Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.5, No.23, 2015

Technology Enhancement Productivity Degraded Dryland through Quality Improvement Compost and Biochar with Indicators Productivity of Crop Soybean

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Abstract
The aim of research to know whether there is interaction of types compost rice straw or cow dung and dosage biochar of rice straw and cow dung to changes in chemical properties and physical soil, plant height and yield of soybeans in dryland degraded.The research was done on dryland Alfisols Bangkalan Madura, which a area 76% of the dry land area in Bangkalan (126 506 hectares) and 73% of large standard dry land in Madura, from 2011 until 2012.Research methods. The research design used a split plot design arranged in a randomized complete block design (RCBD). Factor I (main plot) types of compost 3 levels (O_0: no composting , O_1:compost of rice straw 10 tonnes / hectare, O_2: compost of cow dung 10 tonnes / hectare) and factor II (sub plot) 5 biochar dose levels (B_0: without biochar, B_1:biochar of rice straw 2 tonnes / hectare, B_2: biochar of rice straw 4 tons / hectare, B_3: biochar of cow dung 2 tonnes / hectare, and B_4: biochar of cow dung 4 tonnes / hectare. Soybean plants are used as an indicator in the study. Observations were made two weeks after planting (2 WAP) and two weeks after harvest (2 WAH).The results of the research: Two weeks after planting (2 WAP), the highest C organic soil on combination O_2B_4 (composted cow dung 10 tonnes/hectare and cow dung biochar 4 tonnes/hectare) is 3.354% (high), an increase of 246%. While at 2 WAH C organic soil 2.864% (high enough) an increase 195%. With the increase in soil carbon deposits 195% in two weeks after this harvest, dry land was originally relegated primarily soil organic C were very low (< 1%), soybeans can be planted at least 5 times a season. Besides increasing the productivity of land, a combination of compost 10 toness/hectare (both rice straw compost and cow manure compost) and dose biochar 4 tonnes/hectare (both biochar and biochar rice straw manure) can increase the productivity of soybean plants (2.259 to 2.298) ton/acres, and the results showed an increase in production compared to the average production of local farmers Madura (1.25 tonnes / ha), east Java province (1,342 tons / hectare) and the national average production (1,357 tons / ha) in 2010, resulting in an average increase in production of 74% of the average local production of Madura, east Java and national.
Keywords: degraded dry land, rice straw compost, cow dung compost, biochar of rice straw, biochar of cow dung and soil productivity.

Background

The concept of soil fertility to achieve the ideal situation for the growth and development of plants include water and air occupies the proportion of 50% of the total volume of soil, minerals and organic material occupies about 45% and 5%. **(1)**; **(2).** Although the proportion of organic matter is only 5%, it is the key for the continuity of the dynamics of life in the soil, or it can be said organic material is key to the dynamics of soil fertility. Organic materials is key for the dynamic properties land can be managed to the ideal conditions for plants **(3).**

Soil as a natural resource that is limited, difficult and slow recovery if the "misstep" in management. In wet tropical regions such as Indonesia, especially on dry land, the land susceptible to weathering is intensive enough that result degraded land. Most of the dryland having soil fertility and low organic matter content. The use of chemical fertilizers continuous most of the agricultural land in Indonesia would be nutrient poor. It can be said that the inputs of chemical fertilizer into the soil has reached the threshold of concern, and it is physically more difficult it is restored so that the land will be degraded. To restore soil fertility in degraded drylands especially chemical and physical properties of soil is the addition of organic matter into the soil. Improvement of soil physical, role of organic matter is the glue between the soil particles into aggregates so that the soil organic matter is important in the formation and improvement of soil structure becomes more stable. In chemistry properties , especially organic matter plays a role in the increased cation exchange capacity, pH of soil, and water holding capacity of the soil . However, a major problem in the management of organic matter is high dose to be given, especially in tropical regions such as Indonesia, where the decomposition of organic material very quickly lead to a low carbon stored in the soil, so that the application of organic manures should be given repeatedly **(4).**

Crops require C organic soil were sufficient (≥ 2%) to produce optimally. In Indonesia approximately ± 73% of agricultural land has a C-organic content of the soil <2%. The addition of organic matter into the soil in order to efficiently (not given repeatedly every season), especially in degraded drylands need to be combined with soil conditioner or biochar (charcoal biological). Combining organic materials with biochar is an interesting subject for research. As we know that biochar contains C (carbon) high, resistant to decomposition and demineralization, not as a source of energy for microbes and biochar can store (deposit) of carbon in the soil in a long time, in contrast organic matter easily decomposed as well as the addition source of energy for soil microbial activity, so that the organic material in the soil is depleted.

Composted through composting technology and combined with charcoal biochar to be biochar compost bioactive with biochar composition ranging from 10% - 35% of soil organic C content **(5)** or 10% - 30% of the weight of compost **(6).** In the soil, compost and biochar after mixed into compost which will have bioactive properties as compost resulting from the composting technology with the help of microbes lignoselulotik who remain in the compost, has the ability as a biocontrol agent (biofungisida) to protect plants from root diseases , so-called bioactive. The combination of compost with biochar in the soil, acting as an agent of soil fertility builders, because biochar can increase soil pH while improving water and air circulation in the soil.

Therefore a combination of compost and biochar is very interesting to do research, especially in dry land degraded, critical or marginal lands due to declining soil organic matter content that can not be replaced by the role of chemical fertilizers.

The aim of research

The general objective of the research is to gain a technological improvement in land productivity through improved quality of compost and biochar from rice straw and cattle dung to soybean plants at degraded dryland. .

The aim specific of research to know whether there is interaction of types compost rice straw or cow dung and dosage biochar of rice straw and cow dung to changes in chemical properties (organic C, total N, P_2O_5 and K_2O) soil and physical properties (bulk density and total porosity) soil and yield of soybeans in dryland degraded.

