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RELIABILITY OF SPAD METER TO INDICATE FOLIAR NITROGEN CONTENT IN MATURE OIL PALM

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RELIABILITY OF SPAD METER TO INDICATE FOLIAR NITROGEN CONTENT IN MATURE OIL PALM

BY

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CERTIFICATION

This research report entitled "Reliability of SPAD Meter to Indicate Foliar Nitrogen Content in Mature Oil Palm" is prepared by Mohammad Zafrullah Bin Salim and submitted to the faculty of Agriculture in fulfilment of the requirement of PRT 4999 (Final Year Project) for the award of the degree of Bachelor of Agricultural Science.

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ABSTRACT

Nitrogen (N) is important element in oil palm. It contributes to foliar development and served as a health parameter. N deficiency can affect productivity and yield of oil palm. On the other hand, excessive application can cause leaching and pollution of underground water. In seeking for an alternative to the conventional foliar analysis for N recommendation in oil palm management, SPAD meter is a handheld device that offers estimation of relative chlorophyll content in the leaf that could be directly related to N foliar content. It is non-destructive and affordable. This device proves to be convenient to estimate N content compare to the conventional methods such as soil and foliar sampling. The objective of this study is to determine the relationship between SPAD meter readings with the foliar N content in mature oil palm. This research was carried out in UMB Plantation in Machap Umboo, Melaka. The field Melaka Pinda planted in 2002 and Melaka Pinda 2005 were selected to conduct this experiment. For both fields, 9 plots with 16 palms in each plot were selected. The palms has been fertilized with different rates of N (Ammonium Chloride) that were N0 = 0kg AC, N1 = 1kg AC and N2 = 2kg AC. The parameters recorded were the SPAD readings and N content of the palm. For SPAD measurement, frond number 17 was the preferred one. The relationship between foliar N content and SPAD value of oil palm leaves were analyzed and the results showed that no significant relationship between both parameters. The linear regression between N content and SPAD value were also analyzed, with the highest R^2 value is 0.1595. It is concluded that SPAD-502 meter is not a reliable tool to estimate foliar N content via relative chlorophyll content in mature oil palm but serves as an alternative way to estimate N deficiency in mature oil palm.

ABSTRAK

Nitrogen (N) adalah elemen penting dalam kelapa sawit. Ia menyumbang dalam pembangunan dedaun dan berkhidmat sebagai parameter kesihatan. Kekurangan N boleh menjejaskan produktiviti dan hasil kelapa sawit. Pembajaan yang berlebihan boleh menyebabkan larut lesap dan berlakunya pencemaran air bawah tanah. Meter SPAD adalah sebuah peranti mudah alih yang digunakan untuk menganggarkan kandungan klorofil relatif dalam daun. Ia tidak merosakkan bahan ang diukur malah harganya sangat berpatutan. Objektif kajian ini adalah untuk menentukan hubungan antara bacaan meter SPAD dengan kandungan N dedaun kelapa sawit matang. Kajian ini telah dijalankan di Ladang UMB di Machap Umboo, Melaka. Kawasan Melaka Pinda yang ditanam pada tahun 2002 dan Melaka Pinda 2005 telah dipilih untuk menjalankan eksperimen ini. Bagi kedua-dua buah kawasan, 9 plot dengan 16 pokok kelapa sawit dalam setiap plot telah dipilih. Kelapa sawit tersebut telah dibajakan dengan kadar N (Ammonium Klorida) yang berbeza iaitu N0 = 0kg AK, N1 = 1kg AK dan N2 = 2kg AK. Reka bentuk untuk eksperimen ini adalah Randomized Complete Block Design (RCBD) dengan 3 ulangan. Parameter-parameter yang direkodkan ialah bacaan SPAD dan kandungan N dari sawit. Dalam pengukuran SPAD, pelepah ke-17 dipilih. Hubungan antara kandungan N foliar dan nilai SPAD daun kelapa sawit telah dianalisis dan hasilnya menunjukkan bahawa tiada hubungan yang signifikan antara kedua-dua parameter. Regresi linear antara kandungan N dan nilai SPAD juga dianalisis, dengan nilai R^2 yang paling tinggi adalah 0.1595. Sebagai kesimpulan, SPAD-502 meter bukanlah alat yang berkesan untuk menganggarkan kandungan N dalam daun kelapa sawit matang tetapi ianya boleh dijadikan alternatif untuk menganggarkan kekurangan N dalam kelapa sawit matang.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Malaysia is well known for its production of palm oil. The oil palm *Elaeis guineensis* is planted vastly in Malaysia. The oil derived from the fruits has many beneficial uses in many industries. The oil can be utilized for many raw materials used in our daily life such as cooking, margarine and food products. Recently, palm oil has been chosen as the alternative fuel or bio-fuel due to the scarcity of petroleum (Shuit et al., 2009). Palm oil is also healthy for human's consumption as demonstrated by Hornstra (1989) where with palm oil-rich diets, thrombosis and atherosclerosis risk factors could be reduced. Vitamin A deficiency among kids can also be fought by introducing palm oil during feeding because of its high carotenoid contents.

