

The Effect of Dose Biochar and Organic Matters on Soil Characteristic and Corn Plants Growth on the Land Degraded by Garment Liquid Waste

I Putu Sujana[1] , Indayati Lanya[2], I Nengah Netera Subadiyasa[3], I Wayan Suarna[4]

1. Doctorate Program in Agricultural Sciences, Postgraduate Program of Udayana University.
2. Chairman of the Concentration Management of Land and Environmental Science Lab, Agriculture Faculty of Udayana University.
3. Chairman of Soil Biology Lab of the Faculty of Agriculture, Udayana University, Bali, Indonesia
4. Chairman of the Tropical Forage Science Lab, Faculty of Animal Husbandry, Udayana University, Bali, Indonesia.

[*]Email of the corresponding author : janaputu@yahoo.com

Abstract

The addition of biochar for soil enrichment derived from the combustion of agricultural waste with limited oxygen was potentially good for the improvement of soil characteristic, due to the fact that organic C was still intact in that black carbon (biochar) . This research was conducted in the laboratory and in the greenhouse from April through June 2013, using the Split Plot Design with 3 replicates. The main plot was a kind of organic matter that consisted of chicken manure, rice husks, chicken manure biochar and rice husk biochar. The subplot was the dose of organic matter that consisted of: 0 ton ha^{-1} , 3 tons ha^{-1} , 6 tons ha^{-1} , 9 tons ha $^{-1}$, and 12 tons ha^{-1} . Pyrolysis combustion changed in the characteristics of organic matter, due to the degradation of some organic components in the chicken dung and rice husks, which also directly caused the degradation of its functional groups. Giving rice husk biochar with the optimum dose of 55.72 g pot^{-1} or 9.28 tons ha^{-1} in the soil contaminated by garment liquid-waste improved soil characteristic by the decreasing of the bulk density, availability of heavy metal concentrations (Cu, Pb, Cd and Cr) in the soil and increasing the total soil porosity, the CEC (Cation Exchange Capacity), the availability of P, the availability of K in the soil. This accelerates the growth of corn plants that produce the maximum seed weight of 509.325 g pot^{-1} or 18.19 tons ha^{-1}.

Keywords: biochar,soil characteristics, heavy metal, seed weight

1. Introduction

The unusually rapid development of the textile industry in Bali today and its uncontrollable deposits of waste discharge brings worries for the environmental pollution. Some of them are the pollution of the water resources and agricultural land around it. Further impact is that it can damage the soil physically, chemically and biologically, and eventually degrade the quality and quantity of agricultural product. Another impact is that there is an accumulation of heavy metals in the water and soil that come from the garments' liquid waste.

Nowadays, the food crops such as maize in the lowland south of Denpasar is confronted with management problems of the land which has low potentiality and suitability and irrigation water contaminated by the garments' liquid waste. Some garment businesses and screen printing businesses at the household level in Denpasar do not manage their liquid waste, but let it pass right to the irrigation channel, so that the agricultural land being polluted by liquid waste is unavoidable. In 2010, the production of maize in Denpasar comes only from the Districts of East Denpasar and South Denpasar with the total of, respectively, 9630 tons and 3237 tons, where most of the land areas being planted have low total content of organic C and N and being polluted by garments' waste water containing heavy metals such as Cu , Pb , Cd and Cr with its concentration around the value of pollution (Denpasar City Agriculture Office , 2011) .

The addition of biochar to agricultural land will provide considerable benefits, in a way that it can fix the physical and chemical properties of the soil, retain water and prevent the soil from erosion, due also to the fact that lands have wider surface areas, enriching the organic carbon in the soil, thus indirectly increase crop production (Ismail *et al*, 2011). This is supported by the results of research by Chan *et al*., (2007), who demonstrated that the application of biochar can increase the soil organic C, the soil pH, the soil structure, the soil CEC, and the soil water storage capacity. Increased crop yields through the use of biochar also occurs in maize, cowpea and groundnut (Yamato *et al*., 2006), soybean (Tagoe *et al*., 2008) , upland rice (Asai *et al*., 2009) and rice on acid sulfate soil (Masulili, 2010) .

Besides, the addition of organic material and recycling measures provide a great advantage. The typical compounds which are able to participate in the formation of complex compounds and ion exchange in the presence of organic matter are functional groups such as carboxyl (-COOH), hydroxyl (-OH), karbonit (= C = O), methoxyl ($-OCH_3-$), and amino ($-NH_2$). One of the organic materials that can be used for biochar material is rice husk waste and chicken manure whose availability is abundant and locally available. Rice husk biochar and chicken manure biochar have different physical and chemical characteristics that enable to repair the soil degraded by garments' waste water.

2. Materials and Methods

2.1. Location & Research Materials

Soil samples were taken from the rice-field, in Subak Cuculan South Denpasar, whose daily irrigation water was contaminated by garments' waste water with the depth of 15-20 cm. The biochar and the organic material were taken from the organic waste of rice husks and chicken manure from areas where the research were conducted. The research activities were carried out in the greenhouse laboratory, Faculty of Agriculture of Udayana University (Unud). The analysis was conducted in the Soil Lab of Faculty of Agricultureof Unud, the Analytical Lab of Unud, the MIPA's Microbiology Lab of Unud, the Mathematics and Science joined Lab of Unud, and the Civil Engineering Lab of Unud.

2.2. The Design of Experiments and Procedures

The incubation process was carried out for 1 month in contaminated liquid waste garment soil, with dry air filtered with a sieve < 2mm. Then a 12 kg of land was put into a polybag with as much as 1.72 l de-ionized water added into it to reach the field capacity, and the last, the Biochar and the organic matters were put into it with the dose depending on the treatment.

