UNIVERSITI PUTRA MALAYSIA

APPLICATION OF CHICKEN DUNG AND RICE HUSK BIOCHAR AS SOIL AMENDMENTS FOR IMPROVEMENT OF SOIL PROPERTIES AND GROWTH PERFORMANCE OF *ANDROGRAPHIS PANICULATA* (HEMPEDU BUMI) IN AN ORGANIC SYSTEM

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By

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A project report submitted to the

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CERTIFICATION

This project entitled "Application of Chicken Dung and Rice Husk Biochar as Soil Amendments for Improvement of Soil Properties and Growth Performance of *Andrographis paniculata* (Hempedu Bumi) in an Organic System" is prepared by Raja Nur Atikah Binti Raja Yahya and submitted to the Faculty of Agriculture, University Putra Malaysia in partial fulfillment of the requirementof PRT4999 (Project) for the award of degree of Bachelor Agricultural Science.

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ABSTRACT

The demand for medicinal plant-based raw materials, including organic herbs, is growing at the rate of 15 to 25 percent annually in Malaysia. *Andrographis paniculata* (hempedu bumi) is one of the high value herbal crop. However, the production is still in a small scale in Malaysia. Besides, the low fertility status of Malaysian soils is one of the problem that causes low crop performance. Hence, proper soil amendment capable to improve the soil are needed to assure the production of high quantity and quality of *A. paniculata* in Malaysia. Application of chicken dung as a basal is a common soil amendment that has been used in agriculture crops. It is due to the availability in the market and gives fast respond to the plant by uptake of nitrogen and phosphorus in agricultural soils. On the other hand, biochar is recently a popular soil amendment such as rice husk biochar that is reported to hold nutrients, reduce leaching of nitrogen into the ground water and decrease soil acidity. Therefore, the objective of this study is to determine the optimum rate of chicken manure and rice husk biochar for high yield of *A. paniculata*. There were 9 different treatments, 3 different rates of chicken manure (0 t/ha, 2.5 t/ha, 5 t/ha) and 3 rates of rice husk biochar (0 t/ha, 5 t/ha and 10 t/ha), with 4 replications and 36 a total of experimental units; with two plants per-replication. The study was arranged in a complete randomized block design (RCBD). The soil used for this study has a texture of 62.99% of clay, 6.51% of silt, and 30.51% of sand was taken from Ladang 16, Fakulti Pertanian, is used for preparation of 8kg soil per polybag as a media. After germinating the seeds for one month, the seedlings were transplanted into the polybags which have been mixed with chicken manure and rice husk biochar a week before. Organic fertilizer Bokashi (150 kg N/ha) was applied to all experimental units during transplanting. The plants were irrigated manually twice a day and weeding was done once a week. Plants were harvested on week 8 from transplanted day. The soil samples before planting and after

harvest were analyzed. The soil used were analyzed for pH, exchangeable bases, available P, CEC, total N and total C. The plant growth parameters were measured every 2 weeks; plant height, plant canopy diameter, number of branches, total biomass, fresh and dry weight and shoot to root ratio. SAS software wer used as statistical analysis. The result showed that the application of chicken dung at 5 t/ha and rice husk biochar at 5 t/ha was the optimum rate to increase the biomass production of the plants. Applying chicken dung and rice husk biochar to the soil improved its properties. There were significant differences showed on the soil pH, available phosphorus, and exchangeable base calcium and magnesium. Total carbon, total nitrogen, carbon to nitrogen ratio, exchangeable base potassium, and cation exchange capacity showed non significant and does not differed much from control might be due to leaching and uptake by plants. The application of chicken manure and rice husk biochar have improved the performance and yield of *A. paniculata* and improved the soil chemical properties especially in shoot biomass and soil pH.

