The Effect of Ameliorant and Bacteria Reducing Sulfate on Plant Growth in Acid Sulphate Land

Asmarlaili Sahar[1], Diana Sofia Hanafiah[1] and Muhdi[2]
[1]*Faculty of Agriculture, Universities Sumatera Utara, Medan 20154, Indonesia*
[2]*Faculty of Forestry, Universities Sumatera Utara, Medan 20154, Indonesia*

Keywords: Ameliorant, Chemical Fertilizer, Sulphate Reducing Bacteria, Sulphate Soil Productivity.

Abstract: Provision of organic matter, ameliorant and fertilizer is an important factor for improving sulphate soil productivity. The purpose of this study was to study the effect of ameliorant, chemical fertilizer and sulfate reducing bacteria on acid sulphate soil to palm plant growth. This research has been conducted in greenhouse and Soil Biology Laboratory, Faculty of Agriculture, University of Sumatera Utara Medan with 32 meter above sea level. The materials used in this research are D x P palm oil seedlings with 3 month age as objects to be observed. This research uses Randomized Block Design method. If the results of the analysis of variance showed a significant effect then it will be continued with the average difference test based on Duncan Multiple Range Test at α 5% level. All BPS-driven interactions increase the growth of trunk diameter except interaction with lime amendments. This is because lime treatment can increase the pH because it interacts with sulphate and forms gypsum, while sulphate is also a source of food for the BPS itself, which causes BPS treatment to be ineffective.

1 INTRODUCTION

Climate change is causing several threats in agriculture to increase plant production. There are several factors affected schedules and cropping pattern cause by climate change such as the increase of pest and plant diseases , genetic variability and marginal land. Giving ameliorant and fertilizer is an important factor to improve the productivity of acid sulphate soil. Several research results showed that dolomite administration equivalent to Aluminum 13.7% saturation could increase production of Anjasmoro soybean varieties.

Provision of organic matter, ameliorant and fertilizer is an important factor for improving sulphate soil productivity. Several research results indicate that the administration of organic materials accompanied by N, P, K fertilizers can increase plant growth and crop production in sulfate swamp land.

On sulphate sulphate land that has been planted like palm oil plantation PT Mapoli Raya, to overcome the problem of sulfate oxidation conducted inundation in periodic with Fauzi Yusuf (staff leader of PT Mapoli Raya). However, according to the results of some researchers' research, on sulphate sulphate fields that have been oxidized and if re-infiltrated, the speed of sulfate reduction by BPS natively runs slowly due to low organic matter content resulting in less well-developed anaerobic bacteria.

The oxidation & reduction conditions in acid sulfuric soils greatly affect the activity and population of microbes that play a role in the oxidation process and reduction of sulfate compounds as well as other microbial populations and activities on the soil. To what extent are the chemical and population changes of soil microbes due to the influence of groundwater levels on acid sulphate soils planted with oil palm will be studied in this study.

The purpose of this study was to study the effect of ameliorant, chemical fertilizer and sulfate reducing bacteria on acid sulphate soil to palm plant growth.

2 METHODS

This research has been conducted in greenhouse and Soil Biology Laboratory, Faculty of Agriculture, University of Sumatera Utara Medan with 32 meter above sea level. The materials used in this research are DXP palm oil seedlings with 3 month age as objects to be observed, acid sulphate from PT Mopoli Raya Kebun Payarambe II as planting medium,

Sahar, A., Hanifah, D. and Muhdi, .
The Effect of Ameliorant and Bacteria Reducing Sulfate on Plan Growth in Acid Sulphate Land.
DOI: 10.5220/0010099201100113
In *Proceedings of the International Conference of Science, Technology, Engineering, Environmental and Ramification Researches (ICOSTEERR 2018) - Research in Industry 4.0*, pages 110-113
ISBN: 978-989-758-449-7

($CaMg(CO_3)_2$) as Al setters, polybags the equivalent of 10 kg of soil as soil container, pesticide as controlling plant pest organism, NPK 15:15:15 as nutrient additive, sulfate reducing bacteria isolate from sludge paper waste Toba Pulp Lestari with code 4 as sulphate reducing agent, palm empty fruit bunch compost from PT. Socfindo as land amendment material, chemicals for the manufacture of media (posgate-E) as well as other materials used in this experiment.

This research uses Randomized Block Design method. If the results of the analysis of variance showed a significant effect then it will be continued with the average difference test based on Duncan Multiple Range Test test at α 5% level.