Materials and Method

Material consists of: dryland of Alfisols, chemical materials for soil analysis, anjasmoro soybean varieties, rhizobium, insecticide Decis 2.5 FC, inorganic fertilizer urea, SP36 and KCl. Raw materials used in this study were rice straw and cow dung (which is relatively abundant and is not used optimally) through composting technology (decomposers EM-4)**(7);(8)**, so that the compost produced more qualified (compost quality standards). Likewise raw materials biochar to increase carbon stored (carbon deposits) use rice straw and cow dung through pyrolysis method, namely the burning of rice straw and cow dung with limited air using a semi-continuous combustion with limited air)**(9)**.

The research design

The research design arranged in a split plot design (factorial) were arranged in a randomized block design (RBD), repeated 3x. Experimental with plot size 4.0 m x 1.5 m. Types of compost as the main plots, while the dose of biochar as subplot. Factor I (main plot): compost type 3 levels: O_0 (without composting), $O_{1:}$ compost of rice straw 10.0 tons / ha or 6 kg / plot, O_2: compost of cow dung 10 tons / ha or 6 kg / plot . Factor II (subplots): Dose biochar (B) 5 levels: B_0 (without giving biochar), B_1 (dose of biochar of rice straw 2 tons / ha or 1.2 kg / plot or 12 grams / plant clumps, B_2 (dose of biochar of rice straw 4 tons /hektares or 2.4 kg / plot or 24 grams / plant clumps, B_3 (dose of biochar of cow dung 2 tons / ha or 1.2 kg / plot or 12 grams / plant clumps), B_4 (dose of biochar of cow dung 2 tons / ha or 2.4 kg / plot or 24 grams / plant clump). Amount of combined treatment of 3 x 5 = 15 combinations, and amount of experimental is the 3 x 15 = 45 experimental units.

Observation parameters include: 1) changes in chemical properties (organic C, total N, P_2O_5 and K_2O) soil, 2) physical properties (bulk density, total porosity) soil, 3) and soybean production per hectare. Analysis of research data using analysis of variance (ANOVA) was split plot design arranged in a randomized complete block design (RCBD) factorial. If the results of analysis of variance there are sources of variation that have calculated F is greater than F table value (5% or 1%), then there is a real effect or is very real. Furthermore, to determine the effect of each treatment followed by Tuckey test(5%). Observations change of the chemical-physical properties of the soil was made during the two weeks after planting (2 WAP) and two weeks after harvest (2 WAH).

Results and discussion

The results of soil analysis by composite in the research location obtained: pH 6,35; C organic soil 0,967% (very low); Total N 0,11% (low); P_2O_5 8,08 me/100g (very low), K_2O 24,6 mg/100g (medium); CEC 22,6 me/100g (medium); texture silty clay loam; bulk density 1,33 g/cc and particle density 2,70. If the organic C minimum required annually 2%, then the organic C dibutukan minimum at a depth of 5-15 cm is equal to 2% x soil bulk density soil x depth x area of land / ha = 2% x 1.33 tonnes / ha x 0.10 x 10.000 m2 / ha = 20 tonnes / hectare/year atau10 tonnes/season. Whereas analysis of the characteristics compost and biochar Table 1 and Table 2.

Table 1. Analysis of the characteristics compost of rice straw and cow dung Decomposers (EM-4 }

Parameters	compost of rice straw	compost of cow dung
Variety/Typical	Rice Straw IR-64, Indonesia	Madura Cattle, Indonesia
pH (H_2O)	8,12	6,80
water content (%)	16,42	20,20
C-organic (%)	25,61	26,48
Total N, Kjehdahl (%)	1,64	1,70
C/N	15,62	15,58
Total P_2O_5, Olsen (%)	0,90	1,59
Total K_2O, HCl,25% (%)	1,47	0,76
Bulk density (g/cm^3)	0,54	0,48
Colour	Rather dark brown color and no smell	Black color, no smell

Results of laboratory analysis as shown in Table 1, it can be seen that the quality of good compost or compost lompos rice straw manure has met the standard of quality organic fertilizer crumb / bulk enriched microbial, namely pH (4-9), organic C content ≥ 15%, C / N ratio (N is the total N) between 15-25, a total of macro nutrients (N + P_2O_5 + K_2O) 4% and the minimum water content (15-25)% **(10).**

Table 2. Analysis of the characteristics of biochar of rice straw and cow dung

Parameter	biochar of rice straw	biochar of cow dung
Variety/Typical	Rice Straw IR-64, Indonesia	Madura Cattle, Indonesia
pH (H_2O)	10,25	9,5
Water content (%)	5,4	7,8
C fixed, (%)	46,5	43,3
Total N, (%)	0,93	0,82
C/N	51,67	52,80
P_2O_5, Olsen (%)	0,28	0,35
K_2O, HCl 25% (%)	0,34	0,58
Volatile matter (%)	36,3	34,3
Ash content (%)	11,8	14,6
Bulk density (g/cm^3)	0,28	0,388
Pirolisis period (hour)	7-8	9-10
Colour	Black odorless	Black odorless

Excess of compost of rice straw compared to compost of cow dung seen from the total K_2O content from compost of rice straw higher is 1.47% compared to composted cow dung.(0.76%). However, the total P_2O_5 content in the compost of cow dung is 1.59% higher than the rice straw compost. (0.90%). Bulk density compost of rice straw 0.54 g/cm^3 steeper than cow dung compost 0.48 g/cm^3 means cow dung compost weight is lighter than compost of rice straw.

