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Effects of Liquid Organic Fertilizer towards Acidity of Ex-Coal Mining Soil from Asam-asam Village, South Kalimantan

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Abstract: Open pit mining that commonly implemented in Indonesia has caused ecosystem damage, soil degradation, pollution, water sedimentation, and change of climates. A coal mining site in Asam-asam Villange, South Kalimantan happens the same way. The supporting capacity of topsoil post-mining activities left the area into low grade soil for the plants growth, which could be implied by one of its chemical characteristics, i.e. acidity (pH). Thus we attempt to improve the soil quality by using liquid organic fertilizer for the soil amendment. This paper was aimed to describe the effects of soil amendment by liquid organic fertilizer towards the acidity of the soil from ex-coal mining site Asam-asam Village, South Kalimantan. We used Complete Randomized Design for the experiment. Soil sample of Asam-asam Village was taken from PT. Jorong Barutama Grestone. Treatments of liquid organic fertilizer used for types of fertilizer, namely Formula, Nasa, Biofast, and Green Tonic. Dose variations are 3, 6, 9, and 12 liter per ha with 4 times repetition. Corn plants (Bonanza F1) also used for the biological improvement was planted after 2 days post fertilizing in polybag for six week. The results showed that the treatment of soil amendment by liquid organic fertilizer could improve the acidity condition. Liquid organic fertilizer Formula with dose 6 liter per ha was found to be significantly increase the soil acidity. We conclude that the liquid organic fertilizer is one of effective soil amendment for ex-coal mining site to be re-qualified for plants growth as future productive land area.
Keywords: acidity, coal mining, soil amendment.

Introduction

Generally, the operational technique of coal mining in Indonesia is open pit mining; opening of land area and paring of top soil to obtain the coals. Impact that occurred due to this open coal mining pit is ecosystem damage, soil damage, pollution, water sedimentation, and climates changes. The supporting capacity of top soil post mining activities becomes low[1]. Land area post-coal mining is commonly characterized by the degraded physical, chemical, and biological characteristics of the soil[2]. Focused on its chemical characteristics, the ex-mining area has very low macro nutrient, especially its N, P, K, Na, and Ca, as well as low level of acidity (pH) and Cation Exchange Capacity (CEC)[2].

Chemical characteristics of a soil refer to the basic characteristics of soil acidity level or different pH. Several chemical characteristics used as parameters are soil pH, carbon, nitrogen, and C/N phosphate available. These chemical characteristics could be used to assess whether the soil has potential or not[3].

Soil reaction show the acidity or alkalinity of soil which represent with the value of pH. Soil pH is a good chemical indicator for the soil quality assessment. Understanding the soil pH is very important for the proper management to optimize the soil and plants productivity. Soil pH described the number of hydrogen ion within the soil solution. However, the real concentration of hydrogen ion in the soil solution is rather small amount. Soil with pH 4.0 has only hydrogen ion for 0.0001 mol per liter in its soil water (1 mol is equal to the number of hydrogen atom in 1 g of hydrogen). Thus, to ease the application, pH is presented as negative logarithm of hydrogen ion concentration, scaled 0-14. All changes in number of pH implied the 10 times changes in the concentration of H^+ ion. The increased hydrogen ion leads to decreased pH[4].

The supporting capacity of topsoil post-mining activities left the area into low grade soil for the plants growth, which could be implied by one of its chemical characteristics, i.e. acidity (pH). Thus we attempt to improve the soil quality by using liquid organic fertilizer for the soil amendment. This paper was aimed to describe the effects of soil amendment by liquid organic fertilizer towards the acidity of the soil from ex-coal mining site Asam-asam Village, South Kalimantan.

Material and Methods

Soil Sampling

The experiment of the soil amendment was conducted in a greenhouse in Achmad Yani University, Banjarmasin. The soil was sampled from PT. Jorong Barutama Grestone (JBG), Asam-asam Village, District of Jorong, Regency of Tanah Laut, South Kalimantan. Soil was sampled compositely for the growth media of corn in polybags at the green house. Soil sample for analysis in the laboratory was taken by ring sample in the area of ex-cal mining. Soil sampling point used Diagonal System in three areas of JBG, each area includes with 5 points of diagonal (Fig.1).

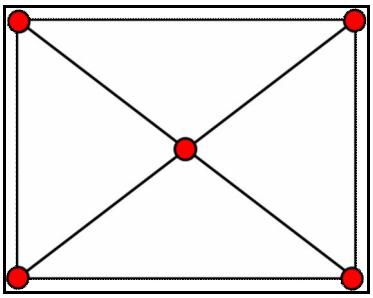

Figure 1. Diagonal System for the Soil Sampling in JBG Area

Experimental method

Liquid organic fertilizer Formula

Liquid organic fertilizer Formula were made from the standard organic compounds of nutrient for plants growth, i.e. N, P, and K. The fertilizer was fermented for 1-2 weeks with microorganism culture of decomposition bacteria. The composition on the fertilizer Formula was described in Table 1.

