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Total amount of Vesicular Arbuskular Mycorrhiza Fungi Spores in the Rhizosphere of Oil Palm (*Elaeis guineensis* Jacq.)

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A B S T R A C T

Vesicular arbuscular mycorrhizae (VAM) are obligate mutualistic symbionts in plant roots cortex and help the absorption of nutrients needed for plants to growth. The research was aimed calculate the spores of VAM and identification to the genus of level. This research has been carried out laboratory analysis in February 2015 to June 2015. The research was conducted by field survey. The purposive sampling area was an oil palm plantation field difference in plant ages. The sampling area was determined purposively on a sample area in palm oil plantations with the different ages of 1 year (Main Nursery), 3 years, 8 years, 14 years and 19 years. The result showed the amount of VAM spores significantly carelated to C-organic in the soil. VAM spore dominated by size 105-53µm. There were 2 genus consisting of 14 morfotipe, genus Acaulospora shows 7 morfotipe and genus Glomus 7 morfotipe, it found in the Sampling area.

Introduction

Indonesian Palm oil plantation is the biggest export commodity which plays a role to source income for Indonesia. The area of Indonesian palm oil plantation in 2014 is around 10.9 million ha consisting of 4.5 million ha of smallholder plantations, 5.7 million ha of private plantations and 0.7 million ha of goverment plantation (Miftahul, *et al.*, 2014). Smallholder manage almost of half Indonesia's palm oil plantation that spread on Sumatera and Kalimantan island which soil type of ultisol which is poor posfor and prone to drought (Sartohadi *et al.*, 2012). Crude Palm Oil Produce in 2014 around 2.7 tons / ha is below the target of 6 tons / ha because almost half of Indonesia's oil palm plantations do not have the best agronomic procedures to manage it.

Palm oil (*Elaeis guineensis Jacq.)* has no good hair root but it well growth in ultisol soil type. That is fungus effect which induction root and manuring effect in palm oil. The soil type of Ultisol is more acid that is great habitat of fungi especially Mycorrhiza. Mycorrhiza is a fungi that symbiosis with plant roots to strengthen absorbs the water or nutrient for especially posfor and protect plan from the drought. Then amount VAM population and genus is different as on age of plant however on different host plant (Setiadi, 1991 *in* Verry *et al.*, 2010). The result of Warow *et*

al., (2010) VAM population on rhizosfer of *Tectona Grandis* in three different host plant and location has 120 VAM per 12 g soil, 182 VAM per 182 g soil and 268.3 VAM per 12 g soil.

Mycorrhiza's population and genus will be different on age of plant and host plant. That's why i have to research population and genus mycorrhiza to *Elaeis guineensis Jacq.* The research was in palm oil plantation PT. Socfindo in North Sumatera as the soil type is ultisol.

Materials and Methods

The materials in this research was 15th soil sample from rhizosfer *Elaeis guineensis Jacq*, roots of *Elaeis guineensis Jacq, Aquades, Trypan Blue* 0,05% (b/v), KOH 10% (b/v), *Lactoglycerol,* H_2O_2 3% (v/v), paper of label.

The research was conduct field sampling survey and laboratory analysis. The sample of research was determined by *purposive sampling* in palm oil plantation has different age. It was 1 years old (S_{Mn}) (*Main Nursery phase)*, 3 years old (S_3), 8 years (S_8), 14 years old (S_{14}), 19 years old (S_{19}). The Sample has 3 times on all age sampling of plant and make it sample with totally was 15 Sample.

Soil chemist analysis was pH, P, and C-organic on all the sample. The isolation spore of fungus was by wet sieving and decanting techniques (Pacioni, 1992) and centrifugation techniques Brundrett *et al.,* (1996). The observation to counting spore of fungus was on per 100 g soil sample throught 3 times and spore identification was taken by *microscope stereo* 10X. The Identification of morfology's carracteristic of VAM fungus are size of spore, colour of spore, Tecsture's surface of spore, and shape of spore through INVAM (2013).

Data analysis

Data analysis aim to test the different age of plant to amount population and genus VAM with Randomized Block Design metode and Duncan Test. Correlation test was peform to the closeness of the observe variables. The variabel in this research was amount VAM, size VAM (mesh 212 µm,106-211 µm, 53-105 µm), fosfor, pH, C-Organic of all the soil sampling on different ages.