The use of biochar for agriculture both derived from crop residues or manure to repair the physical, chemical and biological soil depends carbon fixed (fixed carbon) produced. According to **(11);** Antal and Gronly (2003) *in* **(12)**, the minimum technical requirements of biochar characteristics are as follows: Carbon fixed (fixed carbon): 50-90%; Levels of exhaust gas (volatile matter): 0-40%; Moisture: 1-15% and ash content: 0.5-5%. Chan and Xu (2009) *in* **(12)** stating that the characteristics of biochar is varied depending on the base ingredients. Biochar with woody base material will produce carbon remains greater than biochar from the rest of the crop or livestock manure. Characteristics of biochar produced is as follows: pH: 6.2 to 9.6; fixed carbon from 17.2 to 90.5%; C / N: 7-500; P: 0.22 to 7.3% and K: 0.1 to 5.8%. Based on these characteristics, morphology biochar has absorption (adsorption) high, has an effective pore to bind and store the soil nutrient. Biochar application on degraded lands, can improve air circulation and water in the soil, increase the pH of the soil and absorb excess CO*2*. Composition ideal biochar in soil, depending on the type of organic material. In function of soil conditioner, biochar can serve to hold water and nutrients, then make it as a source of plant needs in a sustainable manner.

1. Change of soil chemical properties two weeks after planting (2 WAP) and two weeks after harvest (2 WAH)

Based on the results of analysis of variance in Appendix 1 and 2, the effect of types of compost and doses biochar at 2 WAP and 2 WAH, there is a significant interaction to changes in C organic soil, P_2O5 and K_2O soil and there was no significant interaction on total N at 2 WAP and 2 WAH. Average results of the analysis of the influence of compost type combination and dose biochar to changes in soil chemical properties that include: organic C, K_2O and P_2O_5 at two weeks after planting (2 WAP) and two weeks after harvest (2 WAH) can be seen in Table 3 and 4.

Effect interaction types of compost and biochar dosage at 2 WAP to changes C organic soil the highest (Table 3) is combination of O_2B_4 (composted of cow dung 10 tonnes / ha and biochar of cow dung 4 tonnes / hectare) is 3.354% (high) and significantly different with combination of other treatments, while the lowest of C organic soil on combination O_0B_0 (without provision of compost and biochar) is 0.97% (very low). Effect interaction of types of compost and biochar dose at 2 WAH (Table 4), changes C organic of soil the highest is combination of O_2B_4 (composting of cow dung 10 tonnes / ha and biochar of cow dung 4 tonnes/hectare) is 2.864% (high enough) and significantly different with a combination of other treatments, while the lowest in the combination of O_0B_0 (without provision of compost and biochar) is 0.781% (very low).

Table 3. Comparison of average of C Organic, P_2O_5 and K_2O soil the effect of interactions the type of compost and dose of biochar at two weeks after planting (2 WAP)

Source		**C Organic Soil (%)**	**P_2O_5 Soil (me/100 g)**	**K_2O Soil (me/100 g)**
O_0	B_0	0,970 a	10,11 a	28,74 a
	B_1	1,351 b	14,56 b	29,43 a b
	B_2	1,732 c	14,76 b	30,02 a b
	B_3	1,341 b	15,32 b	29,24 a
	B_4	1,712 c	16,52 c	29,84 a b
O_1	B_0	2,181 d	18,35 d	33,54 c d
	B_1	2,572 e	18,83 d	**34,69 d e f**
	B_2	2,954 f	19,27 d	**36,59 f**
	B_3	2,604 e	20,77 e	**35,06 d e f**
	B_4	3,063 f	26,03 f	**36,03 e f**
O_2	B_0	2,282 d	30,78 g	31,46 b c
	B_1	2,671 e	31,12 g	33,87 d e
	B_2	3,113 f	31,43 g h	**34,41 d e f**
	B_3	2,735 e	32,51 h	33,49 c d
	B_4	**3,354 g**	**33,92 i**	34,02 d e

Remarks: The same letters on each treatment showed no significant differences based on HSD (5%)
O_0: without provision compost ; O_1: provision compost of rice straw 10 tonnes / hectare
O_2: provision compost of cow dung 10 tonnes / hectare
B_0: without provision biochar ; B_1: provision biochar of rice straw 2 tonnes / hectare ; B_2: provision biochar of rice straw 4 tonnes / hectare ; B_3: provision biochar of cow dung 2 tonnes / hectare
B_4: provision biochar of cow dung 4 tonnes / hectare

Effect interaction of types of compost and biochar dose at 2 WAP to changes P_2O_5 of soil (Table 3) it can be seen that the highest of P_2O_5 on combination O_2B_4 (compost of cow dung 10 tonnes/hectare and biochar 4 tonnes/ha) is 33,920 me/100g (medium) and significantly different from other treatment combinations, while P_2O_5 the lowest on combination O_0B_0 (without provision of compost and biochar) is 10,113 me / 100g (low).

Effect interaction of types compost and biochar dose to changes in soil P_2O_5 at 2 WAH (Table 4) it can be seen that P_2O_5 of soil the highest is combination of O_2B_4 (compost of cow dung 10 tonnes/hectare and biochar of cow dung 4 tonnes/hectare) is 20,480 me/ 100g (low) and significantly different from other treatment combinations, while P_2O_5 the lowest on combination O_0B_0 (without provision of compost and biochar) is 7.983 me/100g (very low).

Effect interaction of types compost and biochar dose at 2 WAP to changes in soil K_2O (Table 3), it can be seen that the highest of K_2O on combination O_1B_2 (compost of rice straw 10 tonnes/hectare and biochar of rice straw 4 tonnes/hectare) is 36.59 me/100 g of soil (medium) and not significantly different with O_1B_4 (36.03 me / 100g) (medium), O_1B_3 (35.06 me/100g) (medium), O_1B_1 (34.69 me/100g) (medium) and O_2B_2 (34.41 me/100g) (medium), while the lowest in the combination of O_0B_0 (without giving compost and biochar) is 28.74 me/100g (medium).