The pot research was conducted in the greenhouse using a split-plot design with 3 times of repetation. The main plot is a type of organic matters consisting of four ingredients, namely,

P = Chicken Manure
Q = Rice Bran
R = Chicken Manure Biochar
S = Rice Husk Biochar

While the lesser plots are composed of organic matter dose of 5 levels, namely,

D0 = Control
D1 = 3 tons ha^{-1} (18 g pot^{-1})
D2 = 6 tons ha^{-1} (36 g pot^{-1})
D3 = 9 tons ha^{-1} (54 g pot^{-1})
D4 = 12 t ha^{-1} (72 g pot^{-1})

2.3. 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 255^0C. 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.

2.3. Analytical Procedures of Soil Characteristics, Biochar and Organic Matter

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. Analysis of the availability of heavy metals in the soil as a result of treatment during incubation using EDTA extraction of heavy metals concentrations were subsequently analyzed by means of AAS. Percentage of the air-dried water content and the field capacity are analyzed with grafimetri method, and the measurement of the content of elements Ca, Mg, Na, and Si is conducted by using a tool called LIBS (Laser Induced Breakdown Spectroscopy). The analysis of the total microorganism content of bacteria and fungi in the soil as a result of treatment was conducted by using Platting Method.

2.5. Using Qualitative Procedure in Analysing Biochar and Organic Matter

The characterization of the qualitative analysis was carried out by using FT-IR spectra (Forier Transform Infrared spectrometry) in order to get a qualitative picture of the functional groups as well as the name of the groups, by softening the material to be analyzed to become a polder, then the compound KBr was added in the ratio 1:3, and the mixture was stirred until it became homogeneous. Then the mixture was printed/pressed into a solid thin pellet, its spectra aromatic compounds were analyzed by putting it into Spectrometer Infrared. The morphological differences and the surface microstructure of the rice husk biochar and the chicken manure biochar were analyzed by using SEM (Scaning Electrone Microscope).

2.6. Statistic Analysis

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% ($P < 0.05$), and quadratic regression to see the optimum dose. All statistical analyzes were performed using the Costat.

3. Results and Discussion

3.1. Quantitative and Qualitative Characteristics of the Biochar and the Organic Matters

The results of the laboratory analysis on the characteristics of organic matters after being changed quantitatively into biochar, as shown in Table 1, showed that there were physical, chemical and biological changes in the characteristics of the organic matter.

Based on the typical uptake standard of the FT-IR spectrum by Skoog, Holler, Nieman, 1998 , the analysis of the infrared spectrum in chicken manure and chicken manure biochar ingredient showed the presence of several functional groups. The spectrum of the FT-IR analytic results on chicken manure and chicken manure biochar showed a significant difference (Figure.1 and 2) . in the case with the results of the FT-IR analysis on the rice husk biochar. It showed a significant difference (Figure 3 and 4).

Table 1 . Characteristics of some organic matter

Characteristics	Chicken Manure	Rice Bran	Chicken Manure Biochar	Rice Husk Biochar
Water content (%)	15.97	11.56	8.41	7.09
Particle Density(g cm^{-3})	−	−	0.95	0.82
EC (mmhos cm^{-1})	50.2	−	7.76	59
pH	8	−	7.2	8.11
N Total (%)	0.26	0.35	0.17	0.23
P available (ppm)	1071.78	−	743.12	583.59
K available (ppm)	1151.25	−	773.63	900.7
CEC (me g^{-1})	−	−	29.27	20.78
Base Saturation (%)	−	−	198.52	115.46
K (%)	14,26	18,37	11,95	37,22
Ca (%)	54,50	63,83	59,38	−
Mg (%)	−	−	3.08	−
Na (%)	15,83	17,78	15,14	34,03
Si (%)	4,85	−	2,78	−
C organic (%)	24.85	43.77	25.34	20.86

