EFFECT OF RICE HULL BIOCHAR APPLICATION ON SOYBEAN SEED GERMINATION

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ABSTRACT

The objective of this research was to determine the effect of ricehull biochar application on soybean seed germination in soil less petridish bioassay and three types of soil. Thestudy was conducted in two stages. The first stages was usedrandomized block designwith three replications. The factor werebiochar rate application : 0,5 g/petridish (M_1); 1,0 g/petridish (M_2); 1,5 g/petridish (M_3); 2,0 g/petridish (M_4). The second stages was usedrandomized block designwith two factors and two replications. The first factor was biochar rate application (10 t/ha, 20 t/ha). The second factor were thethreetypessoils (SeiRampah, Medan, Galang).The results of this first research showed rice hull biochar at 1,0 g/petridish showed the highest soybean germination percentageand rice hull biochar at 0,5 g/petridish showed the highest root length total in soil less petridish bioassay. Rice hull biochar at 10 t/ha showed the highest vigor index of seed germination, root volume, root dry weight, shoot length, and rice hull biochar at 20 t/ha showed the highest shoot dry weight and root length. And the soil from Medan site showed the highest vigor index of seed germination, root dry weight, shoot length. The soil from Galang site showed the highest root length and root volume.

Keywords: Biochar, Rice Hull, Seed Germination, Soybean,

A. INTRODUCTION

Biocharis arich product Cproduced from biomass that has been heatedat a low temperature(~ 350-600°C) in littleor nooxy genenvironment. Biochar characteristics asoilamend ment were high cationex changeca pacity(CEC, 40-80 cmolkg^{-1}), a highsurface area (51-900 m2g^{-1}), which hin crease soilpH andim provewater-holding capacity, and affinity makro and micro nutrients (Lehmann, 2007; Laird, 2008; Gaunt dan Lehmann, 2008; Cheng *et al*, 2008.; Novak *et al*, 2009.; Lehmann dan Joseph, 2009; Roberts *et al.*, 2010).

Agricultural waste, animal wasteis are new able was teva luableasa richsource of carbon. In recent years, biochar has been used as asoila mendmenttoi mprovesoil fertility (Hammes and Schmidt, 2009;CaoandHarris, 2010). Biochar can improve soil fertility and productivity, carbon storage and sequestration, water in filtration into the soil and bind dissolved pollutants (Lehmannand Joseph, 2009).

Several studies have reported thee ffect of biochar in the early stages of plant growth as the phase of seed germination and seedling growth Nutrient status changes in soil mayaffecton seed germination and seedling growth. Some compounds in biochar has the potential either to inhibitor stimulate seed germination and seedling growth (Solaiman et al (2012).

Stimulation or inhibition of seed germination due to the application of biochar has been investigated for forest plants (Choi*et a*l., 2009; Reyes and Casal, 2006; Tian*et al*., 2007), the germination of wheat seed increased due biochar paper mills application with a single dose (10 t/ha). Instead, Free *et al*., (2010) reported that maize seed germination and early growth had no significant effect at various type biochar application. The objective of this research was to determine the effect of ricehull biochar application on soybean seed germination in soil less petridish bioassay and three types of soil

B. MATERIALS and METHODS

This study was conducted in two stage of research in Laboratory of Growth Centre Kopertis I, Medan District in North Sumatera Indonesia. It was located approximately atLatitude 3°36’39,82”N, Longitude 98°42’48,98”E. Thefirst study usedrandomized block designwith 1 factors and three replications. The Factor were biochar rate application : 0,5 g/petridish (M_1); 1,0 g/petridish (M_2); 1,5 g/petridish (M_3); 2,0 g/petridish (M_4). The second study used study usedrandomized block designwith 2 factors and three replications. The first factor was biochar rate application : 10 ton/ha; 20 ton/ha. The second factor were the three type of soil: Sei Rampah, Medan, Galang. All the biochar samples were analyzed the physical dan chemical characteristic like C content, N content, C:N ratio, and pH.

Rice hull for biochar material were collected from rice mill at Sei Rampah District, Sumatera Utara. The crop residue were cut into smaller sizes than dried in thesun and converted to biochar using the simple stove. After4-6 hours biochar was made formed then quenched with water.

A layer of filter paper were placed in 8,5 cm petridishes, then moistened with water. Each of six biochars were added at the doses 0, 0.5, 1.0, 2.5, 5.0

g/Petri dish (equivalent to 0, 10, 20, 50, 100 t/ha on a volume basis at 10 cm soil depth) with three replicates. This germination test was refers to Solaiman et al (2012). Twenty soybean seeds were sown in each petridishes. All Petri dishes were covered with lids and incubated in the dark at 25°C for 4 days when germination percentage and root length were assessed. Root length of germinated seeds was measured in fresh roots using a ruler, and summed for each Petri dish (m/Petri dish).

