UNIVERSITI PUTRA MALAYSIA

EFFECT OF RICE HUSK BIOCHAR AND CHICKEN DUNG AS SOIL AMENDMENT FOR IMPROVEMENT OF SOIL CHEMICAL PROPERTIES AND GROWTH PERFORMANCE OF PHYLLANTUS NIRURI (DUKUNG ANAK) IN AN ORGANIC CULTIVATION SYSTEM

NORMA MAT ZAIN

FP 2015 127

EFFECT OF RICE HUSK BIOCHAR AND CHICKEN DUNG AS SOIL AMENDMENT FOR IMPROVEMENT OF SOIL CHEMICAL PROPERTIES AND GROWTH PERFORMANCE OF *PHYLLANTUS NIRURI* (DUKUNG ANAK) IN AN ORGANIC CULTIVATION SYSTEM

NORMA BINTI MAT ZAIN

DEPARTMENT OF LAND MANAGEMENT
FACULTY OF AGRICULTURE
UNIVERSITI PUTRA MALAYSIA
SERDANG, SELANGOR

2014/2015

EFFECT OF RICE HUSK BIOCHAR AND CHICKEN DUNG AS SOIL AMENDMENT FOR IMPROVEMENT OF SOIL CHEMICAL PROPERTIES AND GROWTH PERFORMANCE OF *PHYLLANTUS NIRURI* (DUKUNG ANAK) IN AN ORGANIC CULTIVATION SYSTEM

By

NORMA BINTI MAT ZAIN

A project submitted to the
Faculty of Agriculture, Universiti Putra Malaysia
in fulfillment of the requirement of PRT4999 (Final Year Project)
for the award of degree of Bachelor of Agricultural Science

DEPARTMENT OF LAND MANAGEMENT
FACULTY OF AGRICULTURE
UNIVERSITI PUTRA MALAYSIA
SERDANG, SELANGOR

2014/2015

ACKNOWLEDGEMENT

First of all, a great thankful to Allah S.W.T whose blessings have enabled me to accomplish my final year project.

I would like to express my gratitude to my project supervisor, Prof. Datin Dr. Rosenani binti Abu Bakar for her proper guidance, unfailing understanding, advices, and comments that she had given me in supervising this research and report writing. I am extremely grateful to all my friends, Raja Nur Atikah binti Raja Yahya, Mustakim Izzat bin Mohd Arif, and Muhd Faiz bin Khusaini that always help me when I was doing the project.

I would like to express my sincere thankful to En. Shahar, En. Kamaruddin, Mr. Jamil, Mr. Hun and all staffs at Department of Land Management who helped me in assisting my experiment. Not forgetting, to all Postgraduates Students, Zahidah binti Abd Razak, Esther, Nurul Hasanah binti Ishak, Lim Chin Tsong, Daniel anak Sang, Tan Wei Loon, Khairun Naim bin Mulana, Rovica anak Radin, Sherwin Lee Chan Kit, and Tang Tze Piew for helping and showing me the right way in conducting the experiment as well as giving guidance and moral support.

Lastly, love and appreciation to my family especially my parents, Mat Zain bin Junoh and Norizan binti Ismail for all their support and prayers for me to finish this project.

TABLE OF CONTENTS

LIST OF PLATES

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Phyllantus niruri is one of the highly demanded herbs in Malaysia for treating diabetes, wounds, scabies, kidney stone and ringworm. The herb production rate is still low due to small scale planting and most of Malaysian soil is infertile because the soil is highly weathered acidic soil. *P. niruri* is planted in an organic system due to highly demand of alternative medicine. Organic system can assure the herbs to become a safe and uncontaminated product. Besides that, the global demand for organically sustainable production herbs also increases. Thus, the infertile soil needs to be improved with the addition of organic amendment to improve herb's growth for increasing biomass production in a larger scale. So, rice husk biochar and chicken dung is a potential soil amendment to improve soil fertility. Biochar is a charcoal that is produced through pyrolysis. It has been reported that the benefits of biochar addition to soil is that it has the ability to retain nutrients, high stability against decay, able to remove carbon dioxide from the atmosphere, and revitalize degraded grounds. Chicken dung is used because it is easily available and commonly used by farmer as amendment for rapid improvement of soil in growing vegetables. A study was conducted to determine the effect combination of biochar and chicken dung application to soil chemical properties and growth performance of *P. niruri.* The experiment was conducted under shelter. There were 9 treatments (0 tan/ha, 5 tan/ha, and 10 tan/ha of biochar and 0 tan/ha, 2.5 tan/ha, and 5 tan/ha of chicken dung respectively) and 4 replications. Treatments were arranged in Randomized Complete Block Design (RCBD). The soil used was taken from Ladang 16, UPM. Different rates of biochar and chicken dung were used to determine the most suitable rate to improve soil chemical properties that give optimum

