UNIVERSITI PUTRA MALAYSIA

MANAGEMENT OF INORGANIC INPUT AND EMPTY FRUIT BUNCHES TOWARDS EFFICIENT NUTRIENT USE BY YOUNG OIL PALM

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Thesis Submitted in Fulfillment of the Requirements for the Degree of Doctor of Philosophy in the Faculty of Agriculture, Universiti Putra Malaysia

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DEDICATION

This thesis is dedicated to my sister

IRINE

For all her love and unfailing support

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In the gathering of information towards the writing of this thesis, I have enjoyed a great deal of selfless help from many people and this brief mention seems a wholly inadequate way of expressing my gratitude to them.

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MANAGEMENT OF INORGANIC INPUT AND EMPTY FRUIT BUNCHES TOWARDS EFFICIENT NUTRIENT USE BY YOUNG OIL PALM

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September 1999

Chairman: Associate Prof. Dr Zaharah Abd. Rahman

Faculty: Agriculture

The mechanism governing the effect of oil palm EFB on yield have not been thoroughly investigated. Against this background, four experiments were set up; one in the laboratory and three in the field, in an attempt to determine the decomposition pattern of EFB, identify the quality factor(s) controlling EFB decomposition, determine the effect of EFB application on the leaching of N and uptake of N and K fertilisers.

Results from the laboratory experiment indicate that, EFB decomposed in 3 distinct phases: viz. an initial immobilisation phase, a later immobilisation phase of reduced intensity and a final re-mineralisation phase. Stalks generally decomposed faster than the spikelets. In the field experiment, the decomposition rates and patterns of EFB component parts were relatively the same as in the laboratory.

EFB-lignin, carbon, polyphenol and nitrogen dynamics were evaluated with time and all four-quality parameters showed a strong correlation with soil N dynamics. However EFB-N had a stronger negative (R^2 = -0.95) relation (P=0.01) with soil N dynamics. Application of EFB parts lead to a complete soil N immobilisation for the entire 36 weeks study while EFB tissue N increased with time.

Evaluation of leaching of K, Ca, and Mg from EFB, using two sampling methods viz non-destructive sampling (NDS) and destructive sampling (DS) methods, indicated very high loses of K (87 – 88%), Mg (80 – 86%) and Ca (83 – 88%). For all treatments, K was lost at a much faster rate than Mg and Ca. A comparison of the two sampling methods showed that the NDS method was better as it accounted for higher quantities of nutrients leached.

EFB application reduced N fertiliser loss by about 24.1%. At 6 months after planting (MAP), EFB application significantly decreased N uptake but had no effect on K. However, 12 MAP, EFB significantly increased N and K uptake in palm seedlings by over 37 and 31.8% respectively compared to the non-mulched seedlings. Dry matter weight yield, plant height and leaf numbers were generally enhanced with the application of EFB, indicating the positive influence of EFB application on fertiliser use efficiency and subsequently yield.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah.

PENGURUSAN INPUT TAK ORGANIK DAN TANDAN KOSONG SAWIT BAGI PENGUNAAN NUTRIEN SECARA OPTIMUM OLEH KELAPA SAWIT MUDA

Oleh

WIRKOM EVELYN LAIKA

September 1999

Pengerusi : Profesor Madya Dr Zaharah Abd. Rahman

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Mekanisme yang mengawal kesan tandan kosong sawit (TKS) yang mempengaruhi hasil pengeluaran masih belum dikaji secara teliti. Berdasarkan latar belakang ini, empat kajian telah dilaksanakan. Satu kajian dijalankan di dalam makmal, dan tiga lagi dijalankan di lapangan. Kajian-kajian ini bertujuan untuk menentukan pola uraian TKS, mengenal-pasti faktor atau faktor- faktor kualiti yang mempengaruhi uraian TKS, menentukan kesan penggunaannya terhadap larut lesap N, dan tahap pengambilan baja N dan K oleh anak benih kelapa sawit.

Hasil kajian makmal menunjukkan bahawa tandan kelapa sawit kosong terurai dalam tiga fasa: iaitu fasa imobilisasi awal, fasa imobilisasi kedua dengan

intensiti menurun, dan akhirnya fasa remineralisasi. Tangkai tandan pada umumnya lebih cepat terurai berbanding dengan pepakunya. Melalui kajian lapangan, terbukti bahawa kadar penguraian dan pola bahagian komponen tandan kosong masing-masing sama dengan hasil penemuan kajian di-makmal. Dinamika kandungan lignin, karbon, polifenol, dan nitrogen telah dinilai berdasarkan masa, dan didapati keempat-empat parameter ini menunjukkan korelasi yang tinggi dengan dinamika N dalam tanah. Walau bagaimanapun dinamika N tandan kosong menunjukkan korelasi negatif (P=0.01) yang lebih kuat (R^2=-0.95) dengan dinamika N tanah. Penggunaan bahagian-bahagian TKS akan menyebabkan kesemua N tanah di-immobilisasi dalam jangka masa 36 minggu kajian, manakala N tisu TKS meningkat mengikut masa.

Penilaian terhadap larut lesap K, Ca dan Mg daripada tandan kosong dengan menggunakan dua kaedah persampelan, iaitu persampelan tak destruktif (PTD), dan persampelan destruktif (PD) menunjukkan larut lesap yang tinggi (iaitu 87-88% K, 80-86% Mg, dan 83-88% Ca). Dalam semua rawatan, K terlarut lesap dengan kadar yang paling cepat berbanding dengan Mg dan Ca. Perbandingan antara dua kaedah persampelan menunjukkan bahawa kaedah PTD lebih baik kerana kaedah ini dapat menunjukkan kuantiti nutrien terlarut lesap yang lebih tinggi.

Penggunaan tandan kosong sawit dapat mengurangkan kehilangan baja N sebanyak 24.1%. Pada masa 6 bulan selepas ditanam, penggunaan tandan kosong sawit mengurangkan penggambilan N dengan bererti tetapi tiada kesan yang bererti terhadap penggambilan K. Walau bagaimanapun, pada tahap 12 bulan selepas ditanam, penggambilan N dan K oleh anak benih kelapa sawit menunjukkan peningkatan yang bererti, melebihi 37 dan 31.8 %, apabila TKS digunakan dibandingkan dengan rawatan tanpa sungkupan TKS. Hasil berat kering, tinggi anak pokok, dan bilangan daun pada amnya bertambah jika TKS digunakan, dan ini menunjukkan pengaruh positif penggunaan TKS terhadap kecekapan baja yang digunakan, dan seterusnya hasil yang diperolehi.

CHAPTER I

Introduction

Malaysia is in the humid tropics and soils of this region are generally highly weathered and highly leached (Agboola, 1990) and thus must be nurtured with great care to enable appreciable crop production. The humid tropics is made up of three main soil orders, namely, Alfisols, Ultisols and Oxisols (Sanchez, 1976). In Peninsular Malaysia, the Ultisols and Oxisols occupy over 75% of cultivable land (Sharifuddin *et al.*, 1993). These soils are inherently infertile as they are low in soil organic matter. Considering the heavy rainfall regime in Malaysia (Sanchez, 1976), and the already fragile nature of the soils based on their low activity kaolinite clay, cultivation can only lead to further depletion of soil nutrients.

Until recently inorganic fertilizer application was seen as the panacea to these adverse soil conditions. Sanchez (1976) stated that, "*when mechanisation is feasible and fertilizers are available at a reasonable cost, there is no reason to consider organic matter as a major management goal*"