Data analyzed using Analysis of varience (ANOVA) to separate the main effect of factors as well as their interactions. Thmean comparisons were made using Duncan's Multiple Range Test (DMRT) at $p<0.05$ between treatments.

C. RESULTS and DISCUSSION

The analysis of varience showed that doses of rice hull biochar significantly affected soybean germination in the soil-less petri dish bioassay. Doses of 10 t/ha biochar application showed the highest soybean germination, which had significantly different with doses of 20 t/ha but no significantly different with other doses treatment (5 and 15 t/ha).

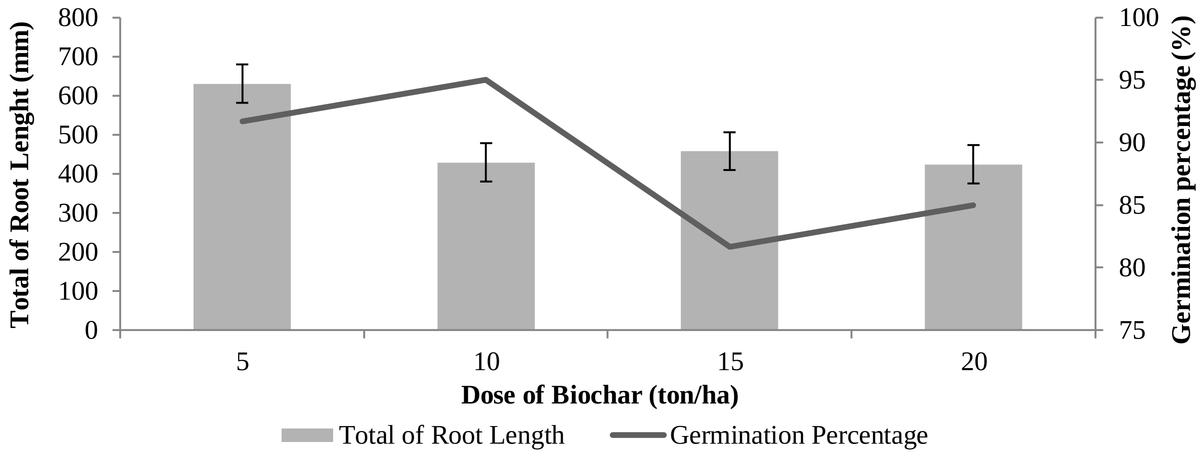

Figure 1. Effect of Doses Biochar on Soybean Germination and Total Root Length

The treatment combination from doses 10 t/ha with each biochar type like Rice hull biochar,maize strover biochar, tapioca residue biochar, and coconut peat biochar increased soybean germination and decreased at higher doses application. Rice straw biochar applied at 5 t/ha showed the highest soybean germination and decreased when rice straw biochar applied at higher doses application. Soybean germination was increased with applied the bagasse biochar at 5 and 20 t/ha, but decreased at 10 and 15 t/ha bagasse biochar application. Soybean germination due to biochar type and doses application can be seen at Figure 1.

In generally, combination treatments of rice hull biochar, bagasse biochar and tapioca residue biochar with all doses application showed soybean germination higher than 65 % but combination maize strover biochar, rice straw biochar and coconut peat biochar with doses biochar showed soybean germination lower than 65 %. Soelaiman *et al* (2012) reported that biochar generally increased wheat seed germination at the lower rates of biochar application (10–50 t/ha) and decreased or had no effect at higher rates of application. Biochar can reduce plantgrowth and yield biochars (Deenik*et al*., 2010) because it may contain undesirable compounds such as crystalline silica, dioxin, polyaromatic hydrocarbons (PAHs), phenolic compounds and heavy metals that are harmful to plants, microbes and humans (Cao *et al*. 2009; Thies and Rillig 2009).

Biochar type and doses of application significantly affected root length total in the soil-less petri dish bioassay. Tapioca residue biochar showed the highest root length total, which had significantlydifferent with another biochar type application. In the other hand Coconut peat biochar showed the lowest root length total which had no significantlydifferent with maize strover biochar, rice straw biochar treatments.