Since the introduction of the crop, research institutes have come up with so many technologies and techniques on efficient oil palm management (Ebongue et al., 2006). One of the important management components in palm oil production is fertilization. The widely used fertilizer is the single-nutrient fertilizer, followed by the compound fertilizer. Compound fertilizers are commonly more expensive than the single fertilizers despite both fertilizers have comparable weights and they are used in lesser rate than the single nutrients. Although compound fertilizers are convenient to use, the

range of composition in the market is limited. Therefore, the amounts of fertilizers applied may not be exactly as the amount required (Corley, 2003b).

The element of nitrogen (N) in the fertilizer is essential in the development of oil palm leaves. It acts as a health parameter for the palm and also an indicator of chloroplast development in the leaves since it is one of the major components that made up chlorophyll. Consequently, N contributes mainly in the foliar development. Deficiency of N might slow down the photosynthetic activity of the palm and causes the leaves to turn yellowish due to lack of chlorophyll content.

While the importance of the N in oil palm management is irrefutable, application of fertilizer without routine analysis especially excessive application as such can cause leaching and hence pollute the underground water. Additionally, fertilizers will go into waste if the application is beyond the optimum level. Excessive application will also mean additional costs incur in terms of labour, fertilizer, time and energy. As the matter of fact, this is not parallel towards sustainable and environmental friendly management (Ebongue et al., 2006).

Over-application of N fertilizer can be substantially reduced through routine analysis that will result in appropriate N recommendation for applying fertilizers (Lin et al., 2013). In routine analysis, conventional methods such as foliar and soil sampling are the preferred ones to obtain N status. However, these methods could be expensive per unit of sample due to the cost of solutions and the chemicals and also unavailable for certain people such as smallholders since accessibility to the sophisticated laboratory

equipment could be restricted (Lin et al., 2010). Besides, they are time consuming since the method of analysis has to follow series of procedures such as drying, grinding, solution preparation and wet digester analyses.

On the other hand, researchers have sought for alternative to replace the use of conventional N analysis technique especially non-destructive approach. Soil Plant Analysis Development (SPAD) meter is a device that is used to measure relative chlorophyll content has been introduced in Japan in 1963 for their rice production. Today, it is widely used for various types of crops. SPAD-502 measures the leaf chlorophyll content by utilizing two light-emitting diodes (650 and 940 nm) and a photodiode detector that sequentially measure red and infrared light through the leaves (Ling et al., 2011).

This meter has been used to determine the N status of a plant due to the fact that N content is always related to the chloroplast development, photosynthetic capacity, and general health of the plant (Ling et al., 2011). The benefit of SPAD meter is it is non-destructive and real time. It is less time consuming and immediate response can be obtained after having the data.

1.2 Objectives

The objectives of this study are to use SPAD meter to evaluate nitrogen content in mature oil palm and examine its relationship to foliar N content and to examine the range of SPAD meter readings on and mature oil palm.

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