herb yield. Parameters such as plant height, plant canopy diameter, and number of branches were taken every 2 weeks after planting. After harvesting in the eighth week of planting, total plant biomass, plant fresh weight and dry weight were determined. Plant samples were analyzed for total N, P, K, Ca and Mg. The soil samples were analyzed for pH, available P, CEC, total C, total N, and exchangeable bases (K, Ca, and Mg). The results obtained showed that there were significant difference between control and treatments of plant growth parameter, plant nutrient uptake and soil chemical properties.

ABSTRAK

Phyllantus niruri ialah sejenis herba yang yang mendapat permintaan tinggi untuk mengubati penyakit seperti kencing manis, luka, kudis, batu karang dan kurap. Tahap pengeluaran herba tersebut masih rendah disebabkan penanaman berskala kecil and kebanyakan tanah di Malaysia tidak subur kerana tanah tersebut ialah tanah berasid luluhawa tinggi. *P. niruri* ditanam menggunakan sistem organik kerana permintaan tinggi terhadap ubatan alternatif. Sistem organik menjadikan produk herba tersebut lebih selamat dan tidak tercemar. Selain itu, permintaan global terhadap herba yang ditanam secara organik adalah meningkat. Maka, tanah yang tidak subur perlu ditambahbaik dengan menambah pemulih tanah untuk meningkatkan pembesaran pokok dan meningkatkan pengeluaran biomas dalam skala besar. Jadi, biochar sekam padi dan najis ayam ialah pemulih tanah yang berpotensi untuk meningkatkan kesuburan tanah. Biochar ialah arang yang dihasilkan melalui proses pirolisis. Kajian telah melaporkan bahawa kebaikan penambahan biochar kepada tanah ialah biochar mempunyai keupayaan untuk mengekalkan nutrient, stabil terhadap pereputan, boleh mengeluarkan karbon dioksida dari atmosfera, dan menambahbaik tanah yang tandus. Najis ayam digunakan kerana bahan tersebut senang diperoleh dan biasanya petani menggunakannya sebagai pembaikpulih tanah untuk menanam sayur. Satu kajian telah dijalankan untuk menentukan kesan kombinasi biochar dan najis ayam terhadap sifat kimia tanah dan pembesaran *P. niruri.* Kajian terrsebut dijalankan di bawah teduhan. Terdapat 9 kombinasi rawatan antara (0 t/ha, 5 t/ha dan 10 t/ha) biochar dan (0 t/ha, 2.5 t/ha dan 5 t/ha) najis ayam dan 4 replikasi. Rawatan disusun dengan menggunakan blok rawak lengkap (RCBD). Tanah yang digunakan diambil dari ladang 16, UPM. Kadar biochar dan najis

ayam yang berbeza digunakan untuk menetukan kadar yang sesuai untuk meningkatkan sifat kimia tanah dan hasil herba yang optimum. Parameter seperti tinggi pokok, diameter kanopi tumbuhan dan bilangan dahan dicatatkan setiap dua minggu selepas penanaman. Selepas tumbuhan dituai pada minggu kelapan , jumlah biomas, berat basah dan berat kering dicatatkan. Bagi tumbuhan pula, tisu pokok dianalisis untuk penetuan jumlah nitrogen, fosforus, potasium, kalsium dan magnesium. Sampel tanah dianalisis bagi penentuan pH, P tersedia dalam tanah, jumlah karbon dan nitrogen, KPK, dan tukar ganti bes (potassium, kalsium dan magnesium).. Keputusan yang diperoleh menunjukkan terdapat perbezaan yang signifikan bagi parameter pembesaran pokok, sifat kimia tanah dan nutrient tumbuhan terhadap rawatan berbanding kawalan.

