UTILIZATION OF WASTE MATERIAL AS AN ACTIVE SAGO BIOCHAR P AVAILABLE TO INCREASE AND GROWTH IN CORN ULTISOL

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ABSTRACT

The high demand for agriculture products, but the Decrease of available agricultural land because of the changes in its function into non-agriculture, causes the utilization of dry land, such as Ultisol, to be a cultivation land. Ultisol has some problems, such as pH and low P content, but there are some possibilities to improve the land as agriculture areas. Sago waste is used as ameliorant biochar of the land. The material has chemical properties required for the land and the plants, as well as for the resistant of decomposition. The study Aimed at finding the kind of the biochar and the fertilization dosage combination to increase of the supply of P for the growth of corn in the Ultisol. The experiment was Carried out using three kinds of biochars, and five dosage levels of P fertilization as stated in completely randomized design with three replications. The results of the study Showed that the use of the sago wastes biochar as the ameliorant of the Ultisol was Able to Increase the soil pH to 6.0 and the P content of 11 ppm in a week incubation before cultivation. The condition indicated resources that the biochar was Able to reduce the acidity so that the P was more effective in the Ultisol. The pyrolysis biorchar 400 ° C, in all of the dosage levels Increased the chemical properties of the soil and Also improved the growth of the plants. The combination dosage fertilization 36 kg P2O5 / ha was enough to supply the P availability and Able to improve the growth of the corn in the Ultisol. The results of the study Showed that the use of the sago wastes biochar as the ameliorant of the Ultisol was Able to Increase the soil pH to 6.0 and the P content of 11 ppm in a week incubation before cultivation. The condition indicated resources that the biochar was Able to reduce the acidity so that the P was more effective in the Ultisol. The pyrolysis biorchar 400 ° C, in all of the dosage levels Increased the chemical properties of the soil and Also improved the growth of the plants. The combination dosage fertilization 36 kg P2O5 / ha was enough to supply the P availability and Able to improve the growth of the corn in the Ultisol. The results of the study Showed that the use of the sago wastes biochar as the ameliorant of the Ultisol was Able to Increase the soil pH to 6.0 and the P content of 11 ppm in a week incubation before cultivation. The condition indicated resources that the biochar was Able to reduce the acidity so that the P was more effective in the Ultisol. The pyrolysis biorchar 400 ° C, in all of the dosage levels Increased the chemical properties of the soil and Also improved the growth of the plants. The combination dosage fertilization 36 kg P2O5 / ha was enough to supply the P availability and Able to improve the growth of the corn in the Ultisol. The pyrolysis biorchar 400 ° C, in all of the dosage levels Increased the chemical properties of the soil and Also improved the growth of the plants. The combination dosage fertilization 36 kg P2O5 / ha was enough to supply the P availability and Able to improve the growth of the corn in the Ultisol. The pyrolysis biorchar 400 ° C, in all of the dosage levels Increased the chemical properties of the soil and Also improved the growth of the plants. The combination dosage fertilization 36 kg P2O5 / ha was enough to supply the P availability and Able to improve the growth of the corn in the Ultisol.

Key words: biochar, sago waste, ameliorant, P-availability, Ultisol, corn

INTRODUCTION

Ultisol is acidic soil dry land with the widest distribution in Indonesia. Although it has many problems in its management, this land can still be improved. The main problem in such Ultisol acidic pH, typically under 5.0 and P availability is very low. The low pH and available P is related to the concentration of cations and cation H is high. Clay mineral (clay) type 1: 1 (kaolonit), which is capable of fixing between kisis-P amorphous mineral lattice. Besides Al reacts strongly to retain P are difficult to remove, so that the plant P deficiency can inhibit growth (dwarf). Efforts to improve the limiting factors to do with the provision of biochar and fertilizer P. Biochar serves as ameliorant (pembenah) of land which ensure soil moisture because of large water retention (Laird et al., 2010), reduces the mobility of N, P leaching due to runoff, the Commission and the soil pH increases (Liang et al., 2006; Lehmann, 2007; Cheng et al., 2007). Fertilization P functions provide nutrients to quickly absorbed by plants.

Biochar is charcoal biological results of pyrolysis (combustion) incomplete without oxygen or low oxygen, called biological charcoal because it comes from biomass (agricultural, plantation and forestry). Biochar is determined by the quality of raw materials and the process of pyrolysis. Composition of biochar; heteroatoms, such as carbon 15-70% (Lehmann and Joseph, 2009), nutrient (N, P, K, Ca, Mg) and micronutrients (Zn, Cu, Mn), calcite (CaCO3) (Amonnette & Joseph, 2009) , its surface is surrounded by a functional group (Cheng et al., 2007; Shen et al., 2008) that are ampoter. In addition biochar reduce environmental pollution from agricultural biomass pile and reduce carbon dioxide emissions.

