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The Influence Of Organic Matter Application On Contaminated Paddy Field By Acids Mine Drainage To Soil Chemical Characteristic, Growth And Yield Of Rice

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Abstract: *A research about paddy growth in contaminated soil by coal acid mine drainage has been carried out, This research aims to find out the effect of organic matter in recovering soil chemical properties, growth and yield of paddy which were planted in paddy fields contaminated by coal acid mine drainage.The experimental research is statistically designed using a nested design with two factors and an environmental design using of completely randomized block design with three replications. The first factors is the kinds of organic matter (J) with three level, such as Guano (j_1), oil palm biosolids (j_2) and chicken manure (j_3). The second factor is organic doses which are nested in organic matter (7 levels), such as 2,5 t ha^{-1}(d_1); 5,0 t ha^{-1}(d_2); 7,5 t ha^{-1}(d_3); 10 t ha^{-1}(d_4); 12,5 t ha^{-1}(d_5); 15 t ha^{-1}(d_6); 17,5 t ha^{-1}(d_7) with an additional control (without any organic matter treatment).The result reveals that an additional organic matter increase soil pH of 22,16% ,available P_2O_5 by 93,3 % and weight of dried grains per hectar (6.4 ton). By adding chicken manure of 15 t ha^{-1}the experiment reveals that the height of plant at7 wap (96,86 cm)and number of tiller (20,03 stem). This result shows that chicken manure give higher yield than guano and oil palm biosolids.*

Key Words: *organic matter, acid mine drainage, contamination*

I. Introduction

Every coal mining activity in South Borneo is nowadays done by the open pit mining method. This method became the favorite choice due to its high productivity, good workplace safety and low operational cost. Despite these advantages, the method has negative effects to the environment.In this case, this coal mining method inflictslandscape damage, biodiversity damage, sedimentation, erosion, and also many forms of pollution to the local environment.

The effects caused by coal mining activity by the open pit method might cause lasting damages. In this case, the damage to the local environment might even persist after the mining activity is done. Open spaces without vegetation cover tend to become critical land. The unmanaged overburden which isn't used to cover the holes caused by open pit coal mining will cause pollution to rivers and crop fields in form of sediments and acid mine drainage.

The acid mine drainage phenomenon, which is characterized by the change of water color to orange, becomes one of the most severe problems due to its ability to contaminate nearby paddy fields. This phenomenon will cause a chain effect that consists of the increase of soil acidity, disruption of balance and availability of nutritional elements in the soil, and theincrease in solubility of microelements on the soil. Paddy fields which are continuously exhibited to acid mine drainage will eventually experience a decrease in productivity.

Studies on the usage of organic matter to repair the physical and chemical properties of acid sulfate soil have been done and suggest positive results. Togatorop dan Setiadi (1999) found out that an application of 10 ton ha^{-1} cow manure clearly increases dried grains, while composted rice straw increases the yield by 48% (Anwar, *et al*., 2006). Otherwise an additional organic matter clearly decreases$Fe2^{+}$and increases available P and also maximum number of tiller and paddy grain (Batubara, *et al*., 2014).

Based on the observation that chemical properties of paddy fields contaminated by acid mine drinage are similar with natural acid sulfate soil, we present a research on the usage of various organic matter with different doses to remediate paddy fields contaminated by acid mine drainage caused by coal mining activity.

II. Materials And Metode

All serial research were conducted at paddy fields which where contaminated by coal acid mine drainage. This research conducted at rice fields in Karangan Putih village, district of Binuang, Tapin residency, Kalimantan Selatan province, Indonesia ((0287338(x) and 9651984(y)) where is situated at active coal mining between October 2013 to July 2014.

This field experimental investigation was using organic matter, such as guano, oil palm biosolids, chicken manure, urea and NPK Phonska fertilizer. It is also using pesticide, Furadan 3G.

