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# The Effect Combination of Dose Biochar with Dose Organic Matters on Soil Characteristics and Maize Plants Growth on Land Degraded by Garments Liquid Waste

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## ABSTRACT

Liquid waste, it has a potential to cause environmental pollution, especially water pollution and the surrounding farmland. Biochar as a soil conditioner derived from the combustion of agricultural waste with limited oxygen , has a good potential to improve soil characteristics degraded by garment liquid waste, due to the organic C was still remained in the black carbon (biochar).This research was conducted in the laboratory and in the field in Agustus through November 2014. Experiments in the field using a factorial randomized block design with three replications . Dose biochar (factor I) consisting of B1 = chicken manure biochar dose (10 tons $ha^{-1}$), B2 = rice husk biochar dose (10 tons $ha^{-1}$), B3 = chicken manure biochar (5 tons $ha^{-1}$) + rice husk biochar dose (5 tons $ha^{-1}$), and the dose of organic matter (factor II), which consisted of chicken manure K1 = dose (10 tons $ha^{-1}$), K2 = rice husk dose (10 tons $ha^{-1}$), K3 = chicken manure dose (5 tons $ha^{-1}$) + rice husk dose (5 tons $ha^{-1}$). The results of the field research showed that : dose combination formulation 10 tons of rice husk biochar $ha^{-1}$ at a dose of 10 tons of chicken manure $ha^{-1}$ could improve the characteristics of the soil and the growth of maize plants. A decline in the value of bulk density, and increased soil water content, total porosity of the soil, available K, available P, and organic C.

**Keywords:** Biochar , Organic Matter , Soil Characteristics

## INTRODUCTION

Management sectors of the textile industry which are not equipped with a liquid waste treatment plant have the potential to cause environmental pollution, especially water pollution and the surrounding farmland. Agricultural land contaminated garment liquid waste in Rancaekek District of Bandung Regency contain heavy metals Pb 15.04 ppm, 0.13 ppm Cd, Cr 19.30 ppm, and 58.0 ppm Cu (Kurnia et al., 2004). This condition is similar to the garment liquid waste contaminated land, that is in Denpasar. This is because the garment industry holds liquid waste in the tank and then disposed to the irrigation or river that may cause pollution. The impact of land degradation that occurs is a decrease in the quality and quantity of agricultural products, as well as the accumulation of heavy metals in water and soils derived from garment liquid waste. Heavy metals contained in the garment liquid waste is toxic to plants that grow there.

Based on Statistic Center Board of Denpasar (2013) there is a wetland area of 2,597 ha farm, the number of subak as many as 41 pieces. Subak area are contaminated by garment liquid waste, screen printing and convection are the highest in the District of South Denpasar, which include the Subak Kerdung 215 ha, 119 ha Subak Kapaon and 99 ha Subak Cuculan. Preliminary results indicate that the liquid waste that contaminate agricultural land garment in Denpasar contain heavy metals such as Cu, Pb, Cd and Cr, with Cr concentration is above the threshold value and the contamination of organic C and N total is low. If the land is planted, the plants will accumulate harmful elements and compounds, which can have negative impacts for those who consume the product.

One solution to cope with, and rehabilitate the wetland area of the garment polluted liquid waste by utilizing the potential of organic materials such as biochar. The Addition of biochar as a soil conditioner derived from the combustion of agricultural waste with limited oxygen, it has good potential as a soil amendment , because organic C still remained in the black carbon and has a long-

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term influence in metal elements (Ferizal *et al* ., 2011). This is supported by the results of research Chan *et al* ., 2007 showed that the application of biochar can increase soil organic C , soil pH , soil structure , soil CEC , and soil water storage capacity . Several other studies also demonstrate the application of biochar to soil can increase crop yields of maize( Yamato *et al.*, 2006), crop yield of soybean, Tagoe *et al.*, 2008., crop yield of common beans, Rondon *et al*., 2007. The results of upland rice (Asai *et al*., 2009) and yield of rice in acid sulfate soil ( Masulili, 2010) .

