UNIVERSITI PUTRA MALAYSIA

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By

FAZIDAH BINTI NAZIRI

Thesis Submitted to the Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Master Science

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Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master Science

BUNCH ASH AS A SOURCE OF POTASSIUM (K) AND SOIL pH IMPROVEMENT FOR ALFALFA (*Medicago sativa* L.)

By

FAZIDAH BINTI NAZIRI

March 2010

Chairman : Mohd Ridzwan bin Abd Halim, PhD

Faculty : Agriculture

Two consecutive field studies were conducted to evaluate the use of bunch ash of oil palm (*Elaeis guineensis*) empty fruit bunch as source of fertilizer and soil amendment to increase soil pH in the cultivation of alfalfa (*Medicago sativa* L.). In the first trial, alfalfa was given two sources of K, either muriate of potash (MOP, 60% K_2O) or bunch ash (BA, 30% K_2O). Four rates of K_2O were applied: 0 (control), 100, 200 and 400kg K_2O per hectare. The trial was carried out using the Randomized Complete Block Design (RCBD) with four replications. In addition to K, equal rates of nitrogen at 17 N kg/ha and phosphate 56 kg P_2O_5 per hectare were applied as basal fertilizers. Initial soil pH was 4.57 and the soil was limed at the rate of 13 t/ha to raise pH to 6.85, the optimum pH for alfalfa. The results showed that BA and MOP gave the same yield and quality of alfalfa at all rates of K_2O. Both sources of fertilizers gave dry matter yield of between 3.4 t ha^{-1} to 7.7 t ha^{-1}, crude protein of leaf between 18.67% - 24.27% and crude protein of stem between 13.31% - 19.26%. The mineral concentration and fibre concentration were also not significantly different between alfalfa applied with MOP and BA. Neutral Detergent Fiber (NDF) of leaves were 72.56% and 72.25%, NDFof stem were 66.5% and

68.0%, respectively for MOP and BA treated alfalfa. Similarly, acid detergent fiber (ADF) of leaves were 15.38% and 20.00%, ADF of stem were 39.31% and 39.34% respectively, while acid detergent lignin of leaves were 12.31% and 12.13%, respectively for MOP and BA. Yield and crude protein increased linearly with increasing rates of K_2O with the maximum values obtained at 400 kg K_2O per hectare.

A second experiment was done to determine whether lime application will affect yield and quality of alfalfa when the optimum rate of BA at 400 kg/ha was used. The treatments comprised of four rates of lime: 0 (control), 1000, 2000 and 4000 kg/ha of GML. The initial acidity of the soil was 5.57. The hypothesis is that lime will not affect alfalfa growth as BA at 400 kg/ha is sufficient to increase pH to optimum level for alfalfa. Soil pH without lime application was raised to 6.05 and it increased linearly up to 7.76 at the highest rate of lime. There was no significant difference in soil pH between control and 1 tonne of lime in two months period of treatment. Dry matter yield, crude protein of leaf and stem, NDF, ADF, ADL, mineral K, P, Ca and Mg in both leaves and alfalfa stem increased with increasing lime applications. This shows that liming is beneficial even when BA is used at optimum level. In conclusion, BA can supply K to alfalfa and increase soil pH, but the use of lime with BA gave better performance of alfalfa than the use of BA alone.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia dalam memenuhi keperluan penganugerahan Ijazah Master Sains.

ABU TANDAN SEBAGAI SUMBER POTASSIUM (K) DAN UNTUK MEMBAIKI pH TANAH BAGI PENANAMAN ALFALFA (*Medicago sativa* L.)