Corn demand is increasing, while efforts to spur the increase in production is still far from the expected. Utilizing dry land (Ultisol) is one in an effort to increase maize production in addition to the application of existing technology. Ultisol have chemical and physical properties that are less good, but with the provision of fertilizer with biochar as ameliorant P then growth and achieve optimum corn production. This study aims to get the kinds of biochar and fertilizer P combination with certain Efficient enhance the growth of corn plants.

RESEARCH METHODS

Research has been conducted at the Faculty of Agriculture greenhouse lasted for three months. Analysis of the soil, biochar, plant tissue is carried out in the Laboratory of Soil Science and Mathematics-Chemistry UGM. Preparation of biochar conducted in Biomass Energy Laboratory, Faculty of Forestry, UGM. The materials used in them Ultisol of Karangsalam Somagede Tanggeran track, Banyumas, Central Java; sago waste of Ambon, corn seed varieties Bima 2 Bantimurung, urea, SP-36, KCl, and kemikalia for analysis of soil chemical properties, biochar and plant tissues. The tools used include ovens, digital scales, AAS, Retort (Pirolisisator), Muffle, as well as other laboratory equipment.

Experiments using completely randomized design (CRD) with two factors, namely kinds of biochar treatment; R1 (200cc), R2 (400oC), R3 (600oC). The second factor is the treatment of manure P (SP-36 as a source of P2O5) dose; D0 = 0 kg P2O5 / ha, D1 = 36 kg P2O5 / ha, D2 = 72 kg P2O5 / ha, D3 = 108 kg P2O5 / ha, D4 = 144 kg P2O5 / ha. Variable ground observations include: pH and P-available.

Before planting soil incubated one week. After incubation the soil analyzed to determine their chemical properties. Corn growth variables were plant height (measured every two weeks during the study), fresh weight Poster (BST) and root (BSA), dry weight of Poster (BKT) and root (BKA), weighed after harvest. Data were analyzed by F-test level of 5%, followed by DMRT 5%.

RESULTS AND DISCUSSION

1. Characteristics of Soil, Waste Sago, and Biochar

Analysi s of the chemical properties of the soil (Table 1), indicating that Ultisol used have low fertility. This land has high potential when done ameliorant to raise the pH, so that fertilization is more effective and available to plants. Substances added to Ultisol should possess potent amelioration, the material shall consist of the chemical nature of the required soil and plants. Biochar is determined by the quality of raw materials and the manufacturing process. It is closely related to loss of nutrient content of the material when the pyrolysis. Biochar used sago waste has the properties required amelioration Ultisol and corn. This is demonstrated by the content of organic C, and a high cellulose and other nutrient content (Table 2).

Table 1. Some chemical properties used Ultisol

component analysis	Unit	Valu e	Pengharkatan *
pH (H2O)		4.83	Sour
(KCl)		3.22	
C-organic	%	1.41	moderate
organic materials	%	2.43	moderate
DHL	ms / cm	1.5	Low
KPK	cmol (+) kg-1	11,963	moderate
Al-dd	cmol (+) kg-1	1,068	Low
Al saturation	%	29.346	High
P-total	ppm	193.54	Very low
P-available (Bray I)	ppm	1.23	Very low
total N-	%	0.14	Low
TTK ca-	cmol (+) kg-1	0.353	Low
TTK Mg-	cmol (+) kg-1	.450	Very low
K-pt	cmol (+) kg-1	.590	moderate

* Pengharkatan according to ISRI, (2009)

Table 2. Some Properties of Chemical Waste Sago

variables	Unit	Valu e	Pengharkatan *
C-the organic	%	54.31	High
BO	%	93.63	Very high
N total	%	0.42	moderate
total P2O5	ppm	1.6	Low
K2O total	%	0.11	Low
KPK	cmol (+) kg-1	53.11	High
C / N	-	129.30	Very high
Cellulose	%	54.28	High
lignin	%	19.35	Low

* Pengharkatan menururt ISRI, (2009)