Results and Discussion

The result of statistic analysis is those some variables has different depend on different age of plants (S) there is amount VAM on mesh 212 µm with pH while another variables are amount VAM in 106-121 µm, amount VAM in 53-105 µm, fosfor, pH, C-Organic has not depend of the different age of plant (Table 1). The variable amount of VAM size 53-105 µm is highest and the variable amount of VAM size ≥ 212 µm is the smallest (Table 2).

Isolation and identification VAM to all of the soil sampling in the different age and host plant showed diversity on structure of spore, Size of spore, then amount of spore. The research was found 2 genus there are *Acaulospora* and *Glomus* consisting of 7 mortotipe for all genus (Table 3).

The result of soil analysis C-organic is very low (0,5%), P_2O_5 very low, and pH less than 7 from all soil sampling are acid. Soil fertily most important to population spore of VAM and diversity of genus then will be influence growth of Palm oil (*Elaeis guineensis Jacq).* In this situation *Elaeis guineensis Jacq* can't growth being well without simbiotic association with VAM. VAM is a symbiotic association between a fungus and a plant. The term mycorrhiza refers to the role of the fungus in the plant's rhizosphere, its root

system. Mycorrhizae play important roles in plant nutrition, soil biology and soil chemistry.

The research showed that VAM has been simbiotic with the plant *Elaeis guineensis Jacq* since on Main Nursery phase (S_{Mn}). In the phase the plant age 3 years (S_3) VAM growth untill the highest phase on the age 14 years (S_{14}) about 116,67 spore, however on the phase plant age 19 years (S_{19}) VAM has been decrease amount VAM about 78 spore (Figure 1).

This study isolates VAM spores based on size which aims to facilitate the identification of spores, in addition the size of the VAM is related to the state of the environment so that it can find out actions for the application of VAM in the plantation. The number of VAM spores can be be distinguished into 3 sizes there are :

a) ≥212 µm : The existence population spore VAM size ≥212 µm in highest phase on age 8 years (S_8) but not significant different with previous year. Then population VAM spore decrease not significant different on phase age 14 years (S_{14}) and there is no spore in age 19 years phase (S_{19}) (Figure 1).

b) 106-211µm: The eistence population spore VAM size 106-211µm not influenced by the different age of plant *Elaeis Guineensis Jacq*. Population VAM spore decrease not significant diffrent from Main nursery phase to plant age 8 years phase (S_8).Then population increase not significant different on age 14 years phase (S_{14}) and increase again in plant age 19 year phase (S_{19}) (Figure 1).

c) 53-105µm: The existence population spore VAM size 53-105µm begin on main nursery phase then increase not significant different untill plant age 14 year phase (S_{14}) then decrease significant different in plant age 19 year phase (S_{19}) (Figure 1).

Table.1 The significant variable Test to different age of plant

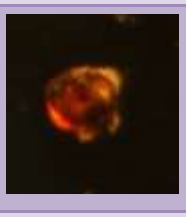
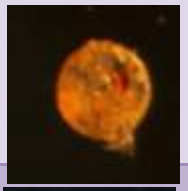
No	Variable	S
1	Total amount of VAM Spore	ns
2	Size Spore ≥ 212 µm	**
3	Size Spore 106 – 211 µm	ns
4	Size Spore 53 - 105 µm	ns
5	P2O5	ns
6	pH	**
7	C-Organic (%)	ns

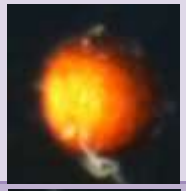
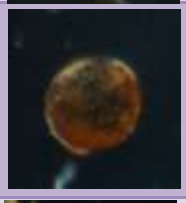
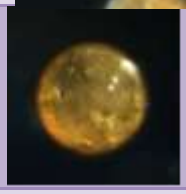
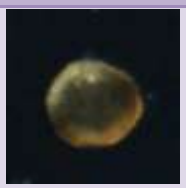
ns : not impact significant (P>0,05)
* : Impact significant (P<0,05)
** : Impact very significant (P<0,01)

Table.2 Amount of VAM Spore

Perlakuan	≥ 212 µm	106–211 µm	53 – 105 µm	∑ MVA (/100 gr tanah)
S_{Mn}	2,33 a	38,00 a	56,33 a	96,67 a
S_3	2,33 a	34,00 a	66,66 a	103,00 a
S_8	3,00 a	33,66 a	70,66 a	107,33 a
S_{14}	2,66 a	39,66 a	74,33 a	116,67 a
S_{19}	0,00 b	28,33 a	49,66 a	78,00 a