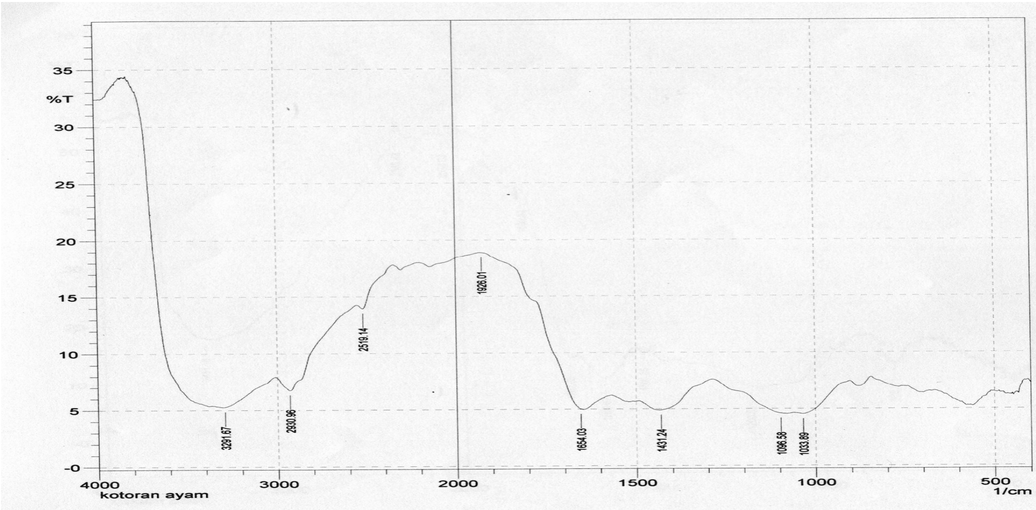

Figure 1 Spectra (FT-IR) of chicken manure organic matter

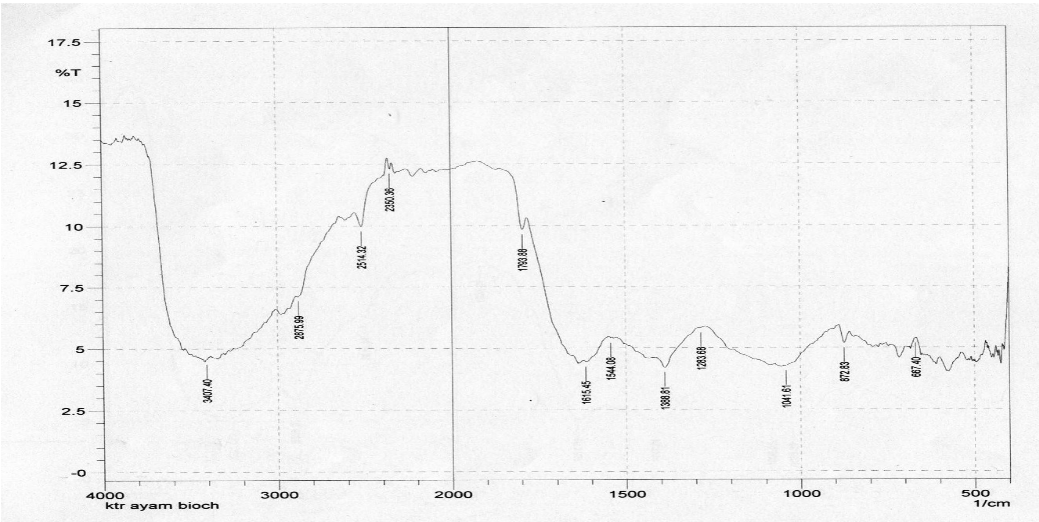

Figure 2 Spectra (FT-IR) of chicken manure biochar

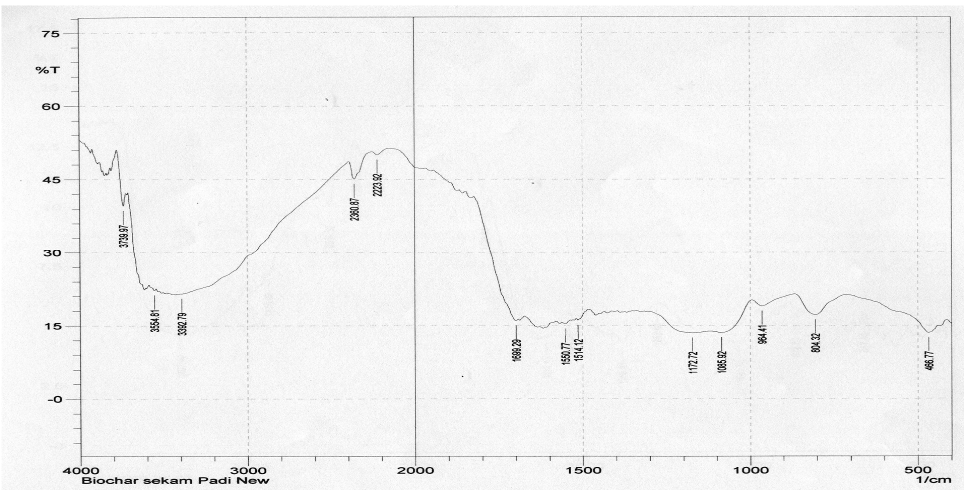

Figure 3 Spectra (FT-IR) of organic matter rice husk

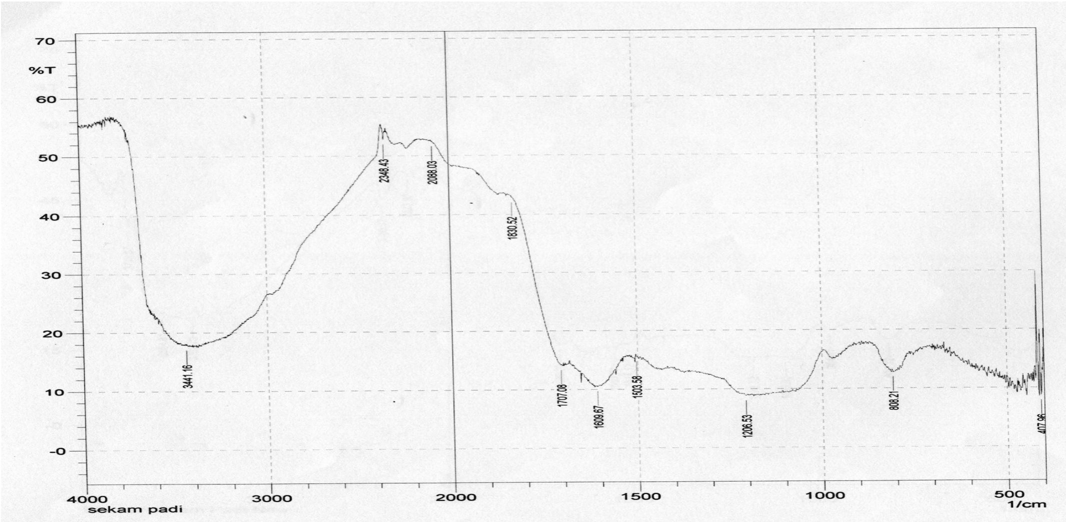

Figure 4 Spectra (FT-IR) rice husk biochar

In the pyrolysis process from the organic chicken manure into chicken manure biochar, after the FT-IR analysis a new functional group of alkenes (C−H), aromatic (C=C), and amine (C−N) was formed. Likewise, when rice husk was converted into biochar by pyrolysis combustion, a new aromatic functional group (C=C), amine (C−N) and nitro functional groups (NO_2) was formed.

