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The potential use of pyrolysis charcoal (bio-char) for Ultisol soil bio-ameliorant

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Introduction

A series of research was carried out with the objective to meet the challenge and determine the direction and strategy required for overcoming highly weathered Ultisol soil that impact to low productivity. Selected ameliorating materials, i.e. bio-char, compost, and peat were examined their physical characteristics to determine the best combination of them as bio-ameliorant carrier materials for aggregate stability bacteria. It is postulated that the oil palm nutshell originating bio-char has a comparable properties as microbial carrier materials and acid soil ameliorant for maize as alternative to the other two said materials.

Results and Discussions

The bio-char originated from oil palm nutshells is shown in Figure 1 indicating a porous microstructure as reported earlier by others [1,2].

Figure 1. Microstructure of bio-char from oil palm nutshells.

Table 1. physico-chemical characteristics of bio-char, compost, and peat.

Type of materials	*Type of analysis*								
	N (%)	P (%)	K (%)	C-org (%)	*CEC* (meq/100g)	BD (g/cc)	PD (g/cc)	Total Pore Space	WHC (%)
Bio-char	1.32	0.07	0.8	25.62	4.58	0.8	1.85	63.3	25.3
Compost	1.38	1.08	0.19	22.38	60.8	0.42	1.45	71.2	9.7
Peat	1.10	0.08	0.18	33.51	103.5	0.25	1.45	82.4	10.1

Table 2. Vegetative growth of maize Bisma var. 8 weeks after planting.

Treatments	*Parameter**	
	Height (cm)	*Number of leaf*
Full rate of NPK fertilizer dosages	129.9 b	10.4 a
Full rate of NPK fertilizer dosages+25% bio-ameliorant (2.1 g/tree)	132.4 b	10.5 a
Full rate of NPK fertilizer dosages+ 50% bio-ameliorant (4.2 g/tree)	149.8 a	10.2 a
50% of NPK fertilizer dosages+ 50% bio-ameliorant (4.2 g/tree)	138.9 ab	9.9 a
Blank	49.4 c	4.9 b
Coefficient of Variability (%)	4.2	4.0

*Figures in the same column followed by similar letter (s) are not significantly different according to Duncan Multiple Range Test (P>0,05).

Bio-char was found to be the most suitable carrier material as it has highest total pore spaces and available water content (Table 1). Microbial population obtained from the granular forms of bio-ameliorant was 107 CFU/gram of the sample until 12 months life time periods. Best vegetative growth performance of maize Bisma var. in Ultisol soil of Experiment Station (KP) Taman Bogo, Lampung, Indonesia was shown by the application of 100% standard dosage of NPK conventional fertilizers in combination with the addition of 4.2 g/tree of bio-ameliorant (Table 2).

Conclusions

Bio-char, compost, and peats exhibited best comparable performances as microbial media and soil ameliorant. This finding would lead to the formulation of most effective soil ameliorant consisting bio-char, organic materials, and basic mineral components.

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