



UNIVERSITI PUTRA MALAYSIA

**EFFECTS OF INTERCROPPING ACACIA MANGIUM WITH PEANUT
(ARACHIS HYPOGAEA) ON TREE/CROP GROWTH AND SOME
CHEMICAL PROPERTIES OF TWO MALAYSIAN SOILS**

ABDELHAI MOHAMMED SHAREIF

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PEANUT (*Arachis hypogaea*) ON TREE/CROP GROWTH AND
SOME CHEMICAL PROPERTIES OF TWO MALAYSIAN SOILS**

By

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Thesis submitted in fulfilment of the requirements
for the degree of Master of Science in
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***This work is dedicated to
the man who first showed me the
way to school....To my late father.***



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Abstract of thesis submitted to the Senate of Universiti Pertanian Malaysia in fulfilment of the requirements for the degree of Master of Science.

Effects of Intercropping *Acacia mangium* With Peanut (*Arachis hypogaea*) on Tree/Crop Growth and Some Chemical Properties of Two Malaysian Soils

by

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Chairman: Assoc. Professor Dr. Nik Muhamad Majid
Faculty: Forestry

Malaysian soils are of low fertility because they are highly weathered soils. Large scale clearance of natural forests and mining activities have resulted in increased erosion and leaching of nutrients thus aggravating this problem of low soil fertility.

Two field experiments were conducted in 1989 at Universiti Pertanian Malaysia to determine the effects of intercropping *Acacia mangium* with peanut (*Arachis hypogaea*) on chemical properties of two types of soils; a normal mineral soil and a desolated ex-tin mining soil. *A. mangium* seedlings were planted in each study site at four different planting distances namely; 2x2, 2x4, 3x3 and 4x4 meters, with uniform spacing for peanut (50 cm x 10 cm). Each of the plots in the



respective spacing distance was divided into two subplots. In one subplot *A. mangium* seedlings were interplanted with peanut while in the other they were left to grow alone. Separate solecropping plots of peanut were used as control in each of the two study sites. Soil chemical properties and the growth performance of the two plant species were compared under sole and intercropped plots of *A. mangium*. Data were analysed using the Analysis of Variance and the Least Significant Difference Test. The experiments were conducted in a split-plot-design with 2x4x3 factorial arrangement of treatments with two cropping systems (mixed and sole cropping), four spacing levels and three replicates.

During a period of 11 months (July 1990 to May 1991) most of the 11 elements analysed showed pronounced increase under the intercropped plots. In the mineral soil (Site A) total C increased from an initial value of 1.5 percent to a maximum of 2.18 percent; pH from 4.4 to 5.2; total N from 0.14 to 0.69 percent; available P from 23.4 to 31.5 Mg/g; soil Ca from 0.16 to 1.41 meq/100g soil and soil Mg from 0.09 to 0.15 meq/100g soil. Soil K however did not show significant increase under the intercropped plots, indicating its



high mobility and tendency to be leached from the surface soil. The soil micronutrients also increased at the end of the experiment, but the increase was insignificant.

In mining soil there was also an increase in most of the above elements as a result of intercropping *A. mangium* with peanut. The increase was lower compared to that of the mineral soil, particularly for total C, total N and available P. However, soil pH, soil Ca, Mg and soil micronutrients showed a higher increase.

The growth of the plants was significantly affected by intercropping. Comparison between spacings revealed that on mineral soil, the growth of plants decreased with both closer (2x2 m) and wider (4x4 m) distances of the trees. The spacing distance of 2x4 m was found to be most favourable for increasing soil nutrients and plant growth. Conversely, on the mining land the growth of plants and soil nutrients were significantly increased in the closer spaced plots. This indicates that the choice of tree density and arrangement in intercropping practices is an important factor to consider.



Abstrak tesis yang dikemukakan kepada Senat
Universiti Pertanian Malaysia untuk memenuhi syarat
ijazah Mater Sains.

**Kesan Penanaman Selingan *Acacia mangium* Dengan
Kacang Tanah (*Arachis hypogaea*) Terhadap
Persifatan Kimia 2 Jenis Tanah Malaysia**

Oleh

ABDELHAI MOHAMMED SHARIEF

April, 1993

Pengerusi: Prof. Madya Dr. Nik Muhamad Majid
Fakulti : Perhutanan

Tanah di Malaysia pada amnya mempunyai tahap kesuburan yang rendah disamping mengalami proses luluhawa dan larutresap yang tinggi. Penebangan hutan semula jadi dan aktiviti perlombongan yang dilakukan secara meluas telah mempertingkatkan proses hakisan dan larutresap nutrien tanah, dan ini memburukkan lagi masalah ketidaksuburan tanah.