The experimental research was statistically designed using a nested design with two factors and an environmental design using of completely randomized block design with three replications. The first factors is the kind of organic matter (J) with three level, such as Guano manure (j_1), oil palm biosolids (j_2) and chicken manure (j_3). The second factor is organic doses which are nested in organic matter (7 levels), such as 2,5 t ha^{-1} (d_1); 5,0 t ha^{-1} (d_2); 7,5 t ha^{-1} (d_3); 10 t ha^{-1} (d_4); 12,5 t ha^{-1} (d_5); 15 t ha^{-1} (d_6); 17,5 t ha^{-1} (d_7) with an additional control (without any organic treatment). Every experimental unit was planted in the plot with size of 3 m x 4 m, with the distance of seedling planting about 20 cm x 20 cm. Observed variables consist of soil pH, available P_2O_5, dissolvedFe, dissolvedsulfate, height of plants,number of tiller,and weight of dried grains per hectar. Analysis of variance (ANOVA) was implemented. If the treatments give an effect to the variables, then Duncan multiple range test (DMRT) was conducted to differentiate the effect of each treatment with 5% confident level(Steel and Torie, 1981; Nazir 1988; Pollet dan Nasrullah, 1994)and to compare the effect those treatments and their control were used contras orthogonal test.

III. Results And Discussion

Analysis of variance towards the soil's amount of dissolved Fe and Sulfate indicates that kinds and doses of the organic mattertreatment do not show any significant effects towards their observed values. However, the pH andavailable P_2O_5, treatment with various organic matter indicates a significant compared to the control (without organic matter). The average of the pH, dissolved Fe, dissolved sulfate and available P_2O_5 can be seen in Table 1.

Table 1.Average pH, Dissolved Fe, Dissolved Sulfate and Available P_2O_5forTreatment of Organic Matters.

Treatment	Soil chemical properties			
	pH H_2O	Dissolved Fe (ppm)	Dissolved Sulfate (ppm)	Available P_2O_5
Control	4,03*	380,73	239,30	0,56*
d_1/j_1	4,87	314,09	173,71	0,96
d_2/j_1	4,67	374,18	88,29	0,85
d_3/j_1	4,73	440,80	281,40	0,84
d_4/j_1	5,17	369,07	221,64	0,72
d_5/j_1	5,08	330,02	283,38	1,03
d_6/j_1	5,02	338,29	539,16	0,84
d_7/j_1	4,99	280,52	326,60	0,91
d_1/j_2	4,68	338,20	246,76	0,85
d_2/j_2	4,69	332,05	345,29	0,78
d_3/j_2	4,82	254,63	238,72	0,91
d_4/j_2	4,92	295,55	447,67	0,78
d_5/j_2	4,88	274,24	356,24	0,84
d_6/j_2	4,78	451,24	244,68	0,78
d_7/j_2	4,84	387,52	374,51	1,10
d_1/j_3	4,63	541,86	369,47	0,84
d_2/j_3	4,71	378,18	162,59	0,84
d_3/j_3	4,84	315,79	132,12	0,78
d_4/j_3	4,88	346,22	315,16	0,72
d_5/j_3	5,13	256,59	264,18	0,72
d_6/j_3	5,03	312,57	211,91	0,91
d_7/j_3	4,51	390,34	168,39	0,91

* Contrast orthogonal test , Effects of organic matter treatments are significantly different to that of the control.

Various treatments, each administering different organic matter with different doses, do not indicate any significant effect towards dissolved Fe and dissolved sulfate. This is possibly caused by the water that became the cause of contamination came from acid mine drainage which contains dissolved Fe and Sulfate. Hence, giving water to the paddy field will also increase the amount of dissolved Fe and Sulfate.

The treatment of kind organic matter with different doses significantly increased the pH to 4.85 from the value 4.03 in soil without any treatment, which is consistent with the results from Escobar and Hue(2008). On the other hand, the in soil pH is possibly caused by the effects of Fe reduction. Ponnamperuma(1985) in Anwar, et al., (2006) attributed the increase of pH in submerged acidic soil to the reduction of Fe which requires $H^{+.}$ The treatment of organic matter will accelerate the Fe reduction process.

The treatment of organic matter also significantly increased the amount of available P_2O_5 from 0.56 ppm to 0.85 ppm. From Table 1, we might see that the amount of available P_2O_5 after every treatment of organic matters falls in the low criteria (Blakemore *et al*., 1987). According to Purnomo(2002), the efficiency of treatment of P fertilizers on acidic sulfate soil is low since it doesn't increase the amount of available P, rather it merely increases the total of P in the soil. The low pH is hypothesized as the cause of the lack of P.