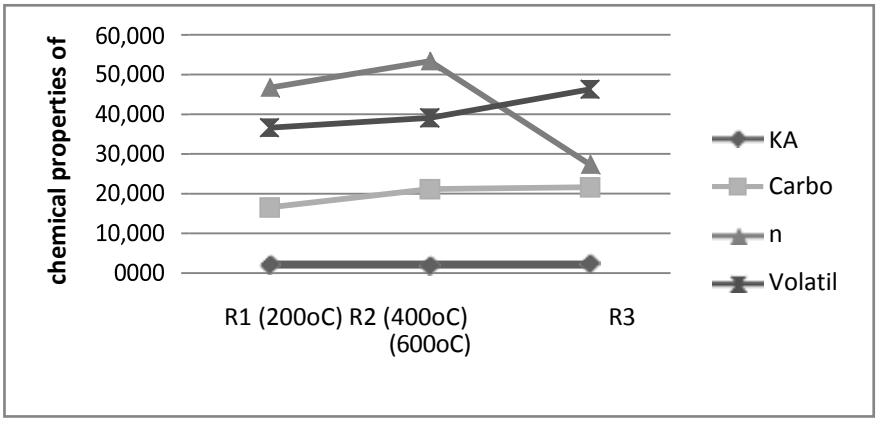

Figure 1. Common chemical properties on biochar

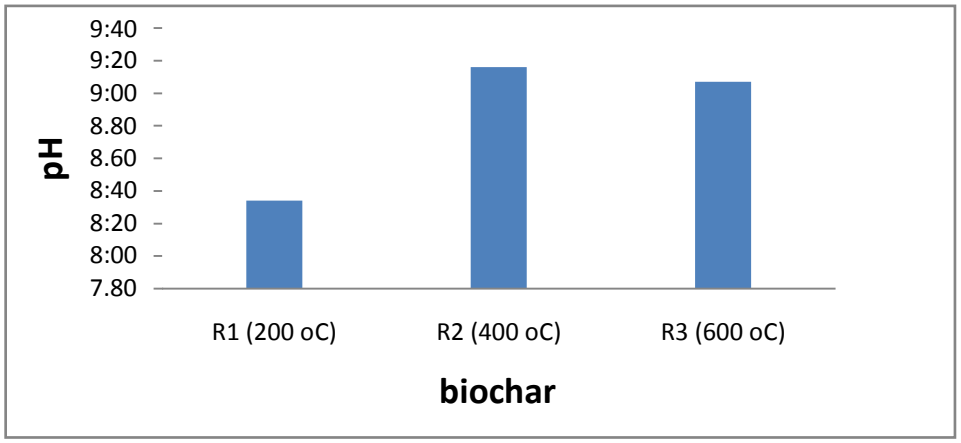

Figure 2. pH Biochar

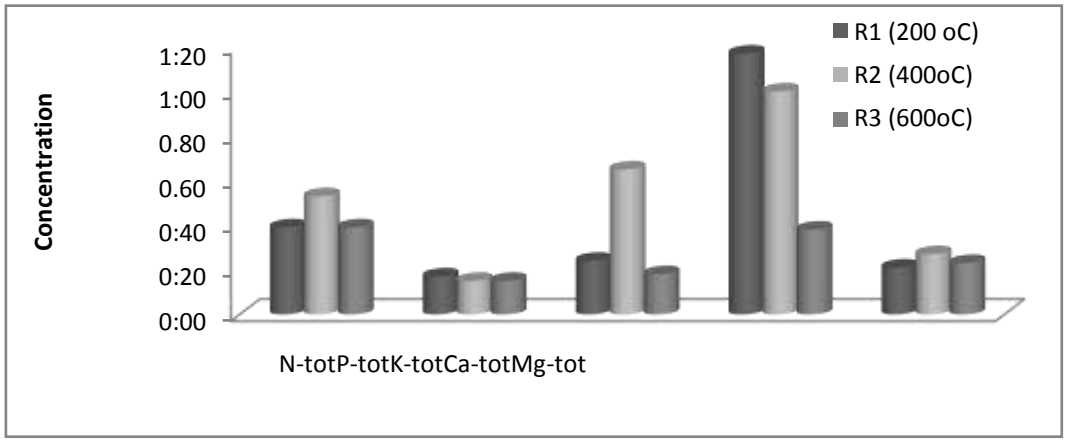

Figure 3. Some of the chemical properties of biochar

Biochar pyrolysis results were used (Figure 1, 2 and 3) containing carbon (36.6- 46.3%), volatile (volatile matter) 27.3-53.3%, ash content (16.5-21.6%), and water content (1.8-2.4 %). The results of the analysis of the composition of the chemical properties of biochar: Air pH (8.3 to 9.0) high, N-total (from 0.39 to 0.53%), medium-high, P-total (1.40-1.80 ppm) is low, and K -Total (0.2 to 1.3%) higher, CA-total (1.0 to 1.3%) is, Mg-total (0.2 to 0.23%) medium. Based on these data can be used as ameliorant biochar soil. Criteria ameliorant written material should be able to improve the physical, chemical and as a source of nutrients for plants even in very small amounts (Nurida et al., 2009; Nurida 2010), environmentally friendly, in-situ, and sustainable.

