Sys Rev Pharm 2020; 11(3): 451 – 456
A multifaceted review journal in the field of pharmacy
E-ISSN 0976-2779 P-ISSN 0975-8453

Oil Palm Empty Fruit Bunch Alkaline Biochar Influences Total Soil Microbial Population, Number of Root Nodules and Soybean Growth in Wonosari Inceptisol

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Article History: Submitted: 25.12.2019 Revised: 22.02.2020 Accepted: 10.03.2020

ABSTRACT

Alkaline biochar oil palm empty fruit bunches is the result of converting oil palm empty fruit bunch waste from the palm oil mill. The waste converted into resources that can be function to repaired / transformed edacid soils into agricultural land alkaline biochar oil palm empty fruit bunches is the result of converting oil palm empty fruit bunch waste from the palm oil mill. The waste converted into resources that can be function to repaired / transform acid soils into agricultural land. The purpose study is to examine the ability of Biochar Alkaline Oil Palm Empty Fruit Bunches and their effect on the total soil microbial population, the number of root nodules, and the growth parameters of soybean plants in the Inceptisol Tanjung Morawa Medan acid soil. The Screenhouse of the Faculty of Agriculture, University of HKBP Nommensen Medan conducted the greenhouse test phase research by using a completely randomized design research design. Field-testing confirmed by a Dessin factorial randomized trial design. Determination of Total Population of soil microbial cups at both stages of testing is to conduct at the Biology Laboratory of the University of North Sumatra, Meda. (The research method uses all statistical observations in the form of analysis of variance analysis (ANOVA). The results of the different parameter tests followed by Duncan's Multiple Range Test the results showed the influence of Biochar as acid amelioration for acid soil affected the total microbial population and the growth of soybean plants.

The research (including chemical and physical properties) with various parameters of other plant elements proved that the alkaline biochar of the palm oil-palm bunches was able to replace agricultural lime (calcite) in repairing acid soils. Further research results show the use of biochar oil palm empty fruit bunches has a more diverse effect; because in addition to improving soil chemical properties such as pH and alkaline nutrient levels, this material also helps improve soil physical conditions in terms of porosity and acidic soil water systems, compared to agricultural lime only has a chemical effect. The advantages of biochar oil palm empty fruit bunches are renewable resources (replacing resources) replacing agricultural lime (calcite) which is a mining material that is classified as an unrenewable resource.

Keywords: Eksudat root, mucilage, low- and high-M r compounds, rizosfer

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DOI: 10.5530/srp.2020.3.57

INTRODUCTION

Biochar Bunches Empty Palm is superior to the agricultural limestone\/calcite is a material biochar bunches empty palm is able to improve two categories of acid soil properties (1. Chemically increasing basic nutrients and soil pH; and (2) Physics of material has a very large percent pore, so that it can improve the holding capacity of ground water while also supporting soil aieration, with these properties this biochar material can be a substrate for soil microbes while agricultural / calcite lime material improves acid soil conditions only at just one category that is chemically in terms of increasing basic nutrients and soil pH. Aranghayati oil palm empty fruit bunches are alkaline (Lumbanraja et al., 2018) containing various basic nutrients (Ca, Mg, K). This material is a renewable resource which has the potential to support efforts to increase the use of acidic soils in Indonesia in an effort to increase food crop production sustainably because the biochar of this empty palm oil palm bunches is more varied in nutrient elements and at the same time renewable (renewable) resources), Acidic land covers 40% of the world's cultivated land (Pariasca etal,2009).In Indonesia, acidic land area of various orders reaches 102,817,113 ha, Sumatra is 29,344,534 ha, and in North Sumatra are 4,156,283 ha with Incept sol order reaching 2,414,939 ha.