CHAPTER 1

INTRODUCTION

Nowadays, people are more concerned about the use of herbs-based medicine in their daily life. They tend to take the medicine as their daily supplement or as medicine in treating diseases. There are many types of herbs that are used as an important ingredient in medicine production. One of the herbs is *Phyllantus niruri* or also kown as 'dukung anak' in Malaysia. This herb has important medicinal value as it can treat kidney stone, diabetes, liver diseases, and wounds. This herb cures itch and other skin infections (Allayurveda, 2010). *Phyllantus niruri* also acts as anti-diabetic activity (Charles, 2007).

The increasing demand for traditional medicine indirectly increase the demand for *P. niruri*. Besides that, all parts of the plant can be used as medicine. Its root, fruits, milky juice, and whole plants are used as medicine (Pankaj, 2002). Demand for herbs increase every year and thus, a larger production scale is needed. However, the production is low due to highly weathered and infertile soils. Malaysian soil has low soil pH due to high intensity of rainfalls. Tropical soil is also low in soil carbon sequestration (Richardson, 2009). Therefore, soil organic amendment needs to be added into the soil. The organic amendment can overcome these problem because it can give benefits to both soil properties and plant growth. The practice of adding organic amendment to soil will have several benefits on soil nutrients, soil physical conditions, soil biological activity, and crop performance (Kang *et al*., 1981; Wade and Sanchez, 1983; Hulugalle *et al.,* 1986). The example of common organic amendment that is used by farmers in Malaysia is chicken dung. Rice husk biochar (RHB) is not commonly used because the raw

materials are difficult to obtain and it must be processed before it can be used. There is also little documentation of *P. niruri* production through organic system.

Biochar is charcoal that is produced through pyrolysis process. The examples of biochar are rice husk, oil palm empty fruit bunch, and rice straw biochar. Lehmann and Joseph (2009) stated that biochar has potential in carbon sequestration and subsequently reduce carbon dioxide in the atmosphere. Addition of biochar to soil can retain nutrients, provide high carbon stability against decay, remove carbon dioxide from the atmosphere and revitalize degraded grounds (Amran *et al*., 2013). Therefore, a lot of attention has been given to the importance of biochar due to the global climate change and identification for a more sustainable soil management approach. The incorporation of biochar into soils can alter soil physical properties including soil texture, structure, pore size distribution and density (Downie *et al*., 2009). The application of biochar into soil is not a new concept. For instance, certain dark earths in the Amazon Basin (so called Amazonian dark earth or "*terra preta*") have received large amount of charred materials, which derived from biomass burning (Lehmann and Joseph, 2009).

The production and application of biochar in Malaysia is still at a lower rate. This is because farmers prefer to burn their rice husk and mixed it with sand and cocopeat to make sowing media for paddy seed. Biochar properties can be significantly influenced by the pyrolysis conditions and feedstock source. This later influenced the characterization of biochars for their application to improve the soil fertility and sequester the carbon in soil. Generally, wood biochars has higher total C, lower ash content, lower total N, P, K, S, Ca, Mg, Al, Na, and Cu contents, and lower the potential cation exchange capacity (CEC) and exchangeable cations than the manured-based biochars, and leaf biochars were generally in between (Annette *et al*., 2010). However, due to high amount of rice husk waste in Malaysia, recently biochar from rice husk has

been produced and has attracted so much attention for its potential. However, there is not much research had been done to study the effect of rice husk biochar on soil properties and crop growth.

Chicken dung is a common soil amendment used by farmers in Malaysia because it is easily available. There is a rapid growth of chicken farm industry in Malaysia and the daily manure production by a laying hen is 138g/day (25% dry substance) and (40% dry substance) by a broiler (Burton and Turner, 2003). They used chicken dung for rapid improvement of soil in growing vegetables. Chicken manure is a good organic fertilizer as it contains nitrogen, phosphorus, and potassium (Easter, 2009). The application of chicken dung gives several benefits to the soil. Chicken manure supply nutrients, improves biological, chemical, and physical properties of soil (Sunarlim, 1999). Otherwise, the application of untreated chicken manure caused environmental pollution by pathogens, ammonia emission and nitrate contamination of groundwater (Nahm, 2003). Without composting, it can damage roots and kill plants (Easter, 2009).

Application of rice husk biochar and chicken dung as a soil amendment may improve soil chemical properties and growth performance of *P. niruri* in an organic system. Thus, the general objective of this study was to study the effect of application of rice husk biochar and chicken dung as soil amendment to improve soil chemical properties and growth performance of *P. niruri* in an organic system. Meanwhile, the specific objectives of this study were:

1. To determine effect of rice husk biochar and chicken dung on soil chemical properties.
2. To determine the optimum rate of rice husk biochar and chicken dung for production of *P. niruri*.