Pyrolysis combustion would result in some degradation of the organic components in chicken manure and rice husks, which directly affected its functional groups to degrade. The emergence of new functional groups would lead to an increase in the higher degree of aromaticity, which would also contribute to the stability of the organic C, more than before it was processed to become biochar. Each group in the molecule generally had its own characteristics, so that the intensity of the absorption band was a measure of the concentration of a typical group owned by the substance. According to Hanudin (2004), organic material contains many compounds composed of functional groups of organic acids. The presence of aromatic functional group (C=C) was high on rice husk biochar, as shown by the results of the analysis of FT - IR absorption wave in Figure 3 with 1514.12 cm^{-1} and 1550.70 cm^{-1}, which could potentially lead to soil aggregation, increasing the content of organic C, and organo mineral complexes. Stephen (2004) said that an aromatic compound was a compound that had a ring structure and a double bond, is stable and degradation resistant. The formation of carboxylate groups (O−H) on the wave absorption 3392.79 cm^{-1} and 3554.81 cm^{-1} and the appearance of the negative charge of the carboxyl group (C−O) in the catchment area 1172.72 cm^{-1} w ould allow the rising value of CEC.

The results of the analysis of biochar characterization of chicken manure and rice husk biochars through SEM pictures with the magnification of 2000 times, it was found out that they had different morphological forms and microstructure (Fig. 5 and 6). The results of chicken manure biochar characterization through SEM images with the magnification of 2000 times, it was found that it was visibly clear from its morphological forms that it had a lot of open pores, but the pores were smaller than the rice husk biochar's in the same spacious size of 10 µm and its micro-structure was neatly organized with smooth-looking granules compared to that of the rice husk biochar. So, the pores on chicken manure biochar had smaller absorption power compared to those existing pores on rice husk biochar. This was supported also by the results of the study by Pohan (2002) who found that rice husk biochar's surface area was 2000 m^2 g^{-1}.

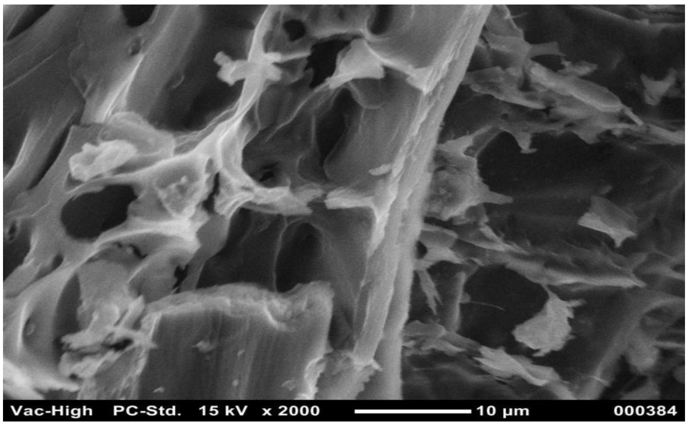

Figure 5. Rice husk Biochar SEM with a magnification of 2000x

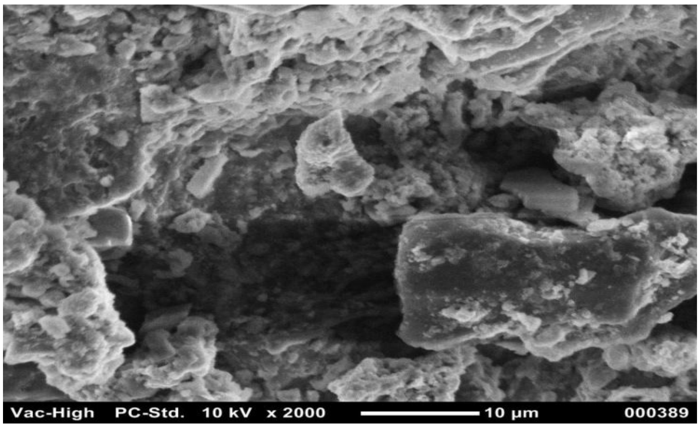

Figure 6. Chicken manure Biochar SEM with a magnification of 2000x

3.2. Physical, Chemical, and Biological Characteristics of the Soil after Treatment

3.2.1. Effect of Dose and Type of Organic Matter on the Soil's Physical Characteristics

A real significant interaction happened to the parameters bulk density particle denstiy, and total porosity. Chicken manure biochar Treatment combined with a dose of 12 tons ha^{-1} provided the highest value of total porosity, and decreasing of the bulk density compared with other treatments (Table 2).

The decrease in the value of the bulk density occured due to the formation of soil aggregates, and it was made more so by the presence of high aromatic functional group and a carboxylic group in the inception of the rice husk biochar, as shown by the results of FT-IR analysis in Figure 3. The biochar was able to improve the soil's physical characteristic, such as improved soil aggregation, water-binding capacity, pH, CEC and soil strength (Lehman *et al*., 2003; Liang *et al*., 2006; Chan *et al*., 2008) The decrease of the bulk density and the increase in porosity of the soil on the ground which was given the rice husk biochar was also associated with the wider surface area of the rice husk biochar compared with other organic materials.