Table 4. Comparison of average of C Organic, P_2O_5 and K_2O soil the effect of interactions the type of compost and dose of biochar at two weeks after harvest (2 WAH)

Source		C Organic Soil (%)	P_2O_5 Soil (me/100 g)	K_2O Soil (me/100 g)
O_0	B_0	0,781 a	7,983 a	23,70 a
	B_1	1,122 b	8,167 a	23,96 a
	B_2	1,463 e	8,357 a	24,23 a b
	B_3	1,132 b	9,040 b	24,30 a b
	B_4	1,483 e	10,103 c	24,36 a b
O_1	B_0	1,251 c	11,920 d	27,36 c d
	B_1	2,122 f	12,110 d	**28,55 c d e**
	B_2	2,445 i	12,323 d	**29,84 e**
	B_3	2,151 f	13,043 e	**28,98 d e**
	B_4	2,594 j	14,253 f	**30,03 e**
O_2	B_0	1,333 d	17,157 g	26,42 b c
	B_1	2,281 g	17,353 g	26,51 b c
	B_2	2,674 k	17,570 g	**28,18 c d e**
	B_3	2,363 h	18,283 h	26,91 c d
	B_4	**2,864 l**	**20,480 i**	**27,88 c d e**

Remarks: The same letters on each treatment showed no significant differences based on HSD (5%)
O_0: without provision compost ; O_1: provision compost of rice straw 10 tonnes / hectare
O_2: provision compost of cow dung 10 tonnes / hectare
B_0: without provision biochar ; B_1: provision biochar of rice straw 2 tonnes / hectare ; B_2: provision biochar of rice straw 4 tonnes / hectare ; B_3: provision biochar of cow dung 2 tonnes / hectare
B_4: provision biochar of cow dung 4 tonnes / hectare

Effect interaction of types compost and biochar dose at 2 WAH to changes in soil K_2O (Table 4), it can be seen that the highest of K_2O in combination O_1B_4 land (rice straw compost 10 tons / ha and biochar of cow dung 4 tonnes/hectare) is 30.03 me / 100 g (medium) and not significantly different from O_1B_2 (29.84 me/100 g) (medium), O_1B_3 (28.98 me / 100g) (medium), O_1B_1 (28.55 me/100g) (medium), O_2B_2 (28.18 me/100g) (medium), O_2B_4 (27.88 me/100 g), while the lowest combination on O_0B_0 (without giving compost and biochar) is 23.70 me/100g (medium).

At upfront has been described that the effect the type of compost and dose of biochar to changes in total N soil at 2 WAP and 2 WAH there is no significant interaction but significantly different each factor based on 5% HSD test. The influence of each factor as shown in Table 5. In Table 5 it can be seen that the influence of the type of compost to the total N soil at two weeks after planting (2 WAP) the highest is O_2 (compost of cow dung 10 tonnes/hectare) is 0.271% (medium) and not significantly different from O_1 (compost of rice straw 10 tonnes/hectare) is 0.267% (medium), while the lowest is the O_0 (without composting) is 0.157% (low).

Further in Table 5 can be known the effect of biochar to total N soil at 2 WAP the highest on B2 (dose biochar of rice straw 4 tonnes/hectare) is 0.245% (medium) and not significantly different with B_4 (dose of biochar cow dung 4 tonnes/ha) is 0.241% (medium), while the lowest on B_0 (without giving biochar) is 0.2140% (low). Average total N of soil at 2 WAH the highest compost on O_2 (compost of cow dung 10 tonnes/hectare) is 0.242% (medium) and significantly different from other treatments, while the lowest in the O_0 (without composting) is 0.126% (low) . Furthermore, it can be seen that the average of total N of soil at 2 WAH, the highest on B_2 (dose biochar of rice straw 4 tonnes/hectare) is 0,216% (medium) and not significantly different with B_4 (dose biochar of cow dung 4 tonnes/hectare) is 0.211% (medium), while the lowest on B_0 (without giving biochar) is 0.184% (low), and lowest in the B_0 is 0.184% (low).

Table 5. Comparison N total of the soil of average at the types of compost and dose of biochar at 2 WAP and 2 WAH, based HSD (5%)

Source	**Total N of the soil (%) (2WAP)**	**Total N of the soil (%) (2 WAH)**
O_0	0,157 a	0,126 a
O_1	0,267 b	0,236 b
O_2	0,271 b	0,242 c
Dose of biochar		
B_0	0,2140 a	0,184 a
B_1	0,2298 b	0,199 b
B_2	0,245 c	0,216 c
B_3	0,2276 b	0,197 b
B_4	0,2413 c	0,211 c

Remarks: The same letters on each treatment showed no significant differences based on HSD (5%)
O_0: without provision compost ; O_1: provision compost of rice straw 10 tonnes / hectare
O_2: provision compost of cow dung 10 tonnes / hectare
B_0: without provision biochar ; B_1: provision biochar of rice straw 2 tonnes / hectare ; B_2: provision biochar of rice straw 4 tonnes / hectare ; B_3: provision biochar of cow dung 2 tonnes / hectare
B_4: provision biochar of cow dung 4 tonnes / hectare

Based on the results analysis of C organic soil (Table 3) can be explained, that increased C organic of soil at 2 WAP reaches 246%, because of the lowest organic C content is 0.970% (O_0B_0) compared to the highest C organic of soil content is 3.354% (O_2B_4). While the highest levels of C organic at 2 WAH (2.864%) resulting in increased levels C organic of soil is 195%.at 2 WAH. By deposit C organic of soil (high enough) at two weeks after this harvest, combination O_2B_4 (composted of cow dung 10 tonnes/hectare and biochar cow dung 4 tonnes/hectare) can provide at least the C organic of soil until with 5 planting seasons, because C organic is released only 15% compared with administration of rice straw compost 10 tonnes/hectare (O_1B_0) alone or composted cow manure 10 tonnes/ hectare (O_2B_0) without combined with biochar is only capable of a maximum 2 seasons because organic C released approximately 42% for soybean (Table 6).

