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The Influence of Mycorrhiza and Phosphate Rock Fertilizer on the Growth of Cacao Seedling

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Abstract

The study was conducted in Gapui of Indra Jaya Sub Distrtict Pidie Jaya, Aceh and Plant Protection Laboratory of Syiah Kuala University, Banda Aceh, Indonesia. It is was investigated from April until June, 2015. Randomized Completely Block Design was arranged with three replications. There were two factors investigated, Mycorrhiza and phosphate rock fertilizer. The factor of mycorrhiza were 3 levels including without mycorrhiza, 10 g and 20 g mycorrhiza^{-1}. The factor of phosphate rock fertilizer were 4 levels including without $P_2O_5^{-1}$, 2.7 g $P_2O_5^{-1}$; 5.4 g $P_2O_5^{-1}$; and 8.0 g $P_2O_5^{-1}$. Parameters are, percentage of infection roots of mycorrhiza and N, P and K absorbed. The result reveals the best percentage of infection roots; N, P and K absorbed on mycorrhiza was found on 20 g^{-1} and the lowest was found in without mycorrhiza. While the best percentage of infection roots; N, P and K absorbed on Phosphate rock fertilizer was found on 8.0 g $P_2O_5^{-1}$ and the lowest was found in without Phosphate rock fertilizer. The best interaction on percentage of infection roots; N, P and K absorbed between them was found on 20 g^{-1}; 8.0 g $P_2O_5^{-1}$ and have different on other treatments.

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Introduction

Cocoa is an agriculture product in Indonesia that play an important role of live lihood of small holder farmers. It is also a commodity that contributed for foreign exchange of Indonesia. Cocoa is a very potential to be developed in Aceh. But heavy matter to produce the production of cacao including Aceh has still masive land such as Ultisol. Ultisol is potential for cocoa development but the soil is poor of nutrient especially phospahate. This matter can be handle by using Mycorrhiza which has combined with phosphate rock of fertilizer (BPS, 2014).

Arbuscular Mycorrhiza Fungi (AMF) which has symbiotic mutualism with plant roots can be used to improve that growth in the soil which has poor of nutrient. Plants inoculated with AMF grow better than without AMF (Fitriana *et al.*, 2017). AMF penetrates the cortical cells of the plant root and provide a range of benefits to their host in exchange for plant assimilated carbohydrates. Through an exhaustive network of hyphae, plants are provided with mineral nutrients (Urcoviche *et al.*, 2015; Xiao *et al.*, 2014). Besides, that mycorrhiza can be absorbed the water (Meddich *et al.*, 2015; Omirou *et al.*, 2013), protection from microbial pathogens (Abo-Elyousr *et al., 2014;* Smith and Read 2008), and facilitating the formation and maintenance of soil structure and dynamics (van der Heijden *et al.* 2008; Leifheit *et al.*, 2014).

Rock phosphate is the natural fertilizer to improve and maintain soil quality to produce better quality of cacao seedlingss. David *et al.* (2016) show that cocoa seeds infected by AMF which are combined with phosphate rock fertilizer can be increasing the growth of cacao seedlings. The purpose of this study is to find out the optimum dosage of mycorrhiza and phosphate rock fertilizer on the growth and development of cacao seedling.

Materials and methods

The study was conducted in Gapui village of Indra Jaya, Pidie District, Aceh, Indonesia and Pant and Disease Protection Laboratory of Agriculture Faculty Syiah Kuala University, Banda Aceh Indonesia from April until June, 2015. Materials used in the this research also were obtain from the farmers at Jurong Anoe Village Padang Tiji District Pidie, Aceh. The soil sterilization was done with the oven at 110 ^{o}C for 3 twice 24 times. The analyzed of soil are sandy loam, pH 6.25, organic C 0.94%, N 0.14%, P 10.713 mg kg^{-1} soil, and cation exchange capacity 30.8 cmol (+) kg^{-1} soil.

AMF used in this reasech was Glomusmoseae obtained from the Plant Dieseas Protection Laboratory of Brawijaya University, Malang. AMF treatments consist of 3 levels are without Mycorrhiza, 10 g^{-1}; 20 g^{-1}. The mycorrhiza application is performed simultaneously with the removal and planting of cocoa seedlings from the seedbed into polybags in the nursery. Phosphate rock fertilizers used in this study were four levels, without P_2O_5; 2.7 g $P_2O_5^{-1}$; 5.4 g $P_2O_5^{-1}$; 8.0 g P_2O^{-1}.

The experimental design used was randomized completely block design (RCBD) with 3 replications. The parameters were the percentage of cacao infection root and absorbing of N, P, K nutrients. The percentage of mycorrhizal infected root was observed at the end of the experiment, using a microscope at the Plant Disease Laboratory of Faculty of Agriculture Syiah Kuala University. Observations were made by the roots of mycorrhizal infected plants on glass preparations. The amount of colonization was calculated as:

$$\text{Percentage root infection} = \frac{total mycorrhiza}{total of analized} \text{ X } 100\%$$

The uptake of N, P and K on the leaves was performed at the Soil Chemistry Laboratory, Faculty of Agriculture, Syiah Kuala University.