LITERATURE REVIEW

(Mulyani et al, 2004) Acidic soil conditions are known to inhibit the survival of beneficial microbes such as rhizobia bacteria as nitrogen-fixing for legumes (Hollier and Michael,

2005), from tracing the theory that the number of bacteria as the largest number of microbes in the soil ranges from 106 to 109 per gram of soil (Sylvia, 2005. Crops grow at soil pH levels above 5.5 to 6.5 (Cornell University, 2010), and basically grow well in the soil pH range of 6-7 (University of Massachusetts, 2016), soybeans grow well at pH ranges from 6.0 to 6.8 (Pioneer, 2014). Indonesian soybean production until the next few years still needs to be increased, because domestic production still cannot meet the needs of this commodity.

Increasing the pH of acidic soils can be done by adding materials containing basic elements, because they cause reactions that produce hydroxyl groups in the soil, thereby reducing the acidity of the soil. Until now, it is known that the most effective way to deal with soil acidity is agricultural lime, which is a natural resource that cannot be recovered (unrenewable resources). This material is very limited; efforts are needed to get substitute materials that can be renewed and able to improve the condition of acid soils. Oil palm empty fruit bunches biochar are alkaline

MATERIALS AND METHODS

Renewable resources), these two things become the superiority of alkaline oil palm empty fruit bunches biochar replacing agricultural lime. Problem Formulation: The presence of acidic soil, which is quite extensive, becomes a potential that can be useful later if there is a way to overcome the existing problems. Oil palm empty fruit bunches Biochar with its potential to have potentially can be used to overcome the acidity of the soil in order to create conditions that improve the condition of the acid soil into agricultural land. On this basis, a study was carried out to examine the effect of oil palm empty fruit bunches as an amelioration of acid soils in an effort to determine their effect on the total soil microbial population and soybean plant growth. Research Objectives: This study aims to examine the effectiveness of oil palm empty fruit bunches biochar in an effort to ameliorate acid soils to affect the total population of soil microbes and determine their effects on the growth of soybean crops. Research Benefits: Through this research, it is expected that facts will be obtained that can be a source of information about the effectiveness of oil palm empty fruit bunches biochar as acid ameliorant affecting the total soil microbial population and knowing its effect on on the growth of soybean crops. Research hypothesis: In this study, it was ssuspected that the oil palm empty fruit bunches; alkaline biochar affected the soil microbial population and the growth of soybean crops.

RESULT AND DISCUSSION

Effect of Biochar Oil Palm Empty Fruit Bunch Application on the Inceptisol Tanjung Morawa Soil Microbial Population

Application of oil palm empty fruit bunch biochar (OPEFBB) has no significant effect on the total soil microbial population Table 1. The decrease in the total soil microbial population is thought to occur due to lack of food sources for soil microbes to describe of the limitations that occur; these results are different from the results of existing research previously (IBI, 2016). This lack of condition results in competition in various matters including food. As it is known that basically, what is a source of food for soil microbes is sourced from the remnants of crops roots while at this stage of research conducted without crops, so that there is a limited supply of organic material as an energy source for soil microbes that exist in the soil.

Table 1. Effect of Oil Palm Empty Fruit Bunch Biochar Application on Total Soil Microbial Population of Wonosari Inceptisol

Treatment	Biochar Crop Palm Oil (t/ha) 0	5	10	15	20	25
Total Soil Microbial Population	10,74	10,25	10,08	10,31	10,00	10,05@, #

Note: @ Value the population value used is the logarithmic value of TPC at dilutions 10-9.
Numbers not followed by letters are not followed by Duncan's multiple range tests.

Carbon material contained in OPEFBB material will be difficult for microbes to decipher as soon as possible in a short time, because the ratio of C and N of OPEFBB material is still very high ie 37.90:1 rounded to 38:1 (Table 1). The level of soil organic C in the soil that using in the study was only 0.93% (with a conversion factor of 1.724, the soil organic matter was only 1.60%). The level of soil organic matter is classified as low so that this can be an inhibiting factor for the development of soil microbes as a whole.

