Malaysia (1.362 million ha or 29.7%) followed by Sarawak (0.840 million hectares or 16.6%) and Johor (0.712 million hectares, or 15:32%). The smallest state has oil palm plantations are in Penang which only 14,000 hectares.

The total area of 2.807 million hectares of oil palm planted by the private estate (59.8%) while 20.2% developed by the Government Scheme (FELDA – 675,167 ha, and FELCRA 80,262 ha and RISDA 160,832 ha), 321,947 hectares (7.1%) by State Government scheme and the rest 540,194 hectares (12.98%) by smallholders. Besides that, smallholder faces difficulties to get information about the soil condition and guidance in oil palm cultivation to improve their yield

The government should establish a system of soil classification for crop farming to ensure that industry continues to grow oil palm and secure the nations interest. Government should provide tools and equipment such as GPS at every station of Department of Agriculture to assist smallholders to make their decision by Good Agriculture Practices (GAP) system.

1.2 OBJECTIVE

1. To determine the physical and chemical properties of oil palm land of smallholder.
2. To identify productivity level between different soils (alluvium, mineral, BRIS and acid sulphate soil) in term of economics impact relation with oil palm and land suitability.

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