APPLICATION OF RICE HUSK BIOCHAR (*Oryza sativa* sp.) ON ACIDIC SOIL

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ABSTRACT:

Application of rice husk biochar (RHB) could improve the plant growth especially in agriculture activities. This study aims to discover the potential of RHB in reducing the acidic soil for crop production. Rice husk from paddy plant (*Oryza sativa* sp.) was collected and RHB was produced by pyrolysis process. Fourier-transform infrared (FTIR) was used to determine the chemical composition in RHB. Three different portions of RHB (0.5, 1.0 and 1.5 g) were added into 10 g of acidic soil (pH 3.38) and control soil (pH 7.2). Inductively coupled plasma optical emission spectrometry (ICP-OES) was used to determine the concentration of the sodium (Na), potassium (K), magnesium (Mg) and phosphorus (P) before and after addition of RHB after 1 week. RHB has increased the soil pH (reduce acidity) and nutrient in the soil which is K (from 0.01018 to 0.011 mg/g) but not really influence the concentration of Na and other macronutrients in acidic soil. The highest increment of soil pH (pH 7.16) was achieved when 1.5 g RHB was added. This result suggests that application of RHB on acidic soil has benefit to both soil pH and plant because increasing soil pH has increased the availability of macronutrient such as potassium in soil.

***Keywords*:** Acidic soil, Macronutrients, Rice husk biochar, Soil pH

INTRODUCTION

Biochar has great potential to increase soil pH because of its properties which is naturally alkaline (Fidel et al., 2016). Black carbon formed through pyrolysis of biomass is known as ‘biochar’ (Van Zwieten et al., 2010). Chan and Xu (2009) indicated that biochar from a wide variety of feedstock were founded in a range of pH 6.2 to 9.6 (Verheijen et al., 2010). Most of the countries that produce a very large amount of husk from rice production are either burnt or dumped it as waste (Mohanta et al., 2012). Traditionally, lime is used to increase soil pH. However, many poor farmers cannot afford to use lime (Samake, 2014). Besides, lime acts as temporary remedy and must be added to soil annually (Masulili et al., 2010). Thus, this study attempts to testify RHB as an alternative to lime in reducing soil acidity at a reasonable cost. Perhaps, the findings will benefit the agricultural sector specifically to lower the cost of reducing soil acidity and enhance the crop production.

METHODS

Sample collection and preparation

The sample of rice husk from paddy plant (*Oryza sativa* sp.) was collected from Bernas factory in Besut, Terengganu. About 1 kg of rice husk was put into a plastic bag and stored in a cool place until next analysis. Five soil samples were collected from palm oil plantation at five different points using soil probe rod with a depth about 0 cm to 20 cm. Control soil was collected from undisturbed area around UiTM Jengka Pahang. Soil samples were sieved through a 2 mm sieve. Rice husk was dried in an oven for 24 hours. Then, it was placed in ceramic crucible covered with a fitting lid and was put in a muffle furnace at 450°C for two hours. The pyrolysis process was done under absence oxygen condition. The resulting biochar material was cooled overnight for further analysis. The dried RHB was placed on a holder inside the FTIR to observe the unidentified components present in the sample.

Determination of Na and K in acidic soil sample using ICP-OES

About 1 g of air-dried soil sample was weighed and placed in a beaker. Then, 16 mL of concentrated nitric acid (HNO_3) and 4 mL of perchloric acid ($HClO_4$) were added into the beaker. After that, the sample was heated using a hot plate for one hour for complete solubilisation. The sample was filtered using filter paper and was transferred into the 100 mL volumetric flask and diluted. The standard solutions were prepared in five concentrations of 2, 4, 6, 8 and 10 mg/L from the multi-element standard solution into five separated volumetric flasks. Deionized water was used as a blank solution. The sample was analysed using the ICP-OES instrument.

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About 10 g soil samples were mixed with 0.5, 1.0 and 1.5 g of RHB respectively. The samples were placed at room temperature for a week. Then, the pH value was determined using the pH meter and its chemical composition including Na and K were analysed using ICP-OES.

RESULTS AND DISCUSSIONS

pH and chemical composition in rice husk biochar

The RHB had slightly alkaline properties with a pH of 7.76. Figure 1 shows band corresponding to O-H group (3368 cm^{-1}), C=O carbonyl (1618 cm^{-1}), silicon oxide (1072 cm^{-1}), C-H aromatic hydrogen (798 cm^{-1}) and another C-H group (519 cm^{-1}). Similar results were reported by Jindo et al. (2014) for O-H group, C=O, and silicon oxide (Si-O).

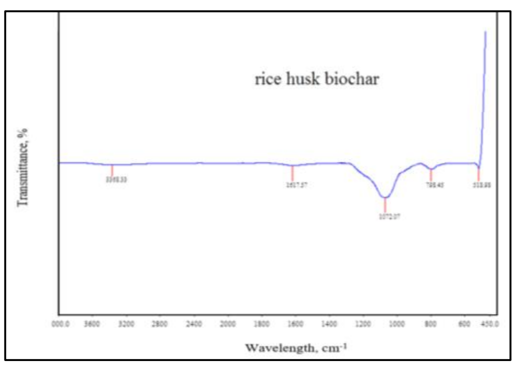

Figure 1 FTIR - Spectrum of RHB used in this study.

Application of rice husk biochar on acidic soil

The pH of the soils varied from 3.38 to 4.44 and considered as a very acidic soil. There was an increasing in soil pH when addition of RHB from 0.5, 1.0 and 1.5 g into 10 g soil respectively. The pH raised with increasing portion of RHB. RHB was slightly alkaline, therefore, it is reasonable for the soil pH increment. This suggests that RHB could be utilized as lime material to increase the pH of acidic soils. Table 1 shows that application of RHB on the acidic soil increased the content K but did not significantly influence the amount of Na. Similar findings were reported by Masulili et al. (2010). According to Silviera (2013), soil pH affects nutrients available for plant growth. Most macronutrient such as potassium, phosphorus, magnesium and calcium decrease their availability as soil acidity increases (Silviera, 2013). Therefore, RHB also can be used to improve the efficiency of nutrients to be absorbed by plants in acidic soil.

Table 1 Effect of RHB on the amount of (a) Na and (b) K in acidic soil at five different sampling points.

(a)

Amount of RHB added into the soil sample	Point 1	Point 2	Point 3	Point 4	Point 5
0.0 g	2.06 ppm	1.71 ppm	1.88 ppm	1.67 ppm	2.85 ppm
0.5 g	1.66 ppm	1.92 ppm	2.04 ppm	1.60 ppm	1.8 ppm
1.0 g	1.71 ppm	1.87 ppm	1.83 ppm	1.96 ppm	3.47 ppm
1.5 g	1.77 ppm	1.24 ppm	1.88 ppm	1.43 ppm	2.29 ppm

(b)

Amount of RHB added into the soil sample	Point 1	Point 2	Point 3	Point 4	Point 5
0.0 g	10.28 ppm	> 11 ppm	8.41 ppm	7.06 ppm	10.18 ppm
0.5 g	> 11 ppm	> 11 ppm	> 11 ppm	9.11 ppm	> 11 ppm
1.0 g	> 11 ppm	> 11 ppm	> 11 ppm	> 11 ppm	> 11 ppm
1.5 g	> 11 ppm	> 11 ppm	> 11 ppm	> 11 ppm	> 11 ppm

CONCLUSION

High RHB concentration increases the soil pH. The macronutrient such as potassium (K) also increase after certain level of RHB introduced. Nevertheless, comprehensive study is needed ensuring the advantages of RHB for agricultural soils.

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