The fact of decreasing number soil microbes, it is very important and needs considered in the use of biochar. The number of bacteria as the largest number of microbes in the soil only ranges between 106 to 109 per gram of soil (Sylvia, 2005); the lowest population in the results of research provides information that the number decreases total soil microbes are still in the optimal range. Microbial functions in the soil include: soil microbes can influence decomposition of raw materials into mineral materials, such as nutrients Nitrogen, Phosphorus, Sulfur and others in the soil, its availability. Another thing that is affected by soil microbial activity is the decomposition of soil organic matter so that it can be used by plants, even the results of this activity can also be useful to increase the soil CEC, including describing the remnants of pesticides in the soil.

Effect of Biochar Application of Oil Palm Empty Bunches and Agricultural Lime on the Total Microbial Population of Tanjung Morawa Inceptisol Land.

The results of the second phase of the study showed that the total soil microbes actually tended to increase the total number of soil microbes. Tabel 1. His trend pattern is consistent with the results of the study expressed by previous biochar researchers who found that biochar material could improve the conditions of soil microbial development (IBI, 2016). This increase occurred as a result of the exudation process of plant roots in the field treatment, which in the case of the household treatment did not occur. The material that roots emit into the soil around the root itself is known as a term known as root exudate. Root exudate is recognized, as having an important role in terms of soil microbial conditions, although how this effect occurs is still not

fully understood (Travis et al., 2003). Plant roots have other functions or roles in terms of their ability to synthesize, accumulate, and excrete various compounds into the soil (Flores *et al.,* 1999).

Table 2. Effect of Biochar Application of Oil Palm Empty Bunches and Agricultural Lime on the Total Microbial Population of Tanjung Morawa Inceptisol Land.

Treatment	Aplication Biochar of oil palm (t/ha)				
	0 t/ha	5 t/ha	10 t/ha	15 t/ha	Rata-rata
	Total Population Mikrobia				
Chalk Farming	0,0 t/ha	6,47	9,54	9,61	10,08	8,92 @ ≠
Chalk Farming	5,5 t/ha	10,62	10,12	10,84	10,32	10,47
average		8,54	9,83	10,23	10,20	

Notes: @ the population, value used is the logarithmic value of TPC at dilutions 10-9. #) numbers not followed by letters are not followed by Duncan's multiple range tests.

The presence of a variety of complex conditions under the soil surface environment, chemical compounds released by plant roots are very important for microbes in the rhizosphere itself (Estabrook and Yoder, 1998; Bais et al., 2001). These root exudates can be in the form of low Mr Compounds: amino acids, organic acids, sugars, various phenolics, and a variety of secondary metabolites, which basically dominate the excretory compounds or root exudates of high Mr-compound compounds: various kinds of sap or mucilage) such as various polysakkarida and various proteins. The results of this study indicate that the effect of BTKS compared to agricultural lime is not significantly different statistically; this is evidence that BTKS material on this influence can substitute agricultural lime.

Influence of Application of Biochar Extract of Palm Oil and Agricultural Lime on the Amount of Soybean Roots in Cape Morawa Inceptisol.

To known that 5% to 21% of carbon bound through photosynthesis is to transferred or transferred from plant roots to the rhizosphere region through root exudates (Marschner, 1995). This rhizosphere region is a very dense zone of microbial populations and in this area as a zone rich in various organic materials, plant roots must compete with various invading microorganisms including bacteria, fungi, to obtain a place or space, water, mineral nutrients (Ryan and Delhaize, 2001). It is known that 5% to 21% of carbon bound through photosynthesis is transferred or transferred from plant roots to rhizosphere regions through root exudates (Marschner, 1995). This rhizosphere region is a very dense zone of microbial populations and in this area as a zone rich in various organic materials, plant roots must compete with various invading microorganisms including bacteria, fungi, to obtain a place or space, water, mineral nutrients (Ryan and Delhaize, 2001). Root exudate which consists of various compounds makes the root can regulate, control or determine what microbes can develop in the environment closest to the roots of the plant itself, strengthen the growth of beneficial microbes that are symbiotic, inhibit the growth of microbes that compete with business plants and change chemical conditions and soil physics (Nardi et al., 2000). Various compounds that are known to have an important role in the interaction of roots with microbes including various flavonoid compounds found in the root exudate of legume plants that activate various bacteria Rhizobium meliloti responsible for the process of forming nodules or nodules on legume plants (Peters et al. 1986). There was no significant effect of the tested treatment on the number of soybean root nodules. The highest number of nodules was obtained when the combination of biochar material BTKS 5, 0 t / ha together with agricultural lime 5, 5 t / ha, followed by the treatment application of oil palm empty fruit bunches biochar equivalent to 5 t / ha as a single treatment. This fact shows that the increase in the number of soybean root nodules formed proves the good effect of the application of alkaline biochar material for oil palm empty fruit bunches on the soil condition, as shown in Table 3.