High organic C content in rice straw compost and cow manure compost (Table 1) combined with a good dose of biochar Biochar rice straw that its C content is very high and the C content of cow dung biochar very high (Table 2), but the cation exchange capacity of biochar higher cow dung **(13)** compared to the cation exchange capacity of biochar rice straw **(14)**, this led to a combination O_2B_4 (cow dung compost 10 tonnes/heclatre and cow dung biochar dose 4 tonnes/hectare) levels in soil organic C was the highest compared to other treatment combinations good two weeks after planting (Table 3) and two weeks after harvest (Table 4). The role of biochar as a soil builder agent in addition to improving the soil cation exchange capacity (increase the buffering capacity of the soil keharaan) is also able to improve the circulation of water and air in the soil **(15).** According to **(12)** produced by carbon deposits during the 100 years of the biochar in soil remaining 40%, this is due to biochar is resistant to weathering and not as energy for microbes.

This is due to compost combined with biochar, in soil the compost and biochar after compost mixed with charcoal would have bioactive properties because the compost resulting from the composting technology with the help of microbes lignoselulotik who remain in the compost, have the ability as an agent biological (biofungisida) to protect plants from root diseases, so-called bioactive.

The presence of bacteria in the root nodules of young soybean plants after exiting the main roots of the hair at the root or branch roots formed by Rhizobium japonicum, causes tryptophan occurred the rapid development of bacterial populations that can tie up N ranged 40-70% from all the nitrogen that plants need. The results showed that each hectare of land planted soybeans can produce 198 kg of root nodules per year, equivalent to 440 kg of urea fertilizer **(16),** so up to two weeks after harvest (2 WAH) content N the total land is still relatively quite.

Table 6. Average C organic soil two weeks after planting (2 WAP) and C organic removed two weeks after harvest (2 WAH)

Source		**C organik soil (%)**		**REMOVED (%) {(1) - (2)} / (1) * 100%**
		2 WAP (1)	**2 WAH (2)**	
O0	**B0**	0,97	0,781	19,48
	B1	1,351	1,122	16,95
	B2	1,732	1,463	15,53
	B3	1,341	1,132	15,59
	B4	1,712	1,483	13,38
O1	**B0**	2,181	1,251	**42,64**
	B1	2,572	2,122	17,50
	B2	2,954	2,445	17,23
	B3	2,602	2,151	17,33
	B4	3,063	2,594	15,31
O2	**B0**	2,282	1,333	**41,59**
	B1	2,671	2,281	14,60
	B2	3,113	2,674	14,10
	B3	2,741	2,363	13,79
	B4	3,354	**2,864**	**14,52**

Remarks: O_0: without provision compost ; O_1: provision compost of rice straw 10 tonnes / hectare
O_2: provision compost of cow dung 10 tonnes / hectare
B_0: without provision biochar ; B_1: provision biochar of rice straw 2 tonnes / hectare ; B_2: provision biochar of rice straw 4 tonnes / hectare ; B_3: provision biochar of cow dung 2 tonnes / hectare
B_4: provision biochar of cow dung 4 tonnes / hectare

Compost as a source of nitrogen (protein) will first experience the decomposition into amino acids (imunisasi process), which in turn by a large number of heterotrophic microbial decomposed into ammonium (amonifikasi process). Amonifikasi can take place in almost every steps, so the ammonium form nitrogen is inorganic (mineral) which is main in the soil **(9).** Ammonium is produced, can be directly absorbed and used by plants for growth or energy by microorganisms to be oxidized to nitrate (nitrification process). So Nitrification is a gradual process that is of nitritasi process carried out by Nitrosomonas bacteria to produce nitrite, which was soon followed by subsequent oxidation to nitrate is carried out by bacteria called Nitrobacter nitratasi. Nitrate is the result of the mineralization process is absorbed by most crops. However, nitrate is easily leached through drainage water and evaporates into the atmosphere in the form of gas (the poor drainage and aeration is limited).

Likewise with P_2O_5 content of cow manure compost (Table 1) and P_2O_5 content in biochar cow manure (Table 2) were higher than the levels of P_2O_5 on rice straw compost (Table 1) and P_2O_5 content in biochar rice straw (Table 2) , so the combination O_2B_4 (cow dung compost 10 tonnes/hectare and a dose of cow dung biochar 4 tonnes/hectare) against P_2O_5 content in the soil is the highest compared to other treatment combinations good two weeks after planting (Table 3) and two weeks after harvest (Table 4).

Phosphorus is one nutrient that is essential for the growth of soybean plants. Effect of compost on the availability of phosphorus can be directly through the process of mineralization or indirectly by helping the release of phosphorus are fixed. For calcareous soils (rather alkaliin) that contains high Ca and Mg phosphate, because the carbonic acid formed as a result of the release of CO_2 in the process of decomposition of organic matter, resulting in increased solubility of Phosphor becomes more.

Organic acids results of the decomposition process of organic matter acts as a solvent of phosphate rock. so that the phosphate released and available to plants. The result of the process of decomposition and mineralization of organic matter, in addition to releasing inorganic phosphorus ($PO4^{3-}$) will also release compounds such as organic P-fitine and nucleic acids. The process of mineralization of organic matter will take place if the high phosphorus content of organic matter, which is often expressed in the ratio C/P. If the ratio C/P low of less than 200, will occur mineralization or release of phosphorus into the soil, but if the ratio C/P high of more than 300 will actually happen immobilization of phosphorus or phosphorus loss. In Table 1, C organic and P_2O_5 on rice straw compost = 25.61% and P_2O_5 = 0.9%, the C/P = 28,46 < 200, and C organic compost of cow dung = 26.48% and P_2O_5 = 1.59%, the C/P = 16,65 < 200. With C/P is smaller than 200 is good rice straw compost or composted of cow dung will happen mineralization or release of phosphorus into the soil to be used by soybean plants. Phosphorus plays an important role in protein synthesis, the formation of flowers and seeds as well as accelerate ripening. Phosphorus deficiency can cause stunted plant growth, the less inhibited ripening and low production.