Dua ujikaji lapangan telah dikendalikan pada tahun 1989 di Universiti Pertanian Malaysia untuk menentukan kesan penanaman selingan *Acacia mangium* dengan kacang tanah (*Arachis hypogaea*) terhadap persifatan kimia 2 jenis tanah; tanah mineral biasa; dan tanah terbiar bekas lombong bijih timah. Anak benih *A. mangium*



ditanam di setiap tapak kajian pada 4 penanaman yang berbeza iaitu 2x2, 2x4, 3x3 dan 4x4 meter; kacang tanah pula ditanam dengan penjarakan yang seragam (50 cm x 10 cm). Setiap plot penjarakan itu dibahagikan kepada 2 subplot. Pada satu subplot, anak benih *A. mangium* ditanam berselang dengan kacang tanah, sementara yang satu lagi ditanam hanya dengan *A. mangium* sahaja. Plot berasingan turut ditanam dengan kacang tanah hanya sebagai kawalan untuk setiap jenis tanah. Perstasi tumbesaran kedua-dua spesies tanaman, termasuk konsentran nutriennya dibandingkan antara plot penanaman tunggal dan penanaman selingan anak benih *A. mangium*. Data dianalisis menggunakan Analisis Varians dan Ujian Beza Varians Terkecil. Ujikaji dikendalikan dengan rekabentuk-plot-terbelah dengan susunan olahan faktor 2x3x4 yang terdiri dari 2 sistem penanaman (penanaman tunggal dan bercampur), 4 tahap penjarakan, dan 3 replikasi.

Dalam tempoh 11 bulan (Julai 1990 hingga Mei 1991) kebanyakan daripada kesebelas unsur yang dianalisis didapati meningkat bagi plot tanaman selingan. Pada tanah mineral (Tahap A), jumlah C bertambah dari nilai 1.5 peratus pada peringkat awal kepada maksimum 2.18 peratus; pH bertambah dari 4.4 ke 5.2; jumlah N dari



0.14 ke 0.69 peratus; kandungan P dari 23.4 ke 31.5 mg/g, Ca tanah dari 0.16 ke 1.41 meq/100g tanah; dan Mg tanah dari 0.09 ke 0.15 meq/100g tanah. Walau bagaimanapun K tanah tidak menunjukkan pertambahan yang signifikan pada plot penanaman selingan, dan ini menunjukkan kemungkinan tinggi berlakunya larutresap dari tanah permukaan. Mikronutrien tanah juga bertambah pada penghujung ujikaji tetapi pertambahan ini tidak signifikan.

Bagi tanah lombong, kebanyakan unsur di atas juga bertambah apabila *A. mangium* ditanam berselang dengan kacang tanah. Walau bagaimanapun pertambahannya adalah lebih rendah berbanding tanah mineral, terutamanya untuk jumlah C, jumlah N, dan kandungan P. Nilai, pH, Ca, Mg, dan mikronutrien tanah didapati bertambah dengan banyak di tanah lombong. Tumbesaran kedua-dua tanaman ini dipengaruhi; secara signifikan oleh penanaman selingan. Perbandingan antara jarak dan tanaman yang berbeza pada tanah mineral menunjukkan tumbesaran tanaman yang lambat pada kedua-dua penjarakan tanaman rapat (2x2 m), ataupun renggang (4x4 m). Penjarakan 2x4 m didapati lebih cenderung ke arah pertambahan nutrien tanah dan tumbesaran tanaman. Sebaliknya, pada tanah lombong, tumbesaran tanaman dan nutrien tanah



didapati bertamgah secara signifikan pada plot penjarakan yang rapat iaitu penjarakan pada 2x2 m. Ini menunjukkan bahawa pemilihan kepadatan tanaman, dan amalan penyusunan tanaman selingan adalah faktor penting yang perlu diberi perhatian.



CHAPTER I

INTRODUCTION

In the last two decades, vast areas of natural rain-forests in Malaysia were cleared mainly for agricultural development and exploitation of timber. In 1955 forest constituted about 75 percent of the total land area of Peninsular Malaysia. This was further reduced to about 55 percent in 1970, 50 percent in 1980 and about 48 percent in 1990 (Ministry of Primary Industries, Malaysia, 1991).

The effects of this massive removal of natural forests on soil fertility have long been recognized. Soil erosion and nutrient leaching have increased, resulting in serious reduction of soil fertility and increased sedimentation of streams. In addition, the use of heavy machinery during the construction of logging roads, skid trails and other access roads during logging operations have resulted in severe soil compaction (Ling et al., 1979). This has further aggravated the problem of soil degradation and productivity of land.

Another source of soil degradation, particularly in Peninsular Malaysia is the tin mining activity. This activity, which began about 100 years ago, has



left vast tracts of barren infertile land called 'tin-tailings'. It has been estimated that 2 percent of lands in Peninsular Malaysia belongs to soils in this category. Tin-tailings are either very sandy or highly compacted with very low water holding capacity and low plant nutrients (Mitchell, 1959).

The soil fertility problems associated with forest clearance and the tin mining activity in Malaysia are further aggravated by the high rainfall and air temperatures. The mean annual air temperature is around 26° C and with mean annual rainfall exceeding 2000 mm (Bee and Sien, 1974). The heavy rainfall has resulted in excessive leaching of soil nutrients and erosion. This is especially so on bare or exposed soils.

Several recommendations have been suggested to overcome the problem of soil degradation, both on currently cultivated soils or in ex-tin-mining areas. These include mulching with oil palm fronds, natural weeds or other plant residues (Gilbert and Lim, 1982; Gulam and Zaki, 1982). Although these mulching techniques have proved to be effective in controlling erosion and minimizing leaching, they are, however, ineffective in improving soil fertility. This is mainly because of their low organic matter content, resulting in low nutrients being added to the soil. In