Table 2. The effects of interaction between the type and dose of the organic matters on some parameters of the physical and chemical characteristics in the soil after 35-days of incubation.

Treatment	Soil's Physical characteristics			Soil's Chemical characteristics		
	Bulk Density (g cm^{-3})	Particle Density (g cm^{-3})	Total porosity (%)	Available P (ppm)	CEC (me/100g)	Available K (ppm)
PD0	1.050 a	2.152 j	51.208 k	150.53 b	25.83 b	134.00 de
PD1	0.956 b	2.558 d	62.589 h	185.34 de	27.85 de	148.56 bc
PD2	0.940 c	2.635 c	64.309 b	205.30 cd	26.67 ef	147.97 bcd
PD3	0.892 g	2.650 c	66.353 d	231.24 bc	30.26 abc	176.43 a
PD4	0.877 h	2.762 a	68.223 b	276.26 a	30.55 ab	184.70 a
QD0	1.050 a	2.152 j	51.208 k	150.53 f	25.83 b	134.00 de
QD1	0.960 b	2.390 g	59.831 i	154.32 ef	28.81 bcd	112.03 f
QD2	0.925 d	2.686 b	65.552 e	159.25 ef	29.08 bcd	139.70 cd
QD3	0.912 e	2.706 b	66.358 d	161.99 ef	29.53 bcd	136.35 cde
QD4	0.829 j	2.739 a	69.735 a	172.48 def	29.35 bcd	143.92 cd
RD0	1.050 a	2.152 j	51.208 k	150.53 f	25.83 f	134.00 de
RD1	0.924 d	2.205 i	55.659 j	173.94 def	26.89 ef	143.29 cd
RD2	0.881 h	2.405 g	63.611 g	226.81 bc	27.79 de	138.25 cde
RD3	0.851 i	2.456 b	65.349 e	245 26 b	28.54 cde	173.47 a
RD4	0.819 k	2.505 e	67.300 c	290.85 a	30.6 ab	178.73 a
SD0	1.050 a	2.152 j	51.208 k	150.53 f	25.83 f	134.00 de
SD1	0.953 b	2.337 h	59.210 i	162.46 ef	28.96 bcd	125.51 e
SD2	0.916 e	2.480 b	62.355 h	182.57 def	30.39 abc	138.64 cde
SD3	0.910 b	2.502 e	63.389 g	173.34 def	30.78 ab	142.74 cd
SD4	0.811 l	2.702 b	69.824 a	219.38 bc	31.55 a	158.70 b

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

This was in accordance with the results of the analysis of the SEM image with the magnification of 2000x, as shown in Figure 5. This was supported also by the results of the study by Pohan (2002) who found that the rice husk biochar had surface area of 2000 m^{2}g^{-1}. Thies and Rillig (2009) stated that biochar was often used as an absorbent as it had a large surface area, even several thousand times larger than the other sorbent material sources.

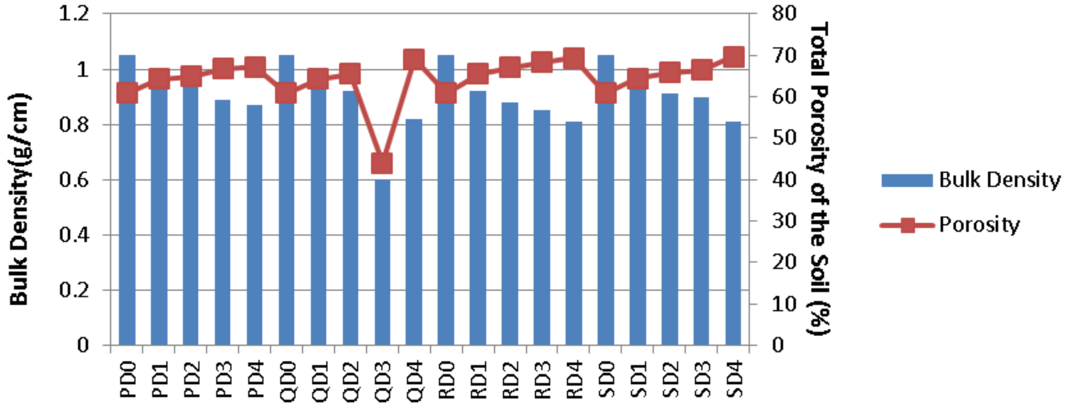

Figure 7 Relationships between Bulk Density and Porosity In Various Treatments

In addition, carbon sorbents such as biochar has been shown to have a very high affinity (Lohmann *et al*., 2005; Brandli *et al*., 2008). The pattern of relationship between the porosity of the soil's bulk density at various treatment combinations of different types of organic materials and the dose indicated that the higher the bulk density value then the lower the porosity value of the total soil (Figure 7). This could happen due to an increase in the soil organic C as a result of the treatment with a dose of organic material types. The organic materials supplied would decompose into the soil which produces organic acids that have an important role in the granulation of the compacted soil, and, thus, the land became a nest.

3.2.2. The Effect of Dose and Type of the Organic Matter on the Soil's Chemical Characteristics

A very significant interaction happened to some of the parameters being observed, except in the parameters pH, total N, and basa saturation. Chicken manure biochar Treatment combined with a dose of 12 tons ha^{-1} provided the highest value of available P, CEC, and K compared with other treatments (Table 2). A real significat interaction happened to the availability of metals Cd, Cr, and Cu, whereas the interaction of Pb is not real. Increasing doses of each of the organic matters could significantly reduce the availability of heavy metals Cd, Cr, and Cu in soil (Table 3).