Soil pH measurements were made at the time after incubation of dolomite lime and inoculum of sulfate reducing compound bacteria. The method used is electrometry method with the ratio of soil and water 1: 2,5.

Plant height is measured by calculating the plant height increase in every two weeks observation for up to 4 months by making a marker which is the standard starting point for measuring plant height by using meter gauge.

Plant stem diameter was measured by calculating the increase of plant diameter in every two weeks of observation up to 4 months by making a marker for the stem diameter data retrieval done on the same stem using a digital thrust tool.

3 RESULT AND DISCUSSION

From observation for ten weeks after planting, it is known that the influence of each factor of amendment material, chemical fertilizer, and sulfate reducing bacteria all interaction of two factors or from three factors consistently has no significant effect on the vegetative variables of oil palm, namely the parameters of plant height and stem diameter at the age of 10 weeks after planting.

Plant High Increase

Amending substances, chemical fertilizers, and sulfate reducing bacteria at week 10 did not significantly affect plant growth. The highest increase of plant height was found in A2P1B0 treatment and the lowest was in A0P0B0 treatment.

In Table 1 it can be seen that the best treatment at week 14 was A2P1B0, in which palm oil treatment was treated with lime and chemical fertilizers. This is because ameliorant is able to increase pH in acid sulphate soil, which makes sulfate form gypsum deposits and chemical fertilizers are well absorbed by plants because soil pH has increased.

Resulted in this research indicated that single factor treatment of ammendment materials, calcification is always the best treatment every week, compared with no amendment or compost, but at week 14 the best compost treatment is obtained. Compost has slow release properties and is capable of chelating Al but the lime reaction is much faster than Compost this is what causes liming much better every week.

The interaction between ammonia and sulfate reducing bacteria (BPS) shows that bacteria would be better given in anaerobic state by inoculation with bacteria, interaction between compost and BPS that can increase the height of oil palm crop, interaction others indicated that treatment without BPS was better than bacteria at age 10 weeks after the main nursery. In the context of sour soil sulfate, composts can maintain a reduction atmosphere, and organic matter provides energy for growth and organic matter provides carbon as an energy source.

Stem diameter increase

Amending substances, chemical fertilizers, and sulfate reducing bacteria at week 10 did not significantly affect plant stem diameter. The highest

Table 1. Increases stem height fourteen weeks after application of dolomite, chemical fertilizer and sulphate reducing composite bacterial inoculum.

Triatment	P0 (with out fertilizer)		P1 (NPK fertilizer 100kg/ha)		
	B0 (with out BRS)	B1 (BRS)	B0 (with out BRS)	B1 (BRS)	Aver age
	----------cm----------				
A0 (with out amandement)	22.18	32.12	30.40	24.88	27.40
A1 (Composs of TKKS 30 ton/ha)	31.43	29.73	24.55	30.85	29.14
A2 (Kapur 1 x aldd)	29.70	24.30	32.95	28.57	28.88
Sub Average	27.77	28.72	29.30	28.10	
Average	28.24		28.70		

Table 2. Increases stem diameter fourteen weeks after application of dolomite lime, chemical fertilizer and sulphate reducing composite bacterial inoculum.

Triatment	P0 (with out fertilizer)		P1 (NPK fertilizer 100kg/ha)		Rataan Average
	B0 (with out BRS)	B1 (BRS)	B0 (with out BRS)	B1 (BRS)	
	----------mm----------				
A0 (with out amandement)	18.20	21.60	20.23	20.90	20.23
A1 (Composs of TKKS 30 ton/ha)	20.37	21.59	18.56	20.38	20.22
A2 (Kapur 1 x aldd)	19.76	18.34	22.66	19.78	20.13
Sub Average	19.44	20.51	20.48	20.35	
Average	19.98		20.42		

plant stem diameter was found in A1P1B0 treatment and the lowest was in A0P0B0 treatment.

The Table 2 showed that one of the best treatments is A0P0B1, which is very contradictory to the opinion of which states that this sulphate reducing bacteria is anaerobic obligate, which is only able to live and thrive in anaerobic atmosphere. Therefore it is found that the sulphate reducing bacteria used to live despite the aerobic conditions in this research. This is also supported by the literature of stating that within a few decades some sulphate reducing bacteria have evolved, which are now some of these bacteria capable of living in oxidation state and may even be oxygenated

Table 3 it was found that at week 14 some of the best treatments were A2P1B0, A0P0B1, A1P0B1, A1P1B1 respectively although statistically not significant. This shows that the BPS treatment is superior to other treatments to increase stem diameter increase. This research indicated that at week 2 to week 6 does not appear to change when added to BPS but at week 8 it is found that BPS treatment can increase the growth of stem diameter better. According, this is because BPS can reduce sulfate and decrease sulfate concentration will increase soil pH. In the forests, reducing soil can reduce cutting cycle and increase biologically productive and sustainable.