Potassium (K) in the soil derived from soil minerals and organic matter. Potassium in the soil have the nature of being mobile (easy to move) so easily lost through leaching or drift movement of water. Based on these properties, K fertilizer efficiency is usually low, but can be improved by way of 2-3 times in one season.

By the time two weeks after planting (2 WAP) K_2O content of rice straw compost were higher than the levels of K_2O in cow manure compost (Table 1) and levels of K_2O in biochar rice straw and sufficient levels of K_2O (Tables 2), the role of rice straw compost and biochar straw more dominant, so the combination O_1B_2 (rice straw compost 10 tonnes / hectare and biochar dose rice straw 4 tonnes/hectare) although its highest K_2O levels 36,59 me / 100 g soil (medium) but not significantly different with O_1B_4 (36.03 me / 100g) (medium), O1B3 (35.06 me / 100g) (medium), O_1B_1 (34.69 me / 100g) (medium) and O_2B_2 (34.41 me / 100g) (medium) (Table 3). Similarly, when two weeks after harvest role of rice straw compost and biochar rice straw is still dominant, but the combination O_2B_4 (cow dung compost 10 tonnes/hectare and a dose of cow dung biochar 4 tonnes/hectare) were not significantly different levels of K_2O in the soil with a combination of O_1B_4 ie 30.03 me / 100 g (medium), O_1B_2 (29.84 me/100 g) (medium), O_1B_3 (28.98 me/100g) (medium), O_1B_1 (28.55 me/100g) (medium), O_2B_2 (28.18 me/100g) (medium) (criterion medium) (Table 4).

Role of compost to improve soil chemical properties, such as the cation exchange capacity, soil pH, soil buffering capacity of the soil fertility. Provision of compost can increase the negative charge that would increase the cation exchange capacity. Compost as a result of the decomposition gives a real contribution to the soil CEC, as a source of negative charge of land, so that the compost is considered to have the composition of colloids such as clay, but compost not semantap colloidal clay, he is dynamic, easily crushed and molded.

2. Changes in the physical properties of the soil two weeks after planting (2 WAP)and two weeks after harvest (2 WAH)

Based on the results of analysis of variance in Appendix 3, the influence of the type of compost and dose of biochar to the soil bulk density and total porosity at 2 WAP there is significant interaction and no significant interaction at 2 WAH but significantly different each factor based 5% HSD test. Average results of soil bulk density and total porosity of soil, the effect of compost and dose biochar two weeks after planting (2 WAP) and two weeks after harvest (2 WAH) can be seen in Table 7.

Interaction of types of compost and biochar dose to changes in soil bulk density at 2 WAP (Table 7) it can be seen that the average soil bulk density of the lowest on a combination of O_2B_2 (compost of rice straw 10 tonnes/hectare and biochar of rice straw 4 tonnes/hectare) is 1.14 g/cc, and not significantly different with O_2B_4 (1.15 g/cc), O_2B_1 (1.15 g/cc), O_2B_3 (1.16 g / cm 3), O_1B_2 (1.16 g/cc), O_1B_4 (1.17 g/cc) and O_1B_3 (1.18 g/cc), while the highest the combination of O_0B_0 (without compost and biochar) is 1.30 g/cc.

Interaction of types of compost and biochar dose to the total porosity of the soil can be seen that the total porosity of the highest ground on combination O_2B_2 (rice straw compost 10 tonnes / hectare and biochar 4 tons / hectare) is 56.49% and not significantly different with O_2B_1 (56.44 %), O_2B_4 (56.27%), O_2B_3 (56.06%), O_1B_2 (56.06%), O_1B_4 (55.68%), O_1B_1 (55.47%) and O_1B_3 (54.92%) , while the lowest total porosity on combination O_0B_0 (without compost and without biochar) that is 51.85% and did not differ with O_0B_3 (51.88%), O_0B_1 (52.61%), O_0B_4 (52.63%), O_1B_0 (52.83%) and O0B2 (53.01%).

Soil bulk density is strongly influenced by the availability of C content in the soil. The greater C content in soil the bulk density tends to be small, it can be interpreted that the better soil aggregation and soil structure becomes more stable and more easily processed soil.

Bulk density relationship and the total soil porosity as shown in Table 7 it can be seen that the smaller the unit weight of the soil the greater the total soil porosity, meaning that the greater the total porosity of the soil the greater the ability of the soil to absorb and store water and provide water in the soil. In Table 1 it is known that the bulk density of compost of cow dung (0.486 g / cc) < compost of rice straw (0.545 g / cc), whereas at the biochar, the bulk density on biochar of rice straw (0.286 g / cc) < biochar of cow dung (0.388 g / cc) (Table 2). Therefore, combination on compost of cow dung and biochar of rice straw tends to be lower on soil bulk density than the combination of rice straw compost combined with good biochar at biochar of rice straw and cow manure (Table 7).