Rice hull biochar, maize strover biochar, rice straw biochar decreased root length total at higher doses application (> 5 t/ha), on the other hand tapioca residue biochar increased root length total when applied at higher doses application. Root length total was increased with applied bagasse biochar at 5 and 20 t/ha, but decreased at 10 and 15 t/ha bagasse biochar application. Root length total due to biochar type and doses application can be seen at Figure 2.

In generally, combination treatments of rice hull biochar, bagasse biochar and tapioca residue biochar with all doses application showed root length total higher than 200 cm but maize strover biochar, rice straw biochar and coconut peat biochar combination treatments showed root length total lower than 200 cm.

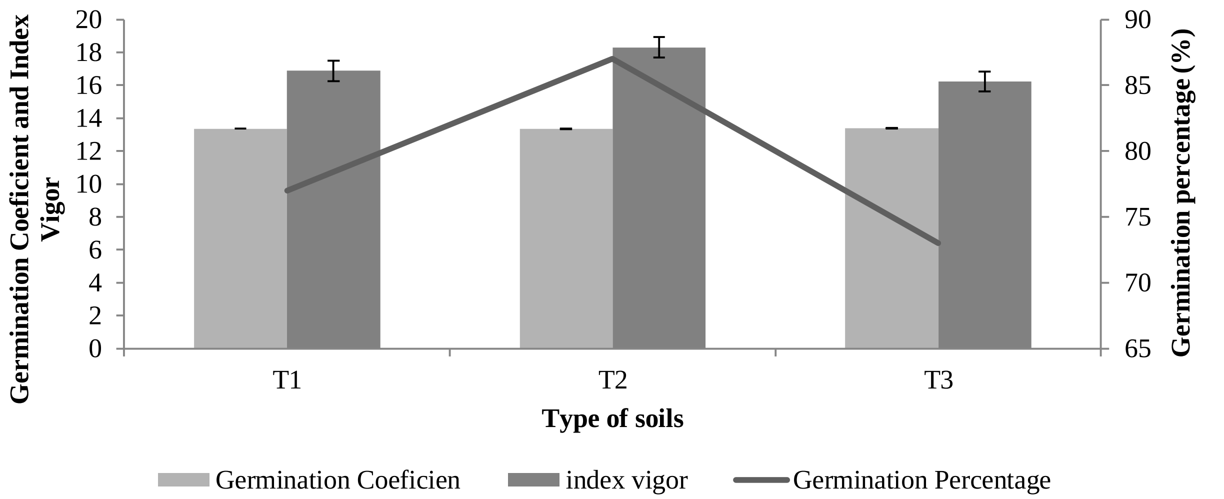

Figure 2. Effect of Types of Soil on Germination Coeficient and Index Vigor