Figure 8 showed the relationship between the CEC and the availability of heavy metals of Pb and Cu in various treatment combinations, where the higher the CEC value then the smaller the value of availability of the heavy metals and vice versa. Figure 9 also showed the relationship between the CEC and the availability of heavy metals of Cd and Cr in various treatment combinations, where the higher the CEC value then the smaller the value of its availability.

Table 3. Effect of dose interaction and the type of organic matter on the availability of some heavy metal concentration in soil after 35 days of incubation

Treatment	The concentration of heavy metal availability (mg kg^{-1})		
	Cd	Cr	Cu
PD0	0.198 a	0.074 a	16.600 a
PD1	0.149 ij	0.060 b	15.466 bc
PD2	0.148 ij	0.057 b	15.36 6 bcd
PD3	0.142 ij	0.048 c	14.636 cde
PD4	0.139 k	0.038 d	14.286 ef
QD0	0.198 a	0.074 a	16.600 a
QD1	0.164 fg	0.036 def	14.173 ef
QD2	0.160 gh	0.031 defg	13.89 3 ef
QD3	0.154 hi	0.024 ghij	13.640 f
QD4	0.146 ijk	0.018 ijk	13.553 f
RD0	0.198 a	0.074 a	16.600 a
RD1	0.182 cd	0.037 de	13.666 f
RD2	0.175 de	0.029 efgh	13.400 f
RD3	0.17 0 ef	0.022 hijk	12.593 g
RD4	0.164 fg	0.018 ijk	12.120 g
SD0	0.198 a	0.074 a	16.600 a
SD1	0.190 ab	0.02 7 fghi	13.493 f
SD2	0.186 bc	0.018 ijk	14.686 cde
SD3	0.176 de	0.016 jk	14.566 de
SD4	0.169 ef	0.013 k	13.493 f

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

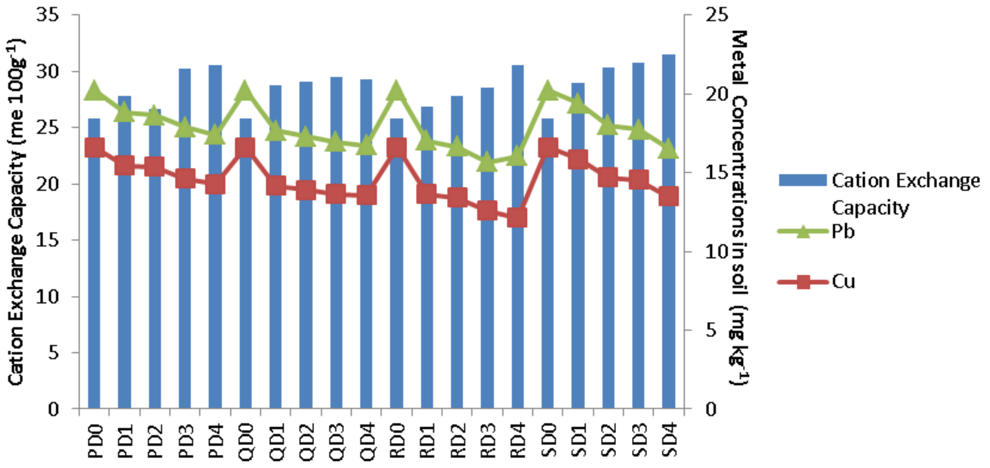

Figure 8 Relationship between CEC with the availability of Pb and Cu in Soil at Various Treatments

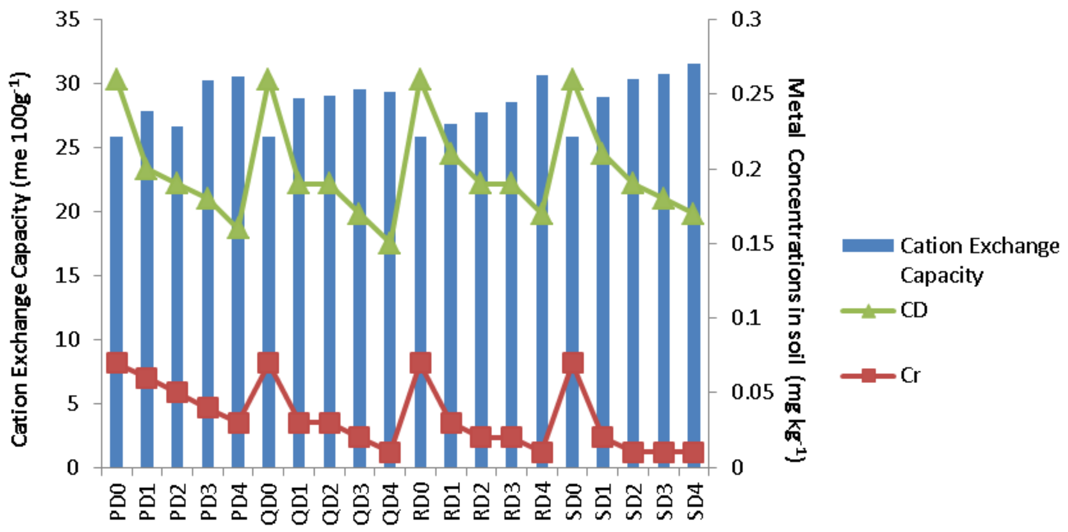

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Figure 9 Relationship between CEC with the availability of metals Cd and Cr in Soil at Various Treatments

