THE EFFECT OF PADDY HUSK BIOCHAR TOWARDS ZINC AVAILABILITY IN CONTAMINATED SOIL

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INTRODUCTION

Soils polluted with heavy metals have become common across the plantation sector. There is a reduction in plant growth as well as the yield toward the plant that have been planted on heavy metal contaminated soil. Agricultural soils normally contain low background levels of heavy metals. Namgay et al., (2010) stated that contamination from industrial activities or byproducts can give a side effect or increase the natural levels of heavy metals in soil, creating a health hazard to people, livestock and plants. Uses of fertilizers and other soil amendments also add small amounts of heavy metals to the soil, which can develop over time with repeated applications.

METHODOLOGY

Location of Study

The experiment of was conducted at Universiti Teknologi MARA Melaka in Jasin.

Paddy Husk Biochar

The biochar was a treatment using four different rates. It was taken from Tanjung Karang, Selangor. It was produced by continuous slow pyrolysis process at temperature of >500 ^{0}C. This experiment used paddy husk biochar because it is taken from one of the major crop in Malaysia which is paddy, thus it supply can be sustained and maintained.

PHB will be a factor to determine whether heavy metal in soil can be reduced.

The rate of biochar application were 0, 15, 20, 30 and 40g/kg soil.

Table 1: Chemical properties of PHB

pH	Cation Exchange Capacity (CEC)
8.7	12.42 mol/kg-1

RESULTS AND DISCUSSION

Different Mean of Zn Availability Before and After Apply Biochar

Based on the mean graph shows the Zn availability and different rate of PHB that have been apply to contaminated soil. This result shows the different concentration of Zn after 3 weeks application of biochar. The highest mean before apply biochar was treatment 2, 239.1 which exceeds the limit concentration of Zn standard in soil. According to Ogundele et al., (2015), heavy metal can be toxic if it is present in excess. However, Zn dropped to 65.7 ppm. Overall, the Zn concentration decreased except for treatment 0 which is control. After 3 weeks, amount of Zn was increased from 64.4 ppm to 138 ppm. For treatment 2, there was a reduction of Zn which was 165.3 ppm to 42.88 ppm. While treatment 3 decreased from 221.2 ppm to 137.1 and treatment 4 also drop from 167.9 ppm to 76.4 ppm.

But the graph showed that there was a fluctuated of Zn concentration in the contaminated soil. This is because different concentration of Zn in soil may have a different reaction toward the biochar. Biochar is a strong sorbent than other forms of organic matters (Yang and Sheng 2003). Previous study by Namgay et al., (2010) proved that the concentration pf heavy metal in plant shoot significantly decreased with the application of 15 g of biochar compared to control (no biochar) treatment. Thus, biochar application help to reduce the uptake of heavy metal concentration in plant shoot.

Basically, from this graph I was able to reach and achieved my objectives, which were to determine the availability of Zn in contaminated soil and determine the potential of Paddy Husk Biochar as a good absorbent of available Zn.