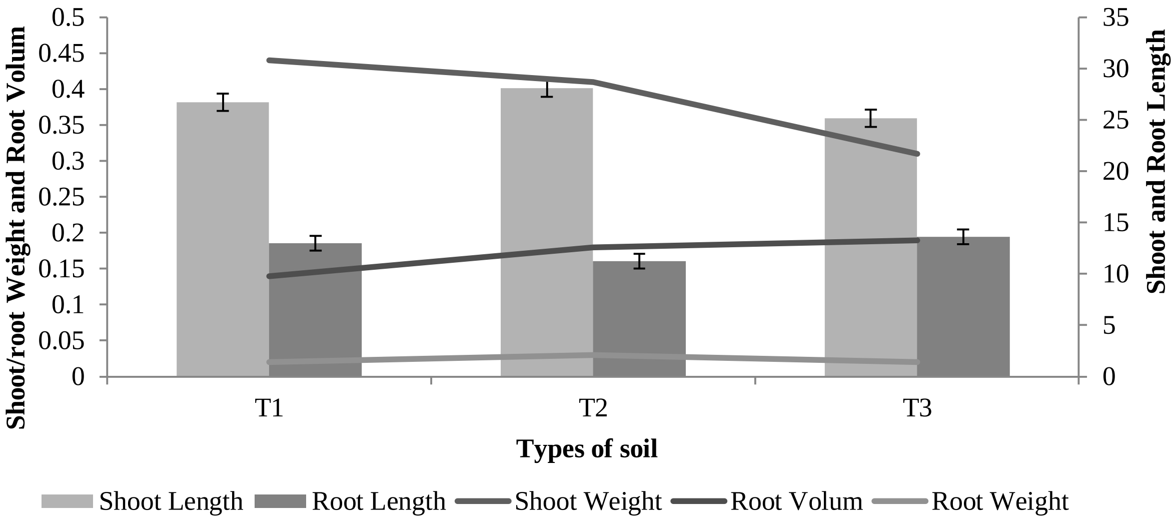

Figure 3. Effect of Types of Soil on Shoot/Root Weight and Root Volum

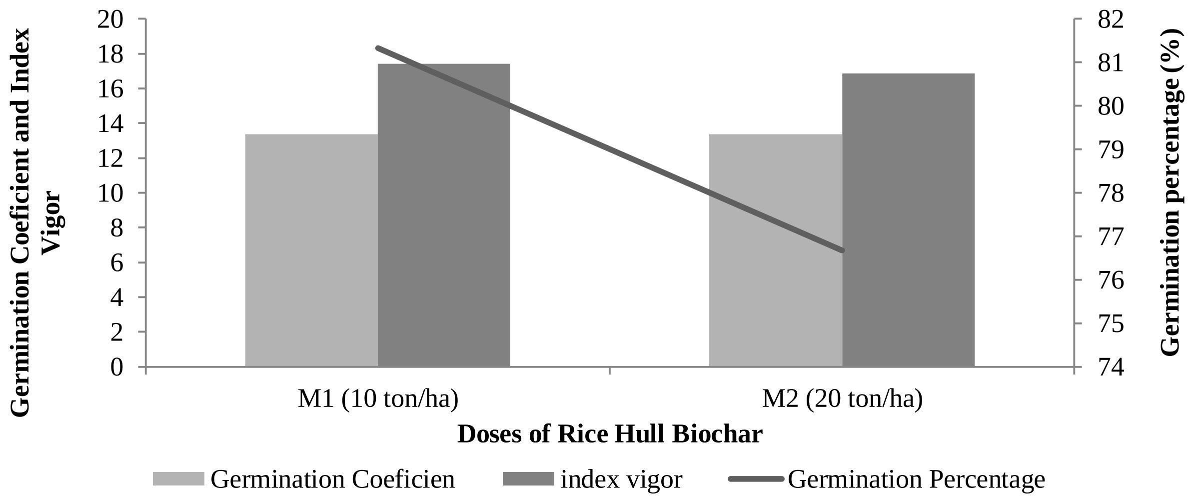

Figure 4. Effect of Doses of Rice Hull Biochar on Germination Coeficient and Index Vigor

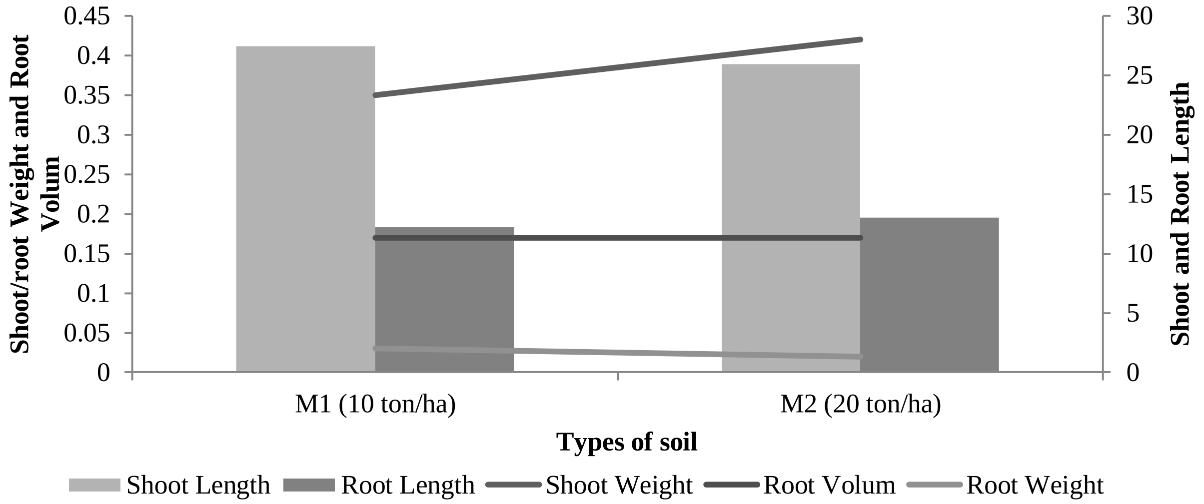

Figure 5. Effect of Types of Soil on Shoot/Root Weight and Root Volum

D. CONCLUSIONS

Rice hull biochar at 10 t/ha showed the highest vigor index of seed germination, root volume, root dry weight, shoot length, and rice hull biochar at 20 t/ha showed the highest shoot dry weight and root length. And the soil from Medan site showed the highest vigor index of seed germination, root dry weight, shoot length. The soil from Galang site showed the highest root length and root volume..

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