Table.3 The morphology carracteristic of VAM spore with visual obsevation

No.	Bentuk Spora	CiriKhas	Genus Spora
1		Size 84,3 µm, colour dark brown, oval, germ cell wall spore brown.	*Acaulospora sp 1*
2		Size 85,5 µm, colour yellow, circle spore with coarse surface	*Acaulospora sp 2*
3		Size 162,3 µm, colour dark brown circle spore with coarse surface.	*Acaulospora sp 3*
4		Size 186 µm,colour yellow, circle spore with coarse surface	*Acaulospora sp 4*
5		Size 86,3 µm, colour yellow, circle spore with coarse surface	*Acaulosporasp 5*

6		Size 241µm, colour yellow to brown, circle spore with coarse surface	*Acaulospora sp 6*
7		Size 166,6µm, colour brown, circle spore with smooth surface	*Acaulospora sp 7*
8		Size 220,6 µm, colour white clear, circle spore with smooth surface	*Glomus sp 1*
9		Size 228 µm, colour yellow clear, circle spore with smooth surface	*Glomus sp 2*
10		Size 66,5 µm, colour yellow clear, oval circle with germ cell wall yellow to brown with smooth surface	*Glomus sp 3*
11		Size 55,7µm, colour yellow clear, germ cell wall yellow clear with smooth surface.	*Glomus sp 4*
12		Size 150µm, colour yellow, circle spore with smooth surface	*Glomus sp 5*
13		Size 60,5µm, it has hifa spore colour yellow clear, circle spore with smooth surface.	*Glomus sp 6*

14		Size 220, 6µm, colour yellow, circle spore and germ cell wall yellow with smooth surface.	*Glomus sp 7*

Figure.1

Table.4 The result of variable observation

Kode	Jumlah Populasi MVA	Jumlahpadaberbagai *mesh*			P-tersedia mg/kg	pH	C-organic %
		≥212	106-211	53-105			
MN	86	2	33	51	0.41	5.91	0.6
MN	86	3	38	45	0.11	6.02	0.6
MN	118	2	43	73	0.07	5.96	0.8
N3	88	3	34	51	0.058	5.72	0.6
N3	111	2	36	73	0.027	5.62	0.7
N3	110	2	32	76	0.13	5.59	0.7
S8	108	2	41	65	0.015	6.13	0.7
S8	125	4	30	91	0.006	6.02	0.8
S8	89	3	30	56	0.134	5.93	0.6
S14	123	3	45	75	0.072	6.07	0.8
S14	119	3	43	73	0.047	6.19	0.8
S14	108	2	31	75	0.018	6.15	0.7
S19	90	0	37	53	0.008	5.79	0.6
S19	85	0	33	52	0.029	5.99	0.6
S19	59	0	15	44	0.137	6.05	0.5
Avergae	100.333	2.067	34.733	63.533	0.085	5.943	0.673
Total	1505	31	521	953	1.271	89.14	10.1

Population VAM spore has been researched consisting different sizes there are ≥212 µm, 106-21µm, dan 53-105µm. Population VAM spore has domination with spore size 53-105µm about 63%, and VAM spore size 106-21µm about 34,6 % while the lowest population is VAM spore size ≥212 µm from all the sample. Spore MVA that found in *Elaeis Guineensis Jacq* was opposite with spora MVA has been found in *Ipomoea batatas L*. And *Manihot esculenta* that VAM spore size 53-105µm to be lowest (Widiatma 2015) (Table 4).

Correlation test showed that variable significant between total amount population VAM with C-Organic. Both of variable was related that mean C-organic influence total amount populasi VAM spore in the soil (r^2=0,97). C-Organic can be ensure mineralization proess whose the result to provide nutrition for the plant's simbiotic with VAM. The highest population VAM dominan will be found on soil with organic contain 1-2% and the lowest population VAM wll be found on soil with organic contain 0,5% by Hameeda *et al.,* (2007).

Identification VAM from all soil sampling in rhizospher *Elaeis Guineensis Jacq* on PT. Socfindo palm oil plantation that based on size of spore, colour of spore, tecsture of spore and shape of spore