Table 7. Comparison of average soil bulk density and total porosity of the soil the effect of interaction compost and dose biochar two weeks after planting (2 WAP) and two weeks after harvest (2 WAH) based of HSD (5%)

Source		Two weeks after planting		Two weeks after harvest		
		Bulk density (g/cc)	**Total porosity (%)**	**Treat ment**	**Bulk density (g/cc)**	**Total porosity (%)**
O_0	B_0	1,30 d	51,85 a	O_0	1,3187 b	50,53 a
	B_1	1,27 c d	52,61 a	O_1	1,2460 a	52,88 b
	B_2	1,25 c	53,01 a b	O_2	1,2360 a	53,50 b
	B_3	1,28 c d	51,88 a			
	B_4	1,26 c d	52,63 a	B_0	1,313 b	50,76 a
O_1	B_0	1,25 c d	52,83 a	B_1	1,257 a	52,71 b
	B_1	**1,18 a b**	**55,47 c**	B_2	1,241 a	53,04 b
	B_2	**1,16 a b**	**56,06 c**	B_3	1,264 a	52,27 a b
	B_3	1,19 b	**54,92 b c**	B_4	1,259 a	52,72 b
	B_4	**1,17 a b**	**55,68 c**			
O_2	B_0	1,24 c	53,21 a b			
	B_1	**1,15 a b**	**56,44 c**			
	B_2	**1,14 a**	**56,49 c**			
	B_3	**1,16 a b**	**56,06 c**			
	B_4	**1,15 a b**	**56,27 c**			

Remarks: The same letters on each parameter treatment showed nosignificant differences based on HSD test (5%)
O_0: without provision compost ; O_1: provision compost of rice straw 10 tonnes / hectare
O_2: provision compost of cow dung 10 tonnes / hectare
B_0: without provision biochar ; B_1: provision biochar of rice straw 2 tonnes / hectare ; B_2: provision biochar of rice straw 4 tonnes / hectare ; B_3: provision biochar of cow dung 2 tonnes / hectare
B_4: provision biochar of cow dung 4 tonnes / hectare

Effect of compost and biochar on soil previously Alfisols rather solid, can form a better structure or crumbs. Sufficient organic matter content in the soil can improve soil conditions that are not too heavy and not too light in ground processing. Effect of compost on soil physical properties of the other is to increase the total porosity of the soil so that the soil can improve the ability to hold water. In fine silty soil, organic matter will improve of pore meso and micro pores decrease. Thereby increasing the pore can be filled the air and lower the water-filled pores, meaning that there will be improved aeration for heavy clay soils. Giving compost (either straw or compost cow dung can improve soil and total pore volume of the soil will lose weight. The results of the average bulk density and total porosity of the compost and biochar soil two weeks after harvest (2 WAH) as shown in Tables 7.

In Table 7 it can be seen that the lowest of bulk density of the soil at two week after harvest (2 WAH) at O_2 treatment is 1.236 g / cc and not significantly different with treatment O_1 (1.246 g / cc) and the lowest at O_0 (1.3187 g / cc), while the highest of total porosity of soil at O_2 treatment is 1.236 g / cm 3 and not significantly with O_1 (1.246 g / cm 3), whereas the highest at O_2 (53.50%) and not significantly with O_1 (52.88%) and lowest at O_0 (50,53%). While on treatment biochar 2 WAH, the lowest soil bulk density at B_2 is 1.241 g / cm 3 and not significantly different with B_4 (1.259 g / cm 3), B_1 (1.257 g / cm 3) and B_3 (1.264 g / cm 3) and the highest in the B0 ie 1.313 g / cm 3. While the total porosity of the soil, the highest at B_2 (53.04%) and not significantly different with B_4 (52.72%), B_1 (52.71%) and B_3 (52.27%), while the lowest in the B_0 (50, 76%).

Effect of compost to increase soil porosity in addition related to soil aeration, also related to the status of the water content in the soil. Provision of compost will improve the soil's ability to hold water so that the ability to provide water for plant growth increases. Optimum moisture content for plant and microorganism life is approximately field capacity. In such Alfisols argillaceous soil with compost will improve the provision of soil infiltration, increasing meso pores and decreasing micro pores **(17).**

3. High and production of soybean

Based on the results of analysis of variance in Appendix 4, the influence of the type of compost and dose of biochar on high and production of soybean there is significant interaction based on 5% HSD test. Average results high and production of soybean the effect of combined compost and biochar can be seen in Table 8.

Interaction of types of compost and dose of biochar in plants of soybean as shown in Table 9, it can be seen that the combination of O_2B_4 on high soybean crop the highest is 60.62 cm and not significantly different with O_1B_4 (59.79 cm), O_2B_2 (58.74 cm), O_0B_4 (58.58 cm), O_1B_2 (58.32 cm), O_1B_3 (57.41 cm), O_0B_2 (56.75 cm), $O1B_1$ (56.04 cm), O_2B_3 (55.10 cm), and the lowest in combination O_0B_0 ie 45.45 cm and not significantly different from O_0B_1 (51.60 cm), O_0B_3 (52.42 cm), O_1B_1 (53.39 cm), O_2B_0 (51.56 cm) and O_2B_1 (51.72 cm).

While the interaction effect of compost type and dose of biochar to the highest production of soybeans per hectare in combination O_2B_4 (2,298 tonnes / hectare) and not significantly different from O_2B_2 (2.282 tonnes / hectare), O_1B_4 (2.268 tons / hectare) and O_1B_2 (2,259 tonnes / hectare) and lowest in the combination O_0B_0 (1.333 tons / hectare).