The addition of organic matter and recycling measures provide a great advantage. Typical compounds are able to participate in the formation of complex compounds and ion exchange in the presence of organic matter is a functonal group such as carboxyl (-COOH), hydroxyl (-OH), carbonyl (= C = O), methoxyl ($-OCH_3$), and amino ($-NH_2$). One of the organic material that can be used for biochar material is rice husk waste and chicken manure and its availability is pretty much localized. Rice husk biochar and biochar chicken manure has the characteristics of different physical and chemical characteristics that allow to repair soil characteristics dehraded by garment liquid waste.

## METHODOLOGY

### Time and Research Design

The answers of the research problem can be found through the research process as follows : This research was conducted in the laboratory, and in the field in Agustus-November 2014. Experiment (Laboratory) included preliminary research including : analysis of garment liquid waste, and the analysis of the soil characteristic of the contaminated with uncontaminated. Experiments in the field using a factorial randomized block design with three replications. Dose biochar ( factor I) consisting of B1 = chicken manure biochar dose (10 tons $ha^{-1}$), B2 = rice husk biochar dose (10 tons $ha^{-1}$), B3 = chicken manure biochar dose ( 5 tons $ha^{-1}$ ). + rice husk biochar dose (5 ton $ha^{-1}$), and doses of organic matter (factor II), which consists of chicken manure K1 = dose (10 ton $ha^{-1}$), K2 = rice husk dose (10 tons $ha^{-1}$), K3 = chicken manure dose (5 tons $ha^{-1}$) + rice husk dose (5 tons $ha^{-1}$). The differences due to the treatment on soil and corn plant against the observed parameters were analyzed by using ANOVA followed by Duncant test with an error rate of 5% ($P < 0.05$).

### Location and Research Materials

Field research were conducted in paddy fields irrigation water contaminated by garment liquid waste, which was located in Subak Cuculan South Denpasar. The biochar and organic matter taken from organic waste such as rice husks and chicken manure of the research area. As for the analysis carried out in the Laboratory Soil Lab Faculty of Agriculture Udayana and Udayana Analytical Lab.

### Procedure Making Biochar

The manufacturing process used a kind of covered container stove made from a simple pertamina drum with an inner diameter of 56 cm and height 42 cm. The chicken manure was wind-dried for 7 days on the floor of the warehouse until it reached 15 % moisture content. During the drying process of sorting and filtering the material a 4 cm diameter sieve was used in order to get the same size, so that in the heating process the heating was spread equally. The chicken manure which had been prepared in weight of 15 kg was then put into a drum and heated on the stove using firewood and coconut fibers (the local fuel substance). The heating was done until the charcoal was formed which took about 5 hours and the temperature was measured every hour, where the average of the temperature was $255^0$C. From the process of making biochar in this way the yield obtained was 68% biochar. The process of making the rice husk biochar, which was also in the form of charcoal, was similar to the process of making the chicken manure biochar, The difference was that there was no process of sorting the biochar, except the checking of the water level to ensure it was closer to 12%. Heating was also done until charcoal was formed which took approximately 5 hours. In this process a yield of 70% was obtained.

### Analytical Procedures of Soil Characteristics

An Initial quantitative analysis was conducted on the air-dried soil, biochar and organic matter using several parameters such as: pH with a pH meter, EC (Electrical Conductivity) with a Conductivity meter, Organic C with Walkley's and Black's method, total N with the Kjeldhall method, P & K is available with the method of Bry-1, CEC & Base Saturation with $NH_4OAc$ extraction method, soil porosity with gravimetric method and, Bulk Density with gravimetric method and ring samples.