The increased value of the available P, CEC, and K parameters and decreased availability of heavy metal concentrations of Cd, Cr and Cu in the rice husk biochar combined treatment with the dose of a 12 ton ha^{-1} , which, infact, was significantly different from the control, occurred because rice husk biochar had the ability to increase the soil pH so as to produce higher value of CEC than other treatments that in turns would eventually be able to absorb heavy metals like Cd, Cr, Cu. And, thus, its availability in the soil became smaller. More over, there was an increased value of CEC in the rice husk biochar because of the appearance of the negative charge of the carboxyl group (C−O) in the catchment area of 1172.72 cm^{-1} from the result of analysis FT-IR. The increased value of CEC in the soil with the addition of biochar was also found by Chan *et* al., (2007). Beside that rice husk biochar has high aromatic series to form organo complexes with Cd, Cr, and Cu. Complex compounds formed from the reaction between the metal ions and organic ligands, in which metal ions or cations as the recipient of electron pairs act as the central atom, while the organic ligand was an electron pair donor. According to Fessenden and Fessenden (1994), cyclic aromatic compounds had a cloud consisting of delocalized π electrons on the top and bottom of the flat area of the molecule. In line with the above results Yamato *et al*., (2006), found that the application of bark of mangium Acacia biochar in the soil brings in an increase in the values of pH, total N, availability of P and CEC. Meanwhile, Lehman and Joseph, (2009) found that the repeated application of biochar in the soil would be able to reduce the accumulation of heavy metals in it.

3.2.3 The Effect of Biochar Dose and Organic Matter Dose on the Characteristics of the Soil's Biology

An unreal interaction happened in the organic C parameters. And, also, the type of organic matter and the dose of the organic matter showed an unreal effect. The higher doses in each organic matter, the greater the total amount of bacteria and fungi in the soil, and vice versa. The highest total amount of fungi was obtained in combinated treatment with doses of 12 tons ha^{-1} at 25 x 10^3 CFU g^{-1} and the lowest was at control treatment of 64 x 10^2 CFU g^{-1}. Meanwhile, the highest total in the soil bacteria was obtained in the rice husk biochar's combined treatment with a dose of 12 tons ha^{-1} at 40 x 10^6 CFU g^{-1} and the lowest in the control treatment was at 57 x 10^5 CFU g^{-1} (Table 4) .

The high value of organic C in rice husk biochar was related to the recalcitrant nature of C in the rice husk biochar as a result of the increase of the aromatic level that rice husk biochar has. This was supported by the results of the FT- IR analysis of the rice husk biochar, aromatic functional group (C=C) appears in the catchment area 1514.12 cm^{-1} and 1550.77 cm^{-1} . The high value of organic C in the rice husk biochar followed by the high value of the bacterial total, that was equal to 40x10^6 CFU g^{-1} in combined treatment with the rice husk biochar with the dose of 12 tons ha^{-1} .

Table 4. The number of total bacteria and fungi due to the influence of dose and type of organic matter in 35 days of incubation

No	Treatment	Total fungi CFU g^{-1}	Total bacterial CFU g^{-1}
1	PD0	64 x 10^2	57 x 10^5
2	PD1	79 x 10^2	204 x 10^5
3	PD2	11 x 10^3	240 x 10^5
4	PD3	13,5 x 10^3	264 x 10^5
5	PD4	14,5 x 10^3	268 x 10^5
6	QD0	64 x 10^2	57 x 10^5
7	QD1	12 x 10^3	55,4 x 10^5
8	QD2	18,5 x 10^3	60,8 x 10^5
9	QD3	19,6 x 10^3	70,4 x 10^5
10	QD4	25,8 x 10^3	160 x 10^5
11	RD0	64 x 10^2	57 x 10^5
12	RD1	88 x 10^2	75,4 x 10^5
13	RD2	11,2 x 10^3	20 x 10^6
14	RD3	12,9 x 10^3	34,8 x 10^6
15	RD4	13 x 10^3	36 x 10^6
16	SD0	64 x 10^2	57 x 10^5
17	SD1	99 x 10^2	74,2 x 10^5
18	SD2	12,5 x 10^3	119,9 x 10^5
19	SD3	21 x 10^3	212 x 10^5
20	SD4	21.5 x 10^3	40 x 10^6

This is due because decreasing of availability of heavy metals and increasing organic C in biochar rice husk which is a good nutrition for bacterial and fungi activity. The results of the study "Teitzel & Parsek 2003" find cell density in cultures of *Pseudomonas aeruginosa* were added 0.125 ppm Pb decreased compared with cultures receiving 0.03 ppm Cd. Novak *et al* (2009) found that the biochar application in acid soils in the southern U.S. increased the soil's pH , organic C , Mn , and Ca, and it also could reduce the content of the S and Zn

3.3 The Effect of dose and type of Organic Matter on the Growth and Yield of Corn

The interaction was highly significant on the wet weight of the crop stover, dry weight of the crop stover ovens, the maximum plant height, and weight of the seeds per pot, while the number of leaves on the parameters of the interaction was not real. The dose of 9 tons ha^{-1} can significantly increase the value of the weight seed per pot, the wet weight of the crop stover, the dry weight of the crop stover oven, and maximum plant heght. (Table 5).

The increased value of the parameter on the wet weight of the total plant per plant, the dry weight of the total plant oven, and the maximum height of the plant in the chicken manure biochar combined treatment with a dose of 9 tons ha^{-1} and the lowest in the control (without a dose of organic material), could be explained that many factors support an increase in the value of the corn crop growth parameters in which these factors could be grown individually or simultaneously.

Table 5. The Effect of interaction of the dose with the type of organic matter on some parameters of the growth and yield of the corn.