A. Influence of Biochar Against Chemical Properties Ultisol

Giving biochar increase the pH, and P-provided Ultisol. Repair Ultisol two chemical properties were measured before planting are presented in Table 3. The increase in pH and improving the P-provided showed that the addition of biochar on Ultisol occur persetindakanpositif.Macam biochar affect pH, column 2 Table 3 shows no increase in pH of 1.1 to 1.2 times pH control. This is indicated by the high pH value of 6.0 (Table 3) in the treatment biochar pyrolysis temperature of 400 ° C and dosages of 72 kg P2O5 / ha (D2R2), meaning that this treatment combination increases the concentration of OH-. The cause is biochar pyrolysis 400 oC increase hydrolysis. Biochar suspected presence triggers the release of base cations from the unit tetrahedron or polymer as cations that are bound weakly by silicate polymer unit and as a counterweight ion. Increasing the pH of the soil due to award biochar though less impressive, but ameliorant made from sago waste has the potential to improve soil pH so that fertilization is more effective, efficient, and available to plants in Ultisol.

Incubation biochar seven days prior to fertilization and implantation showed the smallest available value P in controls (Table 3). Value P-provided maximum of 11.00 ppm occurs in a wide treatment biochar pyrolysis temperature of 400 ° C and 600 ° C at a dose of fertilizer 72 kg P2O5 / ha (D2R2 and D2R3). Giving biochar increases the solubility of P in Ultisol. Improved solubility is caused by increasing the pH due to the neutralization reaction of H + by OH- from mineral hydrolysis with biochar. Another indication that the granting of biochar allegedly degrading the performance of mineral soil and Al which adsorb P. The use of biochar can also reduce the rate of loss of P by immobilizing microbial, surface runoff, and fixation by soil minerals (Lan & Liu, 2008).

B. Biochar influence on the Growth of Corn

Table 4 kinds of biochar and measuring affects the growth of corn plants and chemical pHsifat pH and P-provided Ultisol. Components of growth observed were plant height (Tt), fresh weight Poster (BST), dry weight of Poster (BKT), and root dry weight (BKA) and total P uptake-network. Table 4 shows the components of the growth of corn plants in the control treatment is smaller. Kerdilnya crop plants with a low weight in the control indicates that the corn crop is not a grace against Ultisol.

Table 3. Chemical properties pH and P-provided Ultisol incubation of one week after treatment

Treatment	pH	pH (Ratio *)	P-Bray (ppm)
T0R0 (control)	4.95 a	1.00	1.24 e
D1R1	5.47 a	1.10	9.00 bc
D1R2	5.78 a	1.16	8.50 bc

D1R3	5.53 a	1.15	8.60 c
D2R1	5.80 a	1.13	9.00 bc
D2R2	6.03 a	1.21	11.00 a
D2R3	5.60 a	1.12	11.00 a
D3R1	5.66 a	1.10	9.00 bc
D3R2	5.94 a	1.15	10,00 ab
D3R3	5.66 a	1.15	8.00 c
D4R1	5.52 a	1.19	9.00 c
D4R2	5.70 a	1.20	8.00 c
D4R3	5.48 a	1.12	6.00 c

Description: The numbers on the same lettered columns show the treatment was not significantly different between the DMRT, a level of 95%, R1 = biochar pyrolysis temperature of 200 ° C; R2 = biochar pyrolysis temperature of 400 ° C; R3 = biochar pyrolysis temperature of 600 ° C, T0 = without treatment; D1 = 50% P2O5 / ha; D2 = 100% P2O5 / ha; D2 = 150% P2O5 / ha; D3 = 200% P2O5 / ha. * Ratio = (treatment / control)

Table 4. Components of plant growth and P uptake in the provision of a wide network of biochar and fertilizer P