Table 3. Influence of Application of Biochar Extract of Palm Oil and Agricultural Lime on the Number of Root Roots in Cape Morawa Inceptisol.

Treatment	Oil Palm Emty Fruits Bunch Biochar				
	0 t/ha	5 t/ha	10 t/ha	15 t/ha	Mean
	Jumlah Bintil Akar				
Chalk Farming	0,0 t/ha	13,83	15,16	13,30	14,63	14,23
Chalk Farming	5,5 t/ha	14,63	17,86	14,36	13,36	15,05

average	14,23	16,51	13,83	13,99	
				pH Tanah	
Chalk Farming 0,0 t/ha	5,00d	5,06d	6,23bc	5,56cd	5,46B*
Chalk Farming 5,5 t/ha	6,50ab	6,83ab	5,80bc	7,16a	6,57A
average			5,75	5,95	6,01 6,36

Explanation: *) Numbers followed with different letters is significantly with Duncan's Multiple Range Test at 0.05 by original letter and highly significant at 0.01 by capital letters. **) Numbers did not followed with letters is not continued with Duncan's Multiple Range Test.

Treatment with alkaline biochar oil palm bunches is able to exert an effect that exceeds the influence of agricultural lime. This data also provides evidence that the application of biochar material for oil palm empty fruit bunches is equivalent to 5 t / ha together with agricultural lime still showing a mutually influential effect on the number of root nodules formed which in this case shows that the condition occurs when soil pH 6, 83 Table 3 above.

The Effect of Biochar Application of Palm Oil Empty Bunches and Agricultural Lime on Soybean Plant Growth in Inceptisol Wonosari Tanjung Morawa.

The application of oil palm empty fruit bunches biochar, significantly affected plant height of 21 HST, agricultural lime significantly affected plant height of 14 HST and significantly affected plant height of 21 HST while the interaction between the two had no significant effect as well as 28 HST both had no significant effect as seen in Results data in Table 4.

Table 4. Effect of Oil Palm Empty Fruit Bunches Biochar and Agricultural Lime Application on Soybean Plant Growth in Wonosari Inceptisol.

Treatments	Oil Palm Emty Fruits Bunch Biochar (t/ha)				
	0 t/ha	5 t/ha	10 t/ha	15 t/ha	Means
Crop height at 14 DAP (cm)					
Agricultural Lime 0,0 t/ha	20,46	20,66	18,90	20,40	20,10b
Agricultural Lime 5,5 t/ha	20,50	21,93	21,46	21,10	21,25a
Means	20,483	21,3	20,18	20,75	
Crop height at 21 DAP (cm)					
Agricultural Lime 0,0 t/ha	28,90	31,40	29,26	30,36	29,98B
Agricultural Lime 5,5 t/ha	30,33	31,96	31,96	31,23	31,37A
Means	29,61b	31,68 a	30,61a b	30,8ab*	
Crop height at 28 DAP (cm)					
Agricultural Lime 0,0 t/ha	45,36	47,23	45,46	46,36	46,10≠
Agricultural Lime 5,5 t/ha	46,23	48,70	47,23	47,70	47,46
Means	45,8	47,96	46,35	47,03	
Wet weight of the stem and leaves (g)					
Agricultural Lime 0,0 t/ha	135,10	158,30	125,76	141,66	140,20
Agricultural Lime 5,5 t/ha	139,00	152,56	140,70	152,16	146,10
Means	137,05	155,43	133,23	146,91	
Dry weight of the stem and leaves (g)					
Agricultural Lime 0,0 t/ha	13,40	17,30	13,76	15,20	14,91
Agricultural Lime 5,5 t/ha	15,03	16,93	15,63	16,56	16,04
Means	14,21	17,11	14,7	15,88	
Wet weight of crop roots (g)					