Treatment	Growth Parameter and Results			
	Heavy seeds pot^{-1} (g)	Wet weight of stover plant^{-1} (g)	Oven dry weight of stover plant^{-1} (g)	The maximum plant height (cm)
PD0	300,800 ^{h}	286.200 ^{j}	100.360 ^{fg}	215.166 ^{h}
PD1	391,800 ^{efg}	324.966 ^{cdefg}	113.738 ^{bcde}	227.500 ^{g}
PD2	411,500 ^{def}	318.450 ^{efghi}	106.220 ^{efg}	231.33 3 ^{efg}
PD3	457,200 ^{cd}	339.466 ^{cdef}	120.946 ^{bc}	236.333 ^{cde}
PD4	415,700 ^{def}	314.66 6 ^{efghij}	110.191 ^{cdef}	241.0 00 ^{bcd}
QD0	300,800 ^{h}	287.533 ^{ij}	94,630 ^{g}	219 833 ^{h}
QD1	376,800 ^{fg}	288.083 ^{ij}	100.828 ^{fg}	233.33 3 ^{efg}
QD2	353,666 ^{g}	306.633 ^{ghij}	107.380 ^{def}	235.000 ^{ef}
QD3	455,200 ^{cd}	344.216 ^{cde}	120.480 ^{bc}	235.833 ^{de}
QD4	401,200 ^{def}	310.500 ^{fghij}	108.674 ^{def}	244.500 ^{b}
RD0	300,800 ^{h}	294.866 ^{ghij}	103.897 ^{efg}	219.166 ^{h}
RD1	410,700 ^{def}	320.333 ^{efgh}	112.783 ^{bcde}	241.733 ^{bc}
RD2	444,300 ^{cde}	384.166 ^{b}	134.458 ^{a}	250.050 ^{a}
RD3	515,033 ^{ab}	411.800 ^{a}	143.546 ^{a}	252.18 3 ^{a}
RD4	482,400 ^{bc}	352.683 ^{cd}	123.439 ^{b}	253.183 ^{a}
SD0	300,800 ^{h}	292.20 0 ^{hij}	102.269 ^{efg}	215.166 ^{h}
SD1	411,500 ^{def}	296.850 ^{ghij}	103.897 ^{efg}	229.833 ^{fg}
SD2	447,000 ^{cde}	322.466 ^{defgh}	112.863 ^{bcde}	232.500 ^{efg}
SD3	555,800 ^{a}	353.716 ^{c}	123.800 ^{b}	236.166 ^{cde}
SD4	474,300 ^{bc}	338.51 6 ^{cdef}	118.480 ^{bcd}	250.333 ^{a}

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

The increase in the value of the parameter of the soil's chemical characteristics like the availability of the P, CEC, K values and the porosity of the total soil as well as the declining value of the availability of heavy metals in the soil such as Pb, Cu, Cd, and Cr would allow for the increase of the soil's biological activity and the increasing decomposition of organic material as well. This was evidenced from the results of the study that the total number of bacteria and fungi increased as the increasing total number of doses of organic material was given. Furthermore, those cations the results of the decomposition release such as NH_4^+ could be absorbed by the biochar, thus inhibited nitrification and decreased the loss of NO_3^-. On the other hand a decrease in the solubility of heavy metals in the soil would be able to release the adsorbed P with the increasing pH value of the soil, so that the availability of P is high. The absorption of the heavy metals of Pb and Cd by the plant was affected by low soil pH and low soil CEC (Brown *et al*., 2004; Sukreeyapongse, 2002). While the results of the study by Liang *et al*., 2006 found an increase in the CEC value of biochar can occur via two mechanisms, namely due to the higher surface area of the biochar for the cation absorption and the presence of a higher charge density on biochar was causing increasing degree of oxidation. Likewise, Glaser *et al*., 2002 found that oxidation of aromatic C and the formation of carboxyl groups on biochar was a major yield of maize in the land contaminated by garment wastewater could be improved by giving the optimum dose factor that led to a high CEC value. The above phenomena indicate that the growth and of biochar, to get maximum results. Regression analysis showed the optimum dose of chicken manure 51.264 g pot^{-1} or 8.544 tons ha^{-1} with a maximum grain yield 441.502 g pot^{-1} or 15.767 tons ha^{-1} . The optimum dose of rice husk 61.65 g pot^{-1} or 10.275 tons ha^{-1} with a maximum grain yield 416.38 g pot^{-1} or 14.87 tons ha $^{-1}$. The optimum dose of chicken manure biochar 59.63 g pot^{-1} or 9.93 tons ha^{-1} with a maximum grain yield 502.589 g pot^{-1} or 17.949 tons ha^{-1}. The optimum dose of rice husk biochar 55.72 g pot^{-1} or 9.28 tons ha^{-1} with a maximum grain yield 509.325 g pot^{-1} or 18.19 tons ha^{-1} .

4. Conclusion

Giving rice husk biochar with a dose of 55,72 g pot^{-1} or 9.28 tons ha^{-1} to the soil contaminated by garment wastewater could improve soil properties such as the decreasing of the bulk density, increasing the total soil porosity, increasing CEC, increasing the availability of P, increasing the availability of K, increasing the total fungi and total bacterial and the declining availability of heavy metals (Cu, Pb, Cd, and Cr) in the soil.

The improvement of the soil properties through the provision of rice husk biochar to the soil contaminated by garment wastewater resulted in increasing oven dry weight of stover plant^{-1} and yield of maize. The rice husk biochar gave maximum seed weight of 509.325 g pot^{-1} or 18,19 tons ha^{-1} with an optimum dose of 55,72 g pot^{-1} or 9,28 tons ha^{-1}.

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