REFERENCES

DOA, (2009). Statistics on Herbs. Department of Agriculture Malaysia. Retrieved 16 October 2014 from http://www.doa.gov.my/c/document_library/get5e311.

Glaser, B., Lehmann, J. and Zech, W. 2002. Ameliorating physical and chemical properties of highly weathered soils in the tropics with charcoal. Biol Fertile Soils. 219-230.

Huang, Y., Zou, J.W., Zheng, X.H., Wang, Y.S. and Xu, X.K. 2004. Nitrous oxide emissions as influenced by amendment of plant residues with different C:N ratios. Soil Biol Biochem. 36: 973-981.

International biochar initiative. 2009. Retrieved 16 October 2014 from http://www.biochar-international.org/biochar

J. Lehmann & S. Joseph, 2009, Biochar For Environmental Management, Science & Technology, Earthscan publisher, 987-1-8440-658-1.

JTN, (2010). Pest and disease on *P. niruri*. Department of Agriculture Terengganu. Retrieved on 16 October 2014 from http://jtn.terengganu.gov.my

Keluasan Dan Pengeluaran Tanaman Herba Malaysia Mengikut Negeri, 2007-2011, Portal Rasmi Jabatan Pertanian, Kementerian Pertanian dan Industri Asas Tani Malaysia. Retrieved on 16 October 2014 from www.doa.gov.my/web/guest/data_perangkaan_tanaman.

L.R. Bulluck III, M. Brosius, G.K. Evanylo, & J.B. Ristaino, 2002, Organic & synthetic fertility amendments influence soil microbial, physical & chemical properties on organic & conventional farms, Applied Soil Ecology, 19, 147-160.

L.R. Bulluck III, M. Brosius, G.K. Evanylo, & J.B. Ristaino, 2002, Organic & synthetic fertility amendments influence soil microbial, physical & chemical properties on organic & conventional farms, Applied Soil Ecology, 19, 147-160.

Lehmann, J. and Rondon, M. 2006. Biochar soil management on highly weathered soils in the humid tropics. In: N. Uphoff et al. (Eds.), Biological approaches to sustainable soil system. Florida: CRC Press, Taylor and Francis Group.517-530.

Lehmann, J., da Silva, J.P., Steiner, C., Nehls, T., Zech, W. and Glaser, B. 2003. Nutrient availability and leaching in an archeological anthrosol and a ferrasol of the central amazon basin:fertilizer, manure and charcoal amendment. Plant Soil. 249:343-357.

Leslie, C. September 16, 2002. Building Soil Organic Matter with Organic Amendments.

Masulili, W. H. Utomo, M.S. Syechfani, 2010, Rice husk biochar for rice based ping system in acid soil 1. The characteristics of rice husk biochar & its influence on the properties of acid sulfate & rice growth in west Kalimantan, Indonesia, Journal of Agriculture Science, Vol. 2, No. 1, 39- 47.

MOA, (2012). Herbs Industry. Ministry of Agriculture. Retrieved on 16 October 2014 from http://www.moa.gov.my/web/guest/herba

Musa, Y., Muhamad Ghawas, M. dan Mansor, P (2005). PenanamanTumbuhan Ubatan dan beraroma. Serdang:MARDI. 156 pp.

Musa, Y., Wan Zaki, W.M., Yahaya, H. dan Zaharah, A. (2006). Manual teknologi penanaman dukung anak. Sedang:MARDI. 33 pp

Portal Rasmi Institut Penyelidikan dan Kemajuan Pertanian Malaysia (MARDI), Kementerian Pertanian Malaysia. Retrieved on 16 October 2014 from http://www.mardi.gov.my/.

V. Schulz, R. Hansel, & V. E. Tyler, 2001, Rational Phytotheraphy: A Physician's Guide to Herbal Medicine, Springer-Verlag Berlin Heidelberg New York, 3-540-67096-3.

Zhang, R. Bian, G. Pan, L. Cui, Q. Hussain, L. Anqing, J. Zheng, J. Zheng, X. Zhang, X. Han, X. Yu, 2012, Effects of biochar amendment on soil quality, yield & greenhouse gas emission in a Chinese rice paddy: A field study of 2 consecutive rice growing cycles, Fields Research 127, 153-160.