Results and discussion

Mycorrhiza

Table 1 and 2.Showed that dosage of mycorrhiza is significantly on percentage of infection root and the

uptake of N, P and K. The best mycorrhiza was found in 20 g^{-1}.

It is suspected that mycorrhiza 10-20 g^{-1} is still in low doses. Marquiez and Lebianc (2014) said that mycorrhiza has a hyphae in which the hyphae helps the roots of cocoa seeds absorb nutrients, because the principle of the mycorrhiza can expand the nutrient absorption area so as to increase nutrient uptake. The results of Ni Kadek's research, *et. al.* (2014) giving the dosage of mycorrhizal doses will determine the absorption rate of N, P, and K on leaves.

Table 1. The average of root infection influenced by Mycorrhiza.

Dosage Micorrhiza	Root infection	infection Vesicle (%)	infectionHyfa (%)
Without Micorrhiza (M_0)	66,67 a	6,33 a	6.58 a
10 g polybag^{-1} (M_1)	99,17 b	9,92 b	10,00 b
20 g polybag^{-1} (M_2)	100,00 b	10,00 b	9,92 b
BNJ $_{0,05}$	3,90	0,43	0,66

Table 2. The average of N, P, K absorbed by mycorrhiza.

Dosage of Micorrhiza	absorbing N (%)	absorbing P (%)	absorbing K (%)
without Micorrhiza (M_0)	1,81 a	0,30 a	0,87 a
10 g polybag^{-1} (M_1)	1,85 a	0,30 a	0,90 a
20 g polybag^{-1} (M_2)	1,89 a	0,32 a	0,87 a
BNJ $_{0,05}$	0,12	-	-

Phosphate rock fertilizer

Table 3.and 4 showed that doces Phosphate rock is significantly in infection root and N, P, K Nutrient Absorbed. The best doces of Phosphate rock was found in 8.0 g $P_2O_5^{-1}$. This research give a good impact to cacao seedlings, because rock phosphate fertilizer is one of the soil organic matter that can improve the soil structure so that the land that had been lack of nutrients can be fulfilled. This is in accordance with the opinion of Goenadi *et al.*, (2002) which states that with the addition of rock phosphate fertilizer on plant nurseries indirectly has given the contribution of nutrient elements to the plant, where nutrient element P is second nutrient element after nutrient N. The results of Xiao *et al.*, (2004) said that rock phosphate has an important role in helping to overcome the deficiency of nutrients P.

Table 3. The average of infection root by controlled phosphate rock.

Doces Rock poshpate	Infection mycorrhiza	infection Vesicle (%)	infectionHyfa (%)
P_0	68.89a	68.89a	73.33a
P_1	88.89b	93.33b	90.00b
P_2	98.89c	94.44b	93.33c
P_3	97.78c	93.33b	96.67c
BNJ $_{0,05}$	4,73	5,20	7,98

It is assumed that the P element available in Rockpospat fertilizer has correlation with N element, so that there is only difference in N and P uptake on cocoa seedlings. The relation of the availability of element P with element N and plant growth, the research of Antonius and Suparno (2009) suggests that N and P nutrients have close relation to plant growth because both types of nutrients are needed by cocoa plants to increase their growth.

Table 4. The average of absorbing NPK by controlled phosphate rock.

posphate Rock	absorbing N (%)	absorbing P (%)	absorbing K (%)
P_0	1.78a	0.30a	0.83a
P_1	1.90a	0.30a	0.89a
P_2	1.87a	0.34b	0.90b
P_3	1.85a	0.32ab	0.91ab
BNJ $_{0,05}$	0,14	0,03	0,12

Interaction between mycorrhiza and phosphate rock fertilizer

The best treatment between them was found on 20 g mycorrhiza^{-1} and 8,0 g $P_2O_5^{-1}$. It is can be seen in Table 5. The interaction between mycorrhizal and rock pospat fertilizer caused the interaction on the percentage of infected roots due to the role of mycorrhizal and rock phosphate which work well together to overcome the nutrient deficiency in the planting medium of cocoa seedlings.

Tabel 5. The interaction of absorbing NPK by mycorrhiza and phosphate rock.

Infection mycorrhiza(%)	phosphate rock	mycorrhiza			BNJ 0,05
		M_0	M_1	M_2	
Infection mycorrhiza	P_0	10.00	96.67	100.00	
	P_1	66.67	100.00	100.00	
	P_2	96.67	100.00	100.00	
	P_3	93.33	100.00	100.00	
Infection Vesicle	P_0	10.00	96.67	100.00	
	P_1	80.00	100.00	100.00	
	P_2	83.33	100.00	100.00	
	P_3	80.00	100.00	100.00	
infection Hyfa	P_0	23.33	100.00	96.67	
	P_1	70.00	100.00	100.00	
	P_2	80.00	100.00	100.00	
	P_3	90.00	100.00	100.00	

This is in accordance with the opinion of Louis (2014) who said both types of soil organic matter such as mycorrhiza and rock phosphate is an alternative used to increase cocoa growth caused by nutrient deficiency.