Table 8. Comparison of average high and production of soybean the influence of combined types of compost and dose of biochar based HSD test (5%)

Source		High of soybean (cm)	Production of soybean(ton/ha)
O0	B0	45,45 a	1,333 a
	B1	51,60 a b	1,418 b
	B2	**56,75 b c d**	1,698 c
	B3	52,42 a b	1,447 b
	B4	**58,58 b c d**	1,728 c
O1	B0	53,39 a b	1,993 d
	B1	**56,04 b c d**	2,005 d
	B2	**58,32 b c d**	**2,258 e**
	B3	**57,41 b c d**	2,008 d
	B4	**59,79 c d**	**2,268 e**
O2	B0	51,56 a b	2,010 d
	B1	51,72 a b	2,023 d
	B2	**58,74 b c d**	**2,282 e**
	B3	**55,10 a b c d**	2,032 d
	B4	**60,62 d**	**2,298 e**

Remarks: The same letters on each treatment showed no significant differences based on HSD (5%)
O_0: without provision compost ; O_1: provision compost of rice straw 10 tonnes / hectare
O_2: provision compost of cow dung 10 tonnes / hectare
B_0: without provision biochar ; B_1: provision biochar of rice straw 2 tonnes / hectare ; B_2: provision biochar of rice straw 4 tonnes / hectare ; B_3: provision biochar of cow dung 2 tonnes / hectare
B_4: provision biochar of cow dung 4 tonnes / hectare

Combined of Compost with biochar the influence to high of soybean plant, this is due to the presence of compounds that have an influence on the biological activity of the compound to growth stimulants (auxin) and vitamins. These compounds in the soil derived from plant exudates, manure, compost, crop residues and also from the results of microbial activity in the soil. In addition, the organic acid is indicated by a low molecular weight, especially bicarbonate (such as succinate, cinnamate, fumarate) decomposition of organic matter, in low concentrations can have stimulant properties of such compounds to grow, and therefore contributes positively to high of soybean plants.

Applications composting combined with biochar can increase colony mycorrhiza (17), then it is reported that the use of biochar can increase nitrogen fixation in legumes, improving the fertility of chemical, physical and soil biology and may improve growth and increase crop yields. The results of the study **(18)** showed that the use of biochar can increase crop yields of maize, cowpea and peanuts. The use of biochar from agricultural waste material increases soil N . Biochar with compost combined with a composition of 10-30% of the weight of compost in the planting hole and around of plants in addition to improving soil fertility can also increase the yield of crops **(6).**

(19) reported, the potential of biochar as an agricultural soil conditioner to improve soil fertility, not only contribute nutrients to the soil but also improve the structure / soil physical and chemical. Utilization of rice husk biochar mixture combined with compost able to provide the best results up to 3 x growing season on corn in Ultisol. The advantage to giving biochar in soil, among others: 1) accelerate growth, 2) reducing the use of fertilizers, 3) reduce the amount of nutrients lost / washed, 4) reduce greenhouse gases by absorbing CO_2 from the atmosphere, 5) improve the ability to absorb water and 6) increase the number of microbes and microorganisms in the soil.

All this has a lot of known materials such as limestone soil ameliorant, Legume Cover Crops and which is now being developed also is biochar. Biochar can not be regarded as an organic fertilizer, because biochar can not add nutrients from the contained therein, because that the cation exchange capacity in biochar is high so as to bind cations of land that can be utilized for plant growth. Biochar also has many pores due to the large surface area that has a high water holding capacity. Although biochar is not a fertilizer but kombinasi compost with biochar in the soil can store nutrient in soil, water and air as well as the soil can improve soil productivity.

Biochar has a high internal surface area thus able to absorb nutrients that are beneficial for plant growth. Biochar also serves as improvement material in the soil cation exchange capacity, water storage and air of soil so that can create environmental conditions in accordance with the growth and development of plant roots **(20)**;

(21); **(22)**.

Conclusion

Conclusions obtained in the study in an effort to increase the productivity of degraded dry lands are as follows:

1. Combination O2B4 (combination of cow dung compost 10 tonnes / hectare and biochar of cow dung 4 tons / acre), two weeks after planting (2 WAP) can increase soil organic C content is 246% from C organic soil the initial (O_0B_0) is (0.97 %) (very low) increase 3, 353% (O_2B_4)(high). At two weeks after harvest (2 WAH) to increased 195%, from 0.97% (O_0B_0) increased 2,864% (O_2B_4) (high enough).
   At 2 WAP combination O_2B_4 can increase carbon deposits by 246% and increase levels of 246% P_2O_5 in the soil, while in the 2 WAH combination O_2B_4 increase levels of 102% P_2O_5 in the soil.
   Effect of interaction types of compost and biochar dose against K_2O content of the soil at 2 WAP, a combination of rice straw compost 10 tonnes / hectare and biochar 2 tons / hekatr or 4 tons / hectare both biochar of rice straw and biochar of cow dung can increase the average levels of K_2O in the soil 24%, and the combination of cow dung compost 10 tons / hectare and biochar rice straw 4 tonnes / hectare can increase the levels of 20% K_2O in the soil, while the two WAH combination of rice straw compost 10 tonnes / hectare and biochar 2 tons / hectare or 4 tons / hectare both biochar of rice straw and biochar of cow manure can increase the average level of 2% K_2O in the soil, and the combination of cow dung compost 10 tonnes / hectare and biochar 4 tons / hectare both biochar biochar rice straw and cow dung average K_2O content in the soil decreased 2.5%.
   With the increase of carbon deposits (carbon stored) 2 WAH in the soils, dry land especially initially degraded (the low effect organic C in soil), soybeans can be planted at least 5 times a growing season planted soybeans.
2. Combination O_2B_4 (combination of cow dung compost 10 tons / ha and biochar of cow dung 4 tons / hectare), combination O_2B_2 (compost of cow dung 10 tonnes / hectare and biochar of rice straw 4 tons / hectare), combination O_1B_4 (compost of rice straw 10 tonnes / ha and biochar of cow dung 4 tons / ha) and combination O_1B_2 (compost of rice straw 10 tons / hectare and biochar of rice straw 4 tons / ha), yield soybean production between (2.259 to 2.298) tons / hectare, resulting in increased production compared to the average production of local farmers madura (1.25 tonnes / ha), the province of east Java (1,342 tons / hectare) and the national average production (1,357 tonnes / ha) in 2010 **(23)**, resulting in an average increase in production of 74% of average local production Madura, east Java and national.

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