ABSTRAK

Permintaan ubatan berasaskan tumbuhan merangkumi herba organik semakin meningkat pada kadar tahunan sebanyak 15 – 25 %. Hempedu bumi (*Andrographis paniculata*) adalah salah satu tumbuhan herba yang mempunyai nilai yang tinggi. Walau bagaimanapun, pengeluaran produk masih berada pada skala yang kecil. di samping itu, ketidak kesuburan tanah di Malaysia menjadi punca masalah sehingga mengakibatkan kemerosotan pertumbuhan tanaman. Justeru, penambah baikan tanah yang akan dilakukan dapat membantu dalam pemuliharaan tanah. Seterusnya, memastikan kualiti dan kuantiti pengeluaran hasil tanaman di Malaysia meningkat. Penggunaan tahi ayam sebagai asas dalam penambah baikan tanah merupakan kebiasaan yang dilakukan pada tanaman pertanian. Hal ini kerana, ia mudah didapati di pasaran dan memberikan kesan yang pantas pada pengambilan nitrogen dan fosforus di dalam tanah. Di samping itu, biochar merupakan penambah baikan tanah yang semakin popular seperti biochar daripada sekam padi. Ia dilaporkan dapat memegang nutrien, mengurangkan larut lesap nutrien ke dalam air bawah tanah dan mengurangkan keasidan tanah. Maka, objektif kajian ini adalah untuk mengenal pasti kadar penggunaan baha organik tahi ayam dan sekam padi biochar yang dapat meningkatkan prestasi dan tahap pengeluaran hasil *A. Paniculata*. Terdapat 9 jenis rawatan, 3 kadar baja organik tahi ayam (0, 2.5, 5 tan/ha) dan 3 kadar (0, 5, 10 tan/ha) sekam padi biochar, 4 replikasi, 36 unit eksperimen dan 2 pokok bagi setiap replikasi. Susunan yang digunakan ialah reka bentuk blok rawak (RCBD). Tanah kajian mempunyai tekstur 62.99% lempung, 6.51% pasir dan 30.51% tanah telah diambil di ladang 16, Fakulti Pertanian dan 8 kg tanah digunakan bagi setiap polibeg sebagai media. Selepas penyemaian biji benih selama sebulan, semaian akan dipindahkan ke dalam polibeg yang telah dicampurkan dengan baja organik tahi ayam dan sekam padi biochar seminggu sebelumnya. Baja organik Bokashi diberikan kepada setiap unit

eksperimen pada kadar 150 kg N/ha. Penyiraman dan merumpai dilakukan seminggu sekali. Penuaian di lakukan pada minggu ke 8 selepas hari pemindahan semaian. Sampel tanah sebelum dan selepas penuaian pokok telah dianalisa. Sampel tersebut dianalisa bagi mengenal pasti pH, pertukaran bes, fosforus yang tersedia, kapasiti penukaran kation, jumlah karbon dan jumlah nitrogen . Kadar pertumbuhan tanaman telah diukur setiap 2 minggu antaranya ketiggian pokok, diameter kanopi pokok, bilang cabang pokok, jumlah biomass, berat kering dan basah dan pokok nisbah akar. Perisian SAS telah digunakan bagi analisa statistik. Keputusan kajian menunujukkan aplikasi baja organik tahi ayam pada kadar 5 t/ha dan sekam padi biochar pada kadar 5 t/ha adalah kadar optimum untuk meningkatkan pengeluaran jisim pokok. Aplikasi baja organik tahi ayam dan sekam padi bioachar pada tanah memperbaiki sifat-sifat tanah. Kajian menunjukkan perbezaan yang ketara dapat dilihat pada pH tanah, fosforus yang tersedia, dan pertukaran bes kalsium dan magnesium. Jumlah karbon, jumlah nitrogen, karbon nisbah nitrogen, pertukaran bes kalium dan kapasiti penukaran kation menunjukkan tiada perbezaan ketara mungkin disebabkan larut lesap dan pengambilan oleh pokok. Aplikasi baja organik tahi ayam dan sekam padi biochar telah meningkatkan kadar prestasi dan hasil produksi *A. Paniculata* dan membaiki sifat kimia tanah terutamanya pH tanah.