Conclusion

The best treatment on mycorrhiza was found on 20 g mycorrhiza^{-1}and the lowest was found on without mycorrhiza. While posphat rock fertilizer was found on 8,0 g $P_2O_5^{-1}$and the lowest was found on without posphat rock fertilizer. The interaction between the two treatments has an interaction on the infection root and N, P, K uptake.

Contribution

Mycorhiza and rock phosphate fertilizers can contribute to dry land on other soil types.

Reference

Aboelyousr KAM, Seleim MEA, El KMHA, Moneem,Saead FA. 2014. Integrated effect of Glomus mosseae and selected plant oils on the control of bacterial wilt disease of tomato. Crop Protection **66**,67-71.

Antonius, Suparno, 2009. The effect of AMF inoculum to enhance the potency of Papuan

crandallite phosphate rock and the growth of cocoa seedling. Journal lund University libraries.

BPS, 2014.Potensikakao Indonesia. www. BPS.aceh.com.

David S, Anhardan A, Nurrahmi E. 2016. Pengaruh dosis jamur mikoriza arbuskular dan pupuk rock fosfat terhadap bibit kakao. Serisain, volume 18 nomor 2 tahun 2016.JurnalpenelitianUniversitas Jambi.

Fitriana A, Anhardan Syafruddin, 2017. Pengaruh pemberian mikoriza terhadap pertumbuhan kedelai (Glycine max L. Merrill) pada kondisi kekeringan. Proceding Seminar NasionalPerbaikanKualitasLahanKeringUntukMeningkatkanProduksiPangan.Unsyiah, BPTP Aceh dan ACIAR.

Fitriana A, Anhar, Syafruddin, 2018. The role of arbuscular mycorriza fungi (AMF) on water stress on soybean yield (Glycine max L. Merrill). Journal of Biodiversity Environmental and Sciences.

Goenadi DH, Siswanto, Sugiarto Y. 2000. Bioactivation of poorly soluble phosphate rocks with a phosphorus solubilizing fungus. Soil Sci. Am. J., **64,** 927–932.

Leifheit EF, Veresoglou SD, Lehmann A, Morris EK, Rillig MC. 2014. Multiple factors influence the role of arbuscular mycorrhizal fungi in soil aggregation—a meta-analysis. Plant Soil **374,**523–537.

Louis C. 2014. Terativ cacao as a new fertilizer based reactive phosphate rock for cocoa productivity in Cote A Participatory Approach to Update Fertilization Recommendation. Pages 348-353. Procedia engineering. Online. Elsevier.

Marqueiz EE, Lebianc H. 2014. Effect of arbuscular fungi on the delopment cocoa in the green house. http://tierratropical.org/edition/issue-10-2-2014

Meddich A, Jaitib F, Bourzikc W, El Aslid A, Hafidie M. 2015. Use of mycorrhizal fungi as a strategy for improving the drought tolerance in date palm (Phoenix dactylifera). Scientia Horticulturae **192,**468–474.

Ni Kadek SD, Susrama IGK, Siratami M, AndnyanaM,Wirawan IGP. 2014. Identification of arbuscular mycorrhizal fungi in rhizoosphere soil of several grass species and cacao (theobroma cacao L.) based on spore morphological characteristic. International journal of biosciences and biotechnology.

Omirou M, Ioannides IM, Ehaliotis C. 2013. Mycorrhizal inoculation affects arbuscular mycorrhizal diversity in watermelon roots, but leads to improved colonization and plant response under water stress only. Applied Soil Ecology **63,**112– 119.

Smith SE, Read DJ. 2008. Mycorrhizal symbiosis. 3rd ed. San Diego: Academic

Urcoviche RC, Gazim ZC,Dragunski DC, Barcellos FG, Alberton O. 2015. Plant growth and essential oil content of Menthacrispa inoculated with arbuscular mycorrhizal fungi under different levels of phosphorus. Industrial Crops and Products **67,**103–107

Van der Heijden MGA, Bardgett RD, Van Straalen NM. 2008. The unseen majority: soil microbes as drivers of plant diversity and productivity in terrestrial ecosystems. Ecology Letters 11, 296-310.

Widiastuti H, DarmonoTW, Goenadi DH.1998. Respons bibit kelapa sawit terhadap inokulasi beberapa cendawan AM pada beberapa tingkat pemupukan. MenaraPerkebunan**66(2),**36-46.

Xiao CR, Chi, Huang X, Zhang G, QiuG, Wang D. 2004. Optimization for rock phosphate solubilisation by phosphate solubilizing fungi isolated from phosphate mines. Ecol. ens.

Xiao JX, Hu CY, Chen YY, Yang B, Hua J. 2014. Effects of low magnesium and an arbuscular mycorrhizal fungus on the growth, magnesium distribution and photosynthesis of two citrus cultivars. Scientia Horticulture **177,** 14–20.