## RESULTS AND DISCUSSION

### The Effect Combination of Dose Biochar with Dose of Organic Matter on Soil Physical Characteristics

The effect of biochar dose combination treatment with doses of organic matter provided a very real interaction on several parameters such as soil physical characteristics, soil water content , Particle Density, Bulk Density and total porosity . The effect of biochar treatment dose for each dose of organic matter gave different values for the parameters Particle Density, Bulk Density and total porosity. Likewise dose treatment, the effect of organic matter on biochar each dose gave different values for the parameters Particle Density, Bulk Density and total porosity (Table 1) .

The fall in the value of the increase in bulk density and total porosity of the soil in combination treatment caused B2K1 C content in the treatment B2K1 give a high increase in organic C as well. According to the research Glacer *et al* . , 2002; Hammmond *et al*., 2007; Rondon *et al*., 2007, and Lehman *et al* ., 2003, found that biochar containing recalcitrant aromatic compounds that were able to maintain the stability of C in the soil and air old age . Wolf., 2008; Chan *et al*., 2007., found the mechanism that causes the increase in the value of the physical characteristics of the soil was the presence of an organic acid that can form complexes organomineral resulting in soil aggregation and the presence of a functional component of the organic matter added to the soil

**Table1.** *The Effect of Dose Biochar and Dose Organic Matter Interaction on Some Physical Characteristics of Soil Parameters Incubation 35 days*

Water Content(%)

| Dose Biochar | Dose Organic Matters | | |
|---|---|---|---|
| | K1 | K2 | K3 |
| B1 | 17,137 [b] | 15,196 [d] | 14,210 [e] |
| B2 | 18,399 [a] | 15,144 [d] | 16,560 [c] |
| B3 | 15,294 [d] | 15,091 [d] | 16,541 [c] |

Particle Density (g $cm^{-3}$)

| Dose Biochar | Dose Organic Matters | | |
|---|---|---|---|
| | K1 | K2 | K3 |
| B1 | 2,592 [b] | 2,508 [b] | 2,171 [c] |
| B2 | 2,818 [a] | 2,549 [b] | 2,498 [b] |
| B3 | 2,556 [b] | 2,473 [b] | 2,570 [b] |

Bulk Density(g $cm^{-3}$)

| Dose Biochar | Dose Organic Matters | | |
|---|---|---|---|
| | K1 | K2 | K3 |
| B1 | 1,030 [bc] | 1,083 [ab] | 1,128 [a] |
| B2 | 1,013 [c] | 1,044 [bc] | 1,077 [ab] |
| B3 | 1,082 [ab] | 1,057 [bc] | 1,048 [bc] |

Total Porosity(%)

| Dose Biochar | Dose Organic Matters | | |
|---|---|---|---|
| | K1 | K2 | K3 |
| B1 | 60,277 [b] | 56,780 [d] | 48,004 [c] |
| B2 | 64,042 [a] | 59,213 [bc] | 56,877 [d] |
| B3 | 57,665 [cd] | 56,780 [d] | 59,080 [bc] |

**Description:** *Figures followed by the same letter in the same are not significantly different at 5% level of the Duncan't test.*

*B1* = *10 tons $ha^{-1}$ chicken manure biochar*

*B2* = *10 tons $ha^{-1}$ rice husk biochar*

*B3* = *5 tons $ha^{-1}$ chicken manure biochar + 5 ton $ha^{-1}$ rice husk biochar*