The result of Anova of height of plants at 7 wap shows that the kinds of organic matter and their doses in their kinds of organic matter give significan diferent. Mean different test show as in Table 2

Table 2.The Effect of Doses in their Kinds of Organic Matter toHeight of Plants at 7 wap

Doses/Kinds of organic treament	Height of plants (cm)*/		
	Guano	Oil palm biosolids	Chicken manure
2,5 t ha^{-1}	79,3^{ab}	78,0^{ab}	79,9^{a}
5,0 t ha^{-1}	77,9^{a}	77,6^{a}	83,9^{a}
7,5 t ha^{-1}	80,6^{ab}	81,0^{ab}	88,5^{b}
10 t ha^{-1}	78,6^{ab}	80,8^{ab}	90,3^{b}
12,5 t ha^{-1}	80,8^{ab}	80,3^{ab}	92,9^{bc}
15 t ha^{-1}	82,1^{b}	81,3^{ab}	96,8^{c}
17,5 t ha^{-1}	81,3^{ab}	84,8^{b}	92,8^{bc}

*/ Figures of mean at the same colum which is followed by superscriptlettersnot significantly according to DMRT 5%.

Figures in Table 2 shows that chicken manure with dose at 15 t ha^{-1} results in height of plants at 96.8 cm in 7 wap. This result is higher and significantly different to other dosing treatments, accept to these of 12,5 t ha^{-1}, and 17,5 t ha^{-1}. Guano with dose at 15 t ha^{-1}results in height of plants at 82.1 cm in 7 wap. This result is higher and significantly different to the treatment with dose of dosis 5 t ha^{-1}, but not to other dosing treatments. Oil palm biosolidswith dose at 17,5 t ha^{-1}results in height of plants at 84.8 cm in 7 wap. This result is higher and significantly different to other dosing treatments 2,5 t ha^{-1} dan 5,0 t ha^{-1}.

The result of ANOVA to the number of tiller at 7 wap, kind of and doses in kinds of organic treaments give significantly different effect. The result of of Mean different analysis can be seen at Table 3,

Table 3.The Effect of Doses in their Kinds of Organic Matterto the Number of Tiller at 7 wap.

Doses/Kinds of organic treaments	Number of tiller (stem)*/		
	Guano	Oil palm biosolids	Chicken manure
2,5 t ha^{-1}	16,3^{a}	16,0^{a}	16,0^{a}
5,0 t ha^{-1}	16,7^{ab}	16,0^{a}	17,3^{ab}
7,5 t ha^{-1}	17,7^{ab}	16,7^{ab}	19,3^{bc}
10 t ha^{-1}	16,7^{ab}	17,0^{ab}	19,3^{bc}
12,5 t ha^{-1}	18,0^{ab}	16,0^{a}	21,3^{c}
15 t ha^{-1}	17,0^{ab}	18,0^{ab}	20,3^{c}
17,5 t ha	19,0^{b}	19,0^{b}	21,7^{c}

*/ Figures of mean at the same colum which is followed by superscriptlettersnot significantly according to DMRT 5%.

Figures at Table 3 show that chicken manure with dose at 17,5 t ha^{-1} results in average of 21,7 stemps of tiller number at 7 wap. This result is higher and significantly different than those doses of 2,5 t ha^{-1}, dan 5,0 t ha^{-1}. Guano with dose of 17,5 t ha^{-1}gives tiller number of 19,0 stemps. This figure is higher, but not different significantly to those doses, accept to dose of 2,5t ha^{-1}. Oil palm biosolids with dose of 17,5 t ha^{-1}gives number of tiller at 7wap of 19,0 stemps. This figures is higher and significantly different to those doses of 2,5 t ha^{-1}and 5,0 t ha^{-1}.

The result of ANOVA to weight of dry milling grain per hectar, organic matter treatments gives significant different to their control. The figure of dry milling grain per hectar can be seen at Table 4.