CHAPTER 1

INTRODUCTION

Malaysia is one of the oldest tropical rainforest that is abundant with thousands species of plant. Out of the estimated 15000 known plant species in Malaysia, 3700 are known to be useful, while 2000 species with medicinal value, and 50 used commercially. However, the balance remain largely unexploited. It was estimated that Malaysia herbal industry has 15% of growth rate annually and is projected to have an estimated market value of RM7 billion in 2010, RM15 billion will be in 2015, and RM 29 billion in 2020, (Nor Mohamed, 2011). *Andrographis paniculata* or hempedu bumi is one of the potential high value herbs which had been effectively used of traditional Asian medicine for centuries. Yearly Malaysia has to import 70% of herbal product including *A. paniculata* for local use, (Muhd Setefarzi and Sarmin, 2000).

There are several driving forces for the growth of the herbal industry. Population demographics is one of the driving force by having a large portion of the developed nations which is including the older, thus the higher demand for anti aging and chronic disease cures. Besides, increasing focus on health versus disease and drive towards self–care and self–diagnosis among Malaysian give a big impact in the industrial as a driving forces in increasing the yield of herbs.

Although *A. paniculata* is considered as the herb of the future, the complete information to commercial production in local herbal industry is still lacking. Furthermore, the herb has not been grown in large scale and the present production output is still very low. To gain a foothold in the global herbal market, Malaysian product must possess the standard

of manufacturing, to compete in terms of quality, safety, efficiency, pricing, and etc. There is a need to increase the production of organically grown medicinal herbs as more people are embracing to use organic products. Thus, steps must be taken to increase production of organically grown herbs.

A. paniculata can grow on a wide variety of habitats such as mountain slopes, wetlands, and even on roadside. In natural habitat, it is growing in clay to sandy loamy soil that rich in organic matter which is good for growth and yield, (Farooqui and Sreeramu, 2001). The seeds are covered with a hard coat of wax and need 90 to 100 days of hot, humid weather to grow to its full maturity. The aerial parts of plants are used for the extraction of active phytochemicals and each compound has different potency in pharmacological activities, (Thisoda et al., 2006). There are several active components in the plants such as andrographolide (AG), neoandrographolide (NAG), and 14-deoxy-11,12-didehydroandrographolide (DDAG) which are have therapeutic effects in hard-to-treat diseases such as cancers and HIV, (Valdiani et al., 2014).

However, the low fertility status of Malaysian soils is one of the problems that cause low crop performance. A proper soil amendment such as chicken manure and rice husk biochar capable to improve the soil properties which subsequently will also improve growth performance and crop yield which are needed to assure the production of high quantity and quality of *A. paniculata* in Malaysia.

Chicken dung has nitrogen and phosphorus and for some decades been applied to agricultural soils as an organic fertilizer, (Faridullah et al., 2008). However, nitrogen loss decreased both the fertilizer potential and economic value of the end product, while causing

environmental pollution (Kithome et al., 1999, Bernal et al., 2009 and Steiner et al., 2010). The cumulative N loss was up to 71% of the initial total N under optimal conditions during composting, mainly due to volatilisation of ammonia, (Ogunwande et al., 2008). To reduce N loss and optimize the C/N ratio biochar as a bulking agent, has been used in the composting process, (Steiner et al., 2010, Clough and Condron, 2010, Jindo et al., 2012). Besides, the application of biochar helps to improve the carbon sequestration in the soils and reduces the effect of greenhouse gases which is the important issues nowadays, (Lehmann et al., 2006). Hence, many studies have been focusing on using biochar as soil amendment, (Steiner et al., 2007).

Thus, the obective of this study is to determine the optimum combination rate of chicken dung and rice husk biochar for high yield crop and their effects on soil chemical properties.

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