*K1* = *10 tons $ha^{-1}$ chicken manure*

*K2* = *10 tons $ha^{-1}$ rice bran*

*K3* = *5 tons $ha^{-1}$ chicken manure + 5 ton $ha^{-1}$ rice bran*

## The Effect of Biochar Dose Combination and a Dose of Organic Matter on Chemical and Biological Soil Characteristics

The effect of biochar dose combination treatment with a dose of organic matter showed highly significant interaction parameters chemical characteristics such as DHL, available K, and available P. Effect of biochar dose treatment gives a very real interaction of the C - organic parameters. The effect of biochar treatment dose for each dose of organic matter gave different values for the parameters of soil organic C. Likewise dose treatment affected of organic matter on biochar each dose give different values for the parameters of the C - organic soil (Table 2). The effect of dose biochar and dose of organic matter showed unsignificant on parameters pH,CEC, Base Saturation and N total (Table 3).. Results decomposition of chicken manure will be able to increase the value of available P and available K in the soil . Increased levels of organic matter would be followed by an increase in the value of cation exchange capacity or (CEC) and organic fractions. This was because the soil containing organic materials generally contain organic colloidal able to bind cations. Where, according to Glaser *et al*., 2002; Liang *et al*.,2006; Novak *et al*.,2009, series of aromatic biochar had a major role to decrease the activity of metal and sustainable increase in the value of CEC and C-organic . Soepardi (1983 ) stated that the presence of an organic compound that was high enough allowing the chelate was an organic compound that binds to metal cations such as Fe , Mn , and Al .

**Table2.** *The Effect of Dose and Dose Biochar Organic Matter Interaction on Soil Chemical and Biological Characteristics of Incubation 35 day*

Chemical Characteristics EC (mmhos $cm^{-1}$)

| Dose Biochar | Dose Organic Matters | | |
|---|---|---|---|
| | K1 | K2 | K3 |
| B1 | 13,150 [a] | 5,643 [b] | 3,996 [bc] |
| B2 | 1,196 [c] | 3,920 [bc] | 5,660 [b] |
| B3 | 12,523 [a] | 4,253 [bc] | 4,973 [b] |

K available (ppm)

| Dose Biochar | Dose Organic Matters | | |
|---|---|---|---|
| | K1 | K2 | K3 |
| B1 | 607,200 [a] | 304,043 [b] | 268,576 [b] |
| B2 | 777,246 [a] | 187,470 [b] | 324,243 [b] |
| B3 | 342,283 [b] | 232,513 [b] | 244,190 [b] |

P available (ppm)

| Dose Biochar | Dose Organic Matters | | |
|---|---|---|---|
| | K1 | K2 | K3 |
| B1 | 176,356 [b] | 246,956 [b] | 42,046 [c] |
| B2 | 406,136 [a] | 133,336 [bc] | 215,570 [b] |
| B3 | 128,593 [bc] | 200,340 [b] | 146,360 [bc] |

Biology Characteristics C-organic (%)

| Dose Biochar | Dose Organic Matters | | |
|---|---|---|---|
| | K1 | K2 | K3 |
| B1 | 4,140 [b] | 3,576 [c] | 3,873 [bc] |
| B2 | 4,586 [a] | 3,450 [c] | 3,443 [c] |
| B3 | 3,803 [bc] | 3,530 [c] | 3,820 [bc] |

**Description:** *Figures followed by the same letter in the same are not significantly different at 5% level of the Duncan't test*

**Table3.** *The Effect of Biochar Dose and Dose of Organic Matters Treatments on Some Chemical Characteristics of Soil Parameters After 35 days of incubation*

| Treatment | Chemical Characteristic | | | |
|---|---|---|---|---|
| | pH | CEC(me/100g) | Base Saturation(%) | N total(%) |
| Dose Biochar | | | | |
| B1 | 6,500[a] | 36,593 [a] | 80,671 [a] | 0,196[a] |
| B2 | 6,533[a] | 35,855 [a] | 85,316 [a] | 0,183[a] |

| | | | | |
|---|---|---|---|---|
| B3 | 6,500[a] | 35,627 [a] | 84,547 [a] | 0,168[b] |
| Dose Organic Matters | | | | |
| K1 | 6,588 [a] | 35,168 [b] | 87,326 [a] | 0,174 [a] |
| K2 | 6,466 [b] | 36,713 [a] | 83,980 [a] | 0,196 [a] |
| K3 | 6,477 [b] | 36,194 [ab] | 79,228 [a] | 0,177 [a] |