Agricultural Lime 0,0 t/ha	13,50	15,13	10,36	14,93	13,48
Agricultural Lime 5,5 t/ha	13,70	14,66	14,93	13,00	14,07
Means	13,6	14,9	12,65	13,96	
Dry weight of crop roots (g)					
Agricultural Lime 0,0 t/ha	2,70	3,13	2,23	3,03	2,77
Agricultural Lime 5,5 t/ha	2,76	3,06	2,93	2,80	2,89
Means	2,73	3,1	2,58	2,91	
Explanation: *) Numbers followed with different letters is significantly with Duncan's Multiple Range Test at 0.05 by original letters and highly significant at 0.01 by capital letters. **) Numbers did not followed with letters is not continued with Duncan's Multiple Range Test.					

Plant height of 21 HST shows that the treatment of agricultural lime has a very significant different effect, while the application of BTKS material has an effect at a significantly different level. At the age of 28 HST showed that the two treatments no lo nger showed any significant effect on plant height the interaction of the two treatments did not significantly affect the height parameters of this plant. the application of oil palm empty fruit bunch biochar (BTKS), agricultural lime and interaction do not significantly affect the wet weight or dry weight of the top of the plant as shown in the data presented in Table 4: The trend pattern of the effect of BTKS treatment on the parameters of plant height of 21 HST has already exceeded the peak application. Equation X = - b / 2a is used to get the peak dose for the quadratic equation, then the peak dose of BTKS application to soybean height at 21 HST occurs in the application of BTKS material equivalent to 9.22 t / ha. The results of these calculations indicate that the administration of BTKS material more than the peak dose effect on plant height has decreased.

The wet weight and dry weight of the plant parts performed at the age of 28 HST shows that both the wet weight and the dry weight of the stem and plant leaves are likely to increase, but the improvement in the observed parameters is not significant. The significant increase only occurred when the BTKS material application treatment was equivalent to five t / ha, whereas in the higher BTKS material application there was a decrease in this parameter. The same pattern also occurs with the parameters of observing the weight of the roots of plants, both wet and dry weight of the oven (Table 4.). The results of previous studies such as those conducted by researchers from Massey University found that the application of biological charcoal into agricultural soils was able to increase biomass production by up to 45% and this condition made this material interesting to be included in the agricultural business field (Biochar, 2016). The Massey University researcher, however, the fact that the treatment of BTKS material application into the soil in research with this soybean commodity shows the tendency for the effect to increase. Lehmann, et al. (2003a) with potted research using cowpea (Vigna unguiculata (L.), has directed the same thing Walp.) And rice (Oryza sativa L) plants concluded that the addition of aranghayati markedly increased plant growth and nutrition, it did not stop there Kimetu, et al. (2008) conclude that administration of charcoal to the most degraded soils effectively increases yield.

CONCLUSION

1. The application of agricultural Oil palm empty fruit bunch alkaline biochar material without crops results in a tendency for total soil microbial populations to decline, but in applications accompanied by soybean, cropping the trend is to increase. The total soil microbial population, it also appears the best results for the total soil microbial population result number of root nodules forming. And the best growth results occur concurrently when the application of a single empty palm oil bunch alkaline biochar material at a level of five t / ha or in a combination of this level of treatment with agricultural lime.
2. lime only has a balanced effect even below the results of the application of oil palm empty fruit bunches alkaline to the formation of soybean root nodu biochar, this is an indication of the material in this case the biochar oil palm fruit bunches can repla ce agricultural lime
3. The interaction of oil palm empty fruit bunches alkaline biochar with agricultural lime material does not significantly affect the observed parameters but tends to improve the observed parameter conditions at the material level of 5 t / ha while the application of the above material tends to decrease even though it is still above the control treatment

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