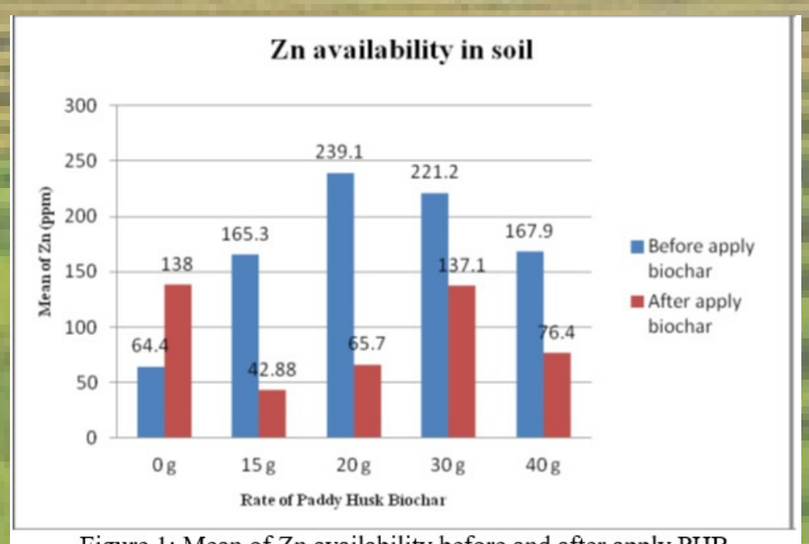

Figure 1: Mean of Zn availability before and after apply PHB

The Effect of biochar toward soil pH

The table shows the changes of pH of the contaminated soil after the application of biochar. The pH before apply the treatment was 4.32, which consider as acidic. There was an increment of pH, which 4.40, 4.82, 4.95, 4.97 and 5.02 for T0, T1, T2, T3 and T4 respectively. According to Masulili (2010), biochar could be utilized as a substitution for lime material to enhance pH of acidic soils. The biochar has accounted positively effect on soil acidity, enhance nutrient, water holding capacity and crop yields (Kamara et al., 2015). Some biochar have been shown to have a high pH, consequently can use as a liming agent when applied to acidic soil (Beesly and Marmirolli, 2011). As stated by Lu et al., (2014), pH functioned to neutralize the soil acidity, which also be a factor in metal mobility. Higher soil pH would promote metal adsorption, subsequently can lessen the bioavailability (Zhang et al., 2013).

Table 2: pH of soil after apply biochar

Treatment	pH
T0	4.40
T1	4.82
T2	4.95
T3	4.98
T4	5.10

CONCLUSION

In this experiment, the main objective is to determine available Zn in contaminated soil and determine the potential of PHB as a good absorbent of Zn. The treatment of this experiment is different rate of biochar which are 0 g, 15 g, 20 g, 30 g, and 40 g. The biochar significantly influenced the Zn availability in soil. This research measure the available Zn in soil before and after applying PHB, which take 3 weeks to let them interact. This study has shown that the application of PHB to soil has a potential to reduce the availability of Zn. However, large amount of PHB applied did not give an impact toward available Zn in soil. So that, small amount was enough to reduce the heavy metal availability in soil. The analysis showed that each treatment except for treatment 0 (control) give a reduction amount available Zn. In addition, biochar also shown to have a liming value, which increased the soil pH from 4.37 to 5.28. However, the temperature during slow-pyrolysis process should be lower, which will affect to have high CEC of biochar to improve it absorption capability. The soil pH also showed an increasing number which every additional of biochar applied, the pH also increased. This may reduce the acidity of soil especially in acidic soil.

RECOMMENDATION

Bioremediation is considered as one of the more secure, cleaner and ecological well-disposed innovation for decontaminating sites which are contaminated with excessive metals. The term bioremediation has been introduced to describe the way toward removing the toxic waste from environment. The procedure of bioremediation uses different agents, for example, microorganisms, organisms, algae and higher plants as major tools in treating heavy metals present in the environment (Kulshreshtha et al., 2014). Biochar and phytoremediation systems can possibly be joined in the remediation on heavy metal contaminated soil. It can lessen the bioavalability of heavy metals in the soil. The plant that absorbs heavy metal also called as hyperaccumulator. It has been found to show higher heavy metal tolerance and accumulating ability as compared to other plants (Dixit et al., 2015). As stated by Jadia and Fulekar (2009), this technology involves the extraction of metals by plant roots and the translocation thereof to shoots. Thlaspi caerulescens (alpine pennycress) is the recommended plant species for Zn and also Cd uptake. The T. caerulescens can accumulate up to 26 000 ppm without showing any serious injury. We should understand, firstly how these properties are relevant for heavy metal absorption and how they contribute to the different mechanism. Most studies utilizing biochar or phytoremediators alone, not in combination or effect of heavy metal. Most experiment uitilizing heavy metal had been carried out under laboratory conditions.

The research also should be further tested for other element in soil which can contribute to heavy metal contamination. Experiments on adsorption study also recommended. Adsorption is generally used as effective physical to eliminate or cut the concentration of pollutants (organic and inorganic) in the polluted environment, soil or water by use of most common adsorbents, such as biochar (Komkiene, 2016). As indicated by Nartey and Zhao (2014), the adsorption mechanisms mainly include electrostatic interaction, ionic exchange, chemical precipitation, and complexion with functional groups on biochar surface. Mechanisms of heavy metal sorption by biochar can be systematically investigated using different methods, including adsorption isotherms and kinetic models, desorption studies, and industrial analysis including XRD, FTIR, and SEM. Subsequently, can determine the exact amount of heavy metal that biochar adsorb. Further research is needed in order to understand the effect of biochar on soil microorganisms and how the interaction between biochar and soil microbes influences remediation of heavy metal polluted soils because such studies are rare in literature.

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