Table 4.Average of Weight of Dried MillingGrain per Hectar for Treatment of Organic Matters.

Treatments	Weight of dry milling grain (tonnes)
Control	3,9*
d_1/j_1	6,0
d_2/j_1	5,3
d_3/j_1	6,3
d_4/j_1	5,8
d_5/j_1	7,0
d_6/j_1	6,8
d_7/j_1	6,8
d_1/j_2	5,3
d_2/j_2	5,9
d_3/j_2	6,4
d_4/j_2	5,7
d_5/j_2	6,4
d_6/j_2	7,6
d_7/j_2	6,8
d_1/j_3	6,5
d_2/j_3	7,2
d_3/j_3	6,3
d_4/j_3	6,7
d_5/j_3	5,9
d_6/j_3	6,3
d_7/j_3	6,6

*Contrast orthogonal test , Effects of Organic matter treatments are significantly different to that of the control.

Organic treatment increases the mass of dry milling grain per hectar (6,3 tonnes) and significantly different to those of the control of 3.9 tonnes. Kind of organic matter increase of height and number of spring per clump and dry milling grain. These figures reveals that nutrition in organic matter can benefit to plants in providing nutrition and chelating metal elements, so that available nutrition will maximally provided for the plants (Batubara, *et al*., 2014).

IV. Conclusion

The treatment of organic matter on paddy fields contaminated by acid mine drainage from coal mines can increase the soil pH around 22.1%(from 3.97 to 4.85), the amount of available P_2O_5 for around 93.3%(from 0.44 ppm to 0.85 ppm) and weight dried milling grain about 6.4 tonnes per hectar. Chicken manure with dose of 15 t ha^{-1} result in 96.86 cm height of plants and the number of tiller of 20.03 stamps at 7 weeks after planting. These figures conclusively reveal that chicken manure gives higher number than those of guano's and oil palm biosolid's ones.

References

[1]. Anwar, K., S.Sabihan., B. Sumawinata., A. Sapei dan T. Alihamsyah. 2006. Pengaruh Kompos Jerami terhadap Kualitas Tanah, Kelarutan Fe^{2+} dan SO_4^{2-} serta Produksi Padi pada Tanah Sulfat Masam. Jurnal Tanah dan Iklim 24:29-39

[2]. Batubara, I.S., Fauzi dan K.S. Lubis. 2014. Pengaruh Pemberian Fosfat Alam dan Bahan Organik terhadap Sifat Kimia Tanah, Pertumbuhan dan Produksi Padi (Oryza sativa L) pada Tanah Sulfat Masam Potensial

[3]. Blakemore, L.C., P.L. Searle and B.K. Daly. 1987. Methods for Chemical analysis of Soils. NZ Soil Bureau.Departement of Scientific and Industrial Reseach.Lower Hutt, New Zealand.

[4]. Dean, A., D Angela and Voss Daniel. 1998. Design Analysis Experiment. Sprinnger. Secaucus NJ USA

[5]. Escobar., M.E and N.V. Hue. 2008. Temporal Change of Selected Chemical Properties in Three Manure. Amended Soils of Hawaii. Bioresources Technology 99 (2008) 8649-8654

[6]. Nazir, M. 1988. Metode Penelitian. Ghalia Indonesia. Jakarta.

[7]. Pollet, A. dan Nasrullah.1994.Penggunaan Metode Statistika untuk Ilmu Hayati.Gadjah Mada University Press.Yogyakarta.

[8]. Purnomo, J. 2002. Pengaruh Pemupukan Fosfat Alam pada Tanah Sulfat Masam Beririgasi Teknis terhadap Pertumbuhan dan Hasil Padi Sawah.Thesis. Fakultas Pertanian UGM

[9]. Steel, R.G.D,.and J.H. Torrie. 1981. Principles and Procedures of Statistics. A Biometrical Approach. Mc. Graw Hill Int. Book Co. New York.

[10]. Togatorop, M.H dan B. Setiadi.1992.Peranan Pupuk Kandang dalam Sistem Usahatani Terpadu Lahan Pasang Surut dan Rawa.Pusat Penelitian dan Pengembangan Peternakan.