Table 1. Laboratory Analysis of Liquid Organic Fertilizer Formula

No.	Composition	Analysis Results	minimal requirement of the liquid organic fertilizer
1	pH (H_2O)	4.36	4 – 8
2	C-org (%)	1.29	6
3	N-total (%)	0.83	3 – 6
4	P_2O_5 (%)	0.123	< 5
5	K_2O (%)	0.14	< 5
6	Ca (%)	0.321	-
7	Mg (%)	0.005	-
8	N-NH_4 (ppm)	41.88	-
9	Na (%)	0.003	
10	Fe (%)	0.0001	Max 0.0400
11	S	0.002	-
12	Total Population of Microorganism	5.71×10^5	-

Experiment Procedure

The research was conducted from January to June 2015. We used complete randomized design with treatments of different types of liquid organic fertilizer, i.e. Formula, Nasa, Biofast, and Green Tonic. The dose varied of 3, 6, 9, and 12 liter per ha with 4 times repetition. Corn (Bonanza F1) was planted after 2 days post fertilizing in 35 cm x 40 cm polybag.

Data Analysis

pH Analysis

Acidity of the soil that treated with liquid organic fertilizer were analyzed in the Laboratory of Soil, Lambung Mangkurat University and Laboratory of Soil, Swamp Soil Research Institute (BALITRA), Banjarbaru, South Kalimantan. The soil sample was analyzed before and after the treatment of liquid organic fertilizer. Soil pH was measured with the method of extraction H_2O and KCl.

Statistical Analysis

Data were analyzed statistically with normality test, homogeneity test and data transformation. The analysis was continued to analysis of variance (ANOVA)[5].

Results and Discussion

Initial pH of Ex-coal Mining Soil

The soil pH of ex-coal mining site is 2.28 with extraction H_2O method and 1.98 with extraction KCl method. It is implied that the soil from the ex-coal mining area is extremely acid, which was caused by the acid water from the mine and heavy metals pollution[6]. This condition is made the plants impossible to grow. According to the Government Regulation No. 150 of 2000, the critical threshold of acidity is 4.5 for soil, thus the soil sample of this study was already over the critical level.

pH of Ex-coal Mining Soil after Amendment

The soil acidity after soil amendment with liquid organic fertilizer was showed improved (Table 2). However, the results are still in the range of very acid due to the short period of the observation.

Table 2. Acidity (pH H_2O) of the Ex-coal Mining Soil after Treatment

No	Liquid Organic Fertilizer	pH H_2O
1	Initial Condition (without fertilizer)	2.28
2	Formula	**4.06**
3	Nasa	3.00
4	Biofast	2.67
5	Green Tonic	2.60

Statistic analysis results showed that all types of liquid organic fertilizer with dose 3, 6, 9, and 12 liter/ha is significantly affect on the soil pH of ex-coal mining soil (α=1%). Least Significant Difference on the soil pH (Table 3) showed that the best improvement on soil pH was found in the liquid organic fertilizer Formula with dose 6 liter per ha, however other dose of liquid organic fertilizer Formula also give higher pH than other types of liquid organic fertilizer.

Table 3. Soil pH from Amendment with Liquid Organic Fertilizer

No.	Treatment	Doses (liter/ha)	pH H_2O
1	Biofast	3	2.72^{ab}
2	Biofast	6	2.75^{ab}
3	Biofast	9	2.64^{a}
4	Biofast	12	2.57^{a}
5	Green Tonic	3	2.58^{a}
6	Green Tonic	6	2.76^{ab}
7	Green Tonic	9	2.56^{a}
8	Green Tonic	12	2.50^{a}
9	Nasa	3	2.89^{abc}
10	Nasa	6	3.04^{abc}
11	Nasa	9	3.42^{bcd}
12	Nasa	12	2.64^{a}
13	Formula	3	3.498^{cd}
14	Formula	6	$\mathbf{4.42^{e}}$
15	Formula	9	4.287^{e}
16	Formula	12	4.032^{de}

Conclusion

The treatment of soil amendment by liquid organic fertilizer could improve the acidity condition of ex-coal mining soil. Liquid organic fertilizer Formula with dose 6 liter per ha was found as the highest that significantly increase the soil acidity. The liquid organic fertilizer is one of effective soil amendment for ex-coal mining site to be re-qualified for plants growth as future productive land area.

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