



UNIVERSITI PUTRA MALAYSIA

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

FAZIDAH BINTI NAZIRI

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**MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA**

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**BUNCH ASH AS SOURCE OF POTASSIUM AND SOIL pH
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By

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**Thesis Submitted to the Graduate Studies, Universiti Putra Malaysia, in
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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

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March 2010

Chairman : Mohd Ridzwan bin Abd Halim, PhD

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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% K₂O) or bunch ash (BA, 30% K₂O). Four rates of K₂O were applied: 0 (control), 100, 200 and 400kg K₂O 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 P₂O₅ 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 K₂O. 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%, NDF of 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:

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Dua kajian ladang dijalankan untuk menilai penggunaan abu tandan (BA) dari kelapa sawit (*Elaeis guineensis*) sebagai sumber baja dan pembbaiki 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 K₂O dengan nilai maksimum di dapati pada 400 kg K₂O 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.

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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.



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Date: 25 March 2010

TABLE OF CONTENT

ABSTRACT	Page i
ABSTRAK	iv
ACKNOWLEDGEMENTS	vii
APPROVAL	ix
DECLARATION	xi
LIST OF TABLES	xii
LIST OF FIGURES	xiii
LIST OF PLATES	xv
LIST OF ABBREVIATIONS	xvi

CHAPTER

1 INTRODUCTION	1
2 LITERATURE REVIEW	
2.1 Alfalfa	
2.1.1 Origin and History	6
2.1.2 Establishment	7
2.1.2.1 Soil	7
2.1.2.2 Irrigation	8
2.1.2.3 Fertilizer	9
2.1.2.4 Harvesting	11
2.1.3 Morphology	
2.1.3.1 Root System	12
2.1.3.2 Stems	14
2.1.3.3 Leaves	14
2.1.3.4 Inflorescence	15
2.1.3.5 Fruit and Seed	16
2.1.4 Diseases	17
2.1.5 Insect Pests	17
2.1.6 Nutrient Content	19
2.2 Products For Industries	
2.2.1 Livestock	20
2.2.2 Biodiesel	21
2.2.3 Human Consumption	21
2.3 Potential Trend	22
2.4 Potassium	
2.4.1 Role of Potassium	22
2.4.2 Sources of Potassium	24
2.4.3 Potassium Chloride (KCl)	24
2.4.4 Bunch Ash	25
2.5 Potassium and Alfalfa	27

2.6	Soil Acidity	28
2.6.1	Effects of pH on Minerals and Growth	29
2.6.2	Changes in Soil pH	30
2.6.3	Increasing Soil pH	31
2.6.4	Effect of pH on Alfalfa	33
3	USE OF BUNCH ASH AS A SOURCE OF POTASSIUM	
3.1	Introduction	35
3.2	Materials and Methods	
3.2.1	Experiment site	35
3.2.2	Treatments	36
3.2.3	Experimental Design	36
3.2.4	Crop Establishment	37
3.2.2	Harvesting	38
3.2.3	Soil Analysis	39
3.2.4	Forage Analysis	40
3.2.5	Statistical Analysis	41
3.3	Results	43
3.3.1	Dry Matter Yield (DMY)	43
3.3.2	Forage Quality	44
3.3.2.1	Crude Protein (CP)	44
3.3.2.2	Neutral Detergent Fiber (NDF)	46
3.3.2.3	Acid Detergent Fiber (ADF)	47
3.3.2.4	Acid Detergent Lignin (ADL)	48
3.3.3	Alfalfa Tissue Concentration	49
3.3.3.1	Tissue Analysis K Concentration	49
3.3.3.2	Tissue Analysis P Concentration	50
3.3.3.3	Tissue Analysis Ca Concentration	52
3.3.3.4	Tissue Analysis Mg Concentration	53
3.3.4	Soil Chemical Properties	
3.3.4.1	Total Nitrogen (N)	55
3.3.4.2	Exchangeable Soil K	56
3.3.4.3	Available P Soil Concentration	57
3.3.4.4	Exchangeable Ca Soil Concentration	59
3.3.4.4	Exchangeable Mg Soil Concentration	60
3.4	Discussions	
3.4.1	Alfalfa Yield And Quality	61
3.4.2	Mineral K, P, Ca and Mg	63
3.4.3	Soil Chemical Total N, P, K, Ca and Mg	64
3.5	Conclusions	66
4	USE OF BUNCH ASH TO INCREASE SOIL pH	
4.1	Introduction	67
4.2	Materials and Methods	67
4.2.1	Experiment site	67
4.2.2	Treatments	68

4.2.3	Experimental Design	68
4.2.4	Crop Establishment	69
4.2.5	Cutting	69
4.2.6	Forage Analysis	70
4.2.7	Soil Analysis	70
4.2.8	Statistical Analysis	71
4.3	Results	
4.3.1	Soil pH	72
4.3.2	Dry Matter Yield (DMY)	73
4.3.3	Forage Quality	74
4.3.3.1	Crude Protein (CP)	
4.3.3.2	Neutral Detergent Fiber (NDF)	
	Acid Detergent Fiber (ADF)	
	Acid Detergent Lignin (ADL)	
4.3.4	Alfalfa Tissue Nutrient Concentration (K,P,Ca and Mg)	78
4.3.5	Soil Chemical Properties	82
4.3.5.1	Total N in Soil	82
4.3.5.2	Exchangeable K, Ca, Mg, Available P in soil	83
4.4	Discussions	
4.4.1	Soil pH	87
4.4.2	Dry Matter Yield (DMY)	87
4.4.3	Crude Protein	88
4.4.4	Forage Quality	88
4.4.5	Alfalfa Tissue Concentration (K, P, Ca and Mg)	89
4.4.6	Soil Chemical Properties (total N, Available P, Exchangeable K,Ca and Mg)	90
4.5	Conclusions	91
5.0	SUMMARY , GENERAL CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH	93
	REFERENCES / BIBLIOGRAPHY	95
	APPENDICES	107
	BIODATA OF THE STUDENT	118