Oleh:

FAZIDAH BINTI NAZIRI

March 2010

Pengerusi : Profesor Madya Mohd Ridzwan bin Abdul Halim, PhD

Fakulti : Pertanian

Dua kajian ladang dijalankan untuk menilai penggunaan abu tandan (BA) dari kelapa sawit (*Elaeis guineensis*) sebagai sumber baja dan pembaikpulih tanah bagi meningkat pH tanah dalam penanaman alfalfa (*Medicago sativa* L.). Dalam kajian pertama, rumput alfalfa menerima dua sumber baja iaitu muriate of potash (MOP) atau abu tandan kelapa sawit. Empat kadar K_2O diberikan iaitu : 1) kawalan,100, 200 dan 400 kg K_2O per hektar. Kajian dijalankan menggunakan kaedah Rekabentuk Blok Rawak Lengkap (RCBD) dengan empat replikasi. Selain baja K, jumlah kadar nitrogen adalah diberikan pada kadar 17 kg N ha^{-1} dan baja fosfat diberikan pada kadar 56 kg P_2O_5 per hektar sebagai baja permulaan. pH tanah permulaan adalah 4.57 dan dikapur pada kadar 13 t ha^{-1} bagi meningkatkan pH tanah kepada 6.85 iaitu pH tanah yang sesuai untuk penanaman rumput alfalfa. Keputusan menunjukkan bahawa abu tandan kelapa sawit memberikan hasil berat kering dan kualiti alfalfa yang sama pada semua kadar K_2O yang diberi. Kedua-dua kadar baja memberikan

hasil berat kering antara 3.4 t ha^{-1} hingga 7.7 t ha^{-1} , protein kasar daun antara 18.67% dan 24.27% dan protein kasar batang 13.31% dan 19.26%. Kualiti fiber kasar menunjukkan tiada perbezaan yang bererti antara dua jenis baja yang diberikan. Serat detergen neutral (NDF) bagi daun adalah antara 72.56% dan 72.25%, NDF batang antara 66.5% dan 68.0% untuk kedua-dua MOP dan BA. Keputusan yang sama direkodkan pada serat detergen asid (ADF) daun iaitu 15.38% dan 20.00%, ADF batang antara 39.31% dan 39.34% manakala lignin detergen asid (ADL) daun adalah antara 12.31% dan 12.13% bagi MOP dan BA . Hasil berat kering dan protein kasar menunjukkan peningkatan secara linear dengan peningkatan kadar K_2O dengan nilai maksimum di dapati pada 400 kg K_2O per hektar.

Kajian kedua telah dijalankan untuk menentukan samada penggunaan kapur memberikan kesan ke atas hasil berat kering dan kualiti alfalfa apabila kadar baja BA yang diberikan pada tahap optimum digunakan. Rawatan mengandungi empat kadar kapur iaitu: 0 (kawalan), 1000, 2000 dan 4000 kg per hentar GML. pH tanah permulaan adalah 5.57. Hipotesis kajian ini ialah kapur tidak akan memberikan kesan ke atas pertumbuhan alfalfa pada 400 kg per hektar kerana ia mencukupi untuk meningkatkan pH tanah ke tahap yang optimum bagi pertumbuhan alfalfa. pH tanah tanpa kapur meningkat kepada 6.05 dan terus meningkat secara linear kepada 7.76 pada penggunaan kapur 4000 kg per hektar. Hasil berat kering, protein kasar daun dan batang, NDF, ADF, ADL, mineral K, P, Ca, Mg dalam kedua-dua bahagian daun dan batang meningkat dengan peningkatan kadar kapur yang diberi. Ini menunjukkan bahawa penggunaan kapur adalah berfaedah walaupun abu tandan kelapa sawit digunakan pada tahap yang optima. Kesimpulannya, abu tanda kelapa sawit boleh membekalkan sumber K dan meningkatkan pH tanah tetapi penggunaan abu tandan

bersama kapur akan memberikan hasil yang lebih baik ke atas pertumbuhan alfalfa jika dibanding penggunaan abu tandan sahaja.

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APPROVAL SHEET 1

I certify that a Thesis Examination Committee has met on July to conduct the final examination of Fazidah binti Naziri on her degree thesis entitled Use Of Bunch Ash As A Source of Potassium and Soil pH Improfor Growing Alfalfa (*Medicago sativa* L.) in Malaysia in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

Members of the Examination Committee were as follows:

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Associate Profesor
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Date :

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master Science. The members of the Supervisory Committee were as follows :

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

FAZIDAH BINTI NAZIRI

Date: 25 March 2010

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