Treatment	High plant (cm)	fresh weight Poster (g)	dry weight Poster (g)	dry weight root (g)	uptake P network (g)
T0R0 (control)	84.67 b	20.10 b	2.57 c	0.45 f	0.18 f
D1R1	251.00 a	528.50 a	79.43 b	16.43 cde	9.68 e
D1R2	227.67 a	472.33 a	101.87 ab	19.61 bc	16.38 d
D1R3	237.33 a	480.17 a	94.70 ab	16.75 bcde	14.46 d
D2R1	233.33 a	491.47 a	80.00 b	15.60 de	26.12 b
D2R2	237.67 a	541.17 a	105.46 ab	23.60 a	23.37 c
D2R3	239.00 a	491.47 a	96.99 ab	18.86 bcd	25.91 bc
D3R1	226.33 a	482.67 a	98.11 ab	19.42 bc	28.38 b
D3R2	247.33 a	516.27 a	107.52 a	20.19 b	27.36 b
D3R3	232.67 a	563.33 a	102.63 ab	18.82 bcd	33.42 a
D4R1	217.33 a	481.13 a	79.67 b	15.18 e	22.92 c
D4R2	217.67 a	511.20 a	107.20 a	19.80 bc	27.04 b
D4R3	219.67 a	496.40 a	99.23 ab	15.80 de	21.96 c

Description: The numbers on the same lettered columns show no significant difference between treatments in (DMRT), a level of 95%, R1 = biochar pyrolysis temperature of 200oC; R2 = biochar pyrolysis temperature of 400 ° C; R3 = biochar pyrolysis temperature of 600 ° C D1 = 36 kg P2O5 / ha; D2 = 72 kg P2O5 / ha; D3 = 104 kg P2O5 / ha; D4 = 144 kg P2O5 / ha,

This happens because their roots petumbuhan inhibition by Al toxicity and kekurangn Susan P. et al., (2007) stated that Al toxicity causes an increase in the viscosity of protoplasm root cells and lower the cell membrane permeable root plants to water and ions. The symptoms are deficient P (leaf purple), this P deficiency causes inhibition of cell$_4$ division, development of roots, the formation of amino acids, ATP, and nucleic acids (Mengel and Kirby 1987). This deficiency due to P is fixed by the amorphous material or kaolonit and Al 3+ which ruled Ultisol and carried by the water runoff.

These symptoms disappeared after a dose of biochar and fertilizer P increased. This situation shows the combined treatment of soil pH which causes mengendapnya Al by the release of H + and inhibit the inception of the polymer Al (Huang & Schnitzer, 1997), anion phosphate (H2PO -) removable and increase available P, this suggests biochar potential as ameliorant to improve properties Ultisol chemistry; although the data treatment of a wide biochar pyrolysis temperature of 400 ° C at all

levels of fertilization value is higher but did not differ from each other plant growth except at the controls, it shows that biochar which is processed at a temperature of 200-600 ° C is able to act as ameliorant in Ultisol (Table 2).

The combination of wide biochar and fertilizer P shows the growth of corn together with other treatments except the control. Growth with the highest values occur in D1R1 treatment, fertilizer use efficiency means that happen. It is thought to use this treatment combination is able to maximize the role of soil as growth media which guarantees the development of roots and growth of higher plants, thus the dependence of conventional fertilizer use can be minimized.

The correlation coefficient soil chemical properties and growth components in Table 5 shows the relationship between pH, P-available, component tissue growth and P uptake is shown by a real coefficient values to very real. The relationship between soil pH consequently increases the availability of P P uptake increased network. Monocot plant is sensitive to the availability of P. availability of P in Ultisol be the main limiting factor of growth, therefore it is necessary to increase ameliorant capable of neutralizing the pH in the soil thereby increasing the availability of P which in turn increases plant growth. This experiment shows the combined treatment of kinds of biochar and fertilizer P given guarantee the availability of P for the growth of corn plants in Ultisol.

Tabel 5. Matrik koefisien korelasi sifat kimia, komponen pertumbuhan tanaman dan serapan P jaringan

Variabel	pH	P-tsd	Tt	BST	BKT	BKA	P jaringan
pH	1						
P-tsd	0,67*	1					
Tinggi tanaman (Tt)	0,69*	0,75*	1				
Berat segar trubus (BST)	0,78*	0,77*	0,97**	1			
Berat kering trubus (BKT)	0,79*	0,71*	0,89**	0,93**	1		
Berat kering akar (BKA)	0,82**	0,77*	0,89**	0,91**	0,96**	1	
Serapan P jaringan	0,87**	0,81**	0,77*	0,75*	0,78*	0,76*	1

*berbeda nyata pada α= 1 %; **berbeda sangat nyata pada α= 5 %; n= 15

CONCLUSION

The administration of sago waste biochar increases the pH of Ultisol soil from acidic conditions to slightly acidic. Fertilizing dose of 50% P2O5 / ha = 100% P2O5 / ha combined with biochar at 400 oC can supply P available for the growth of corn plants. Pyrolysis temperature differences do not affect the performance of biochar as ameliorants. Biochar produced at a temperature of 200-600 oC can improve the chemical properties of Ultisol soil.

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