**Description:** *Figures followed by the same letter in the same are not significantly different at 5% level of the Duncan't test*

### The Effect of Dose Biochar Combination with a Dose of Organic Matters on the Growth and Yield Maize

The effect of dose biochar combination treatment with a dose of organic matter on the growth and yield parameters of maize showed no significant interaction. The influence of each factor on the dose and dose biochar organic matters provided no real influence on the growth and yield parameters, except the parameters of the total wet weight of stover per tile and oven dry weight per tile dose total stover biochar significant effect (Table 3 and 4). Several other studies also demonstrate the application of biochar to soil can increase crop yields, Crop yield of maize (Yamato *et al.*, 2006), crop yield of soybean, Tagoe *et al.*, 2008., crop yield of common beans, Rondon *et al.*, 2007. The results of upland rice (Asai *et al.*, 2009) and yield of rice in acid sulfate soil ( Masulili, 2010). According to Glaser *et al.*, 2000; Steiner., 2006, the provision of biochar into the soil would be able to form organo-mineral complexes in the ground and able to contribute to the additional nutrients in the soil .

**Table3.** *The Effect Treatments Dose Biochar and Dose Organic Matters on Some Growth Parameters of Maize*

| Treatment | Growth Parameter | | | |
|---|---|---|---|---|
| | The Maximum plant height (cm) | The Maximum Number of Leaf (strand) | Wet Weight Wet Weight of Total Tile Stover (kg) | Dry Weight of Dry Weight of Total Tile Stover (kg) |
| Dose Biochar | | | | |
| B1 | 211,000 | 12,000 | 29,356 [a] | 9,672 [a] |
| B2 | 205,444 [a] | 11,555 [a] | 24,959 [b] | 8,176 [ab] |
| B3 | 207,722 [a] | 11,500 [a] | 24,989 [b] | 7,073 [b] |
| Dose Organic matters | | | | |
| K1 | 209,500 [a] | 11,666 [a] | 26,632 [a] | 8,164 [a] |
| K2 | 204,555 [a] | 11,500 [a] | 26,277 [a] | 8,618 [a] |
| K3 | 210,111 [a] | 11,888 [a] | 26,392 [a] | 8,140 [a] |

**Description:** *Figures followed by the same letter in the same are not significantly different at 5% level of the Duncan't test*

**Table4.** *The Effect Treatments Dose Biochar and Dose Organic Matters on Some Yield Parameters of Maize*

| Treatment | Yield Parameter | |
|---|---|---|
| | Wet Weight Seeds per Tile (kg) | Wet Weight Seeds per Hectare (ton) |
| Dose Biochar | | |
| B1 | 4,290 [a] | 16,990 [a] |
| B2 | 3,502 [a] | 13,899 [a] |
| B3 | 4,142 [a] | 16,393 [a] |
| Dose Organic matters | | |
| K1 | 3,914 [a] | 15,534 [a] |
| K2 | 4,180 [a] | 16,546 [a] |
| K3 | 3,840 [a] | 15,204 [a] |

**Description:** *Figures followed by the same letter in the same are not significantly different at 5% level of the Duncan't test*

## CONCLUSION AND SUGGESTION

### Conclusion

Biochar and organic materials had the potential to improve soil Characteristics and crop growth of maize on land degraded by garment liquid waste.

Dose combination formulation 10 tons of rice husk biochar $ha^{-1}$ at a dose of 10 tons of chicken manure dose $ha^{-1}$ could improve the characteristics of the soil. A decrease in bulk density, increased soil moisture content, soil total porosity, available K, available P, and C – organic.

### Suggestions

Formulation dose combination of rice husk biochar 10 tons $ha^{-1}$ at a dose of 10 tons of chicken manure $ha^{-1}$ could be used as a soil conditioner on land contaminated by garment liquid waste.

Government is expected to provide guidance and knowledge to garment entrepreneurs to not discharge effluent into irrigation canals.

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