The interaction between the amendment material and the stem diameter at week 14 below shows that all BPS-driven interactions increase the growth of stem diameter except interaction with lime amendments. This is because lime treatment can increase the pH because it interacts with sulfate and forms gypsum, while sulfate is also a source of food for the BPS itself, which causes BPS treatment to be ineffective.

4 CONCLUSION

All BPS-driven interactions increase the growth of trunk diameter except interaction with lime amendments. This is because lime treatment can increase the pH because it interacts with sulfate and forms gypsum, while sulfate is also a source of food for the BPS itself, which causes BPS treatment to be ineffective.

REFERENCES

Rahmah, M., Hanafiah, D.S., Siregar, L.A.M. 2017. Selection Individual on Mutant Genotyre of Soybean (Glycine max L. MERR) in M5 Generation Based on Resistance of Stem Rot Disease (Athelia rolfsii (Curzi). IOP Conf. Ser.: Earth Environ. Sci. 122 012026

Nilahayati, Rosmayati, Hanafiah, D.S., Harahap, F. 2018. Genetic Variability And Heritability In Kipas Putih Soybean Mutant Line Using Gamma Rays Irradiation In M_3 Generation. IOP Conf. Ser.: Earth Environ. Sci. 122 012041

Asmarlaili, S., Rauf, A., Hanafiah, D.S., Sudarno, Y., Abdi, P. 2018. The soil sulphate effect andmaize plant (Zea mays L.) growth of sulphate reducing bacteria (SRB) inoculation in acid sulfate soils with the different soil water condition. IOP Conf. Ser.: Earth Environ. Sci. 122 012037

Anwar K., Koesrini dan Susilawati, A. 2012. Peningkatan Produktivitas Kedelai pada Tanah Sulfat masam melalui Ameliorasi dan Penggunaan Varietas Toleran. Teknologi

Pemupukan dan Pemulihan Lahan Terdegradasi. Prosiding Seminar Nasional: 677-685.

Hanafiah, A.S., Guci, H., Muhdi. 2016a. Effect of vesicular arbuscular mycorrhiza and organic matter on growth of rubber stump (*Hevea brasiliensis* Muell. Arg.). Int. J. Agr. Agri. Res., Vol. 9(4), 31-35.

Hanafiah, A.S., *Rauf, A., Mazlina, M.* 2016b. Potensi Bakteri Pereduksi Sulfat Terhadap Perubahan Kadar Sulfat Terlarut Media Tumbuh. Jurnal Pertanian Tropik, Vol. 3(3) : 235-238.

Dent, D. 1986. Acid sulphate soils: A basleine for research and development. Publication No. 39 ILRI, Wageningen, The Netherlands.

Atlas, R. and R. Bertha. 1993. Microbial Ecology: Fundamentals and Applications. 3rd ed. The Benjamin Cumming Publ. Com. Inc.

Noor, M. 2004. Lahan Rawa Sifat dan Pengelolaan Tanah Bermasalah Sulfat Masam. PT Raja Grafindo Persada. Jakarta. Hal 25, 115, 177, 184.

Baumgartner, L.K., R.P. Reid, C. Dupraz, A.W. Decho, D. H. Buckley, J.R. Spear, K.M. Przekop, P.T. Visscher, 2006. Sulfate Reducing Bacteria in Microbial Mats : Changing Padaradigms, New Discoveries. Elsevier. Sedimentery Geology 185: 131-145.

Widyati, E. 2007. Pemanfaatan Bakteri Pereduksi Sulfat untuk Bioremediasi Tanah Bekas Tambang Batubara. *Biodiversitas*, 4(8): 283-286.

Purwoko, A., Muhdi, Hanafiah, A.S. 2018. Residual stand damages caused by conventional and reduced impact timber harvesting in the natural forest. International Journal of Mechanical Engineering and Technology, 9(3):313–325.

Latifah, S., Muhdi, Purwoko, A., Tanjung, E. 2018. Estimation of aboveground tree biomass Toona sureni and Coffea arabica in agroforestry system of Simalungun, North Sumatra, Indonesia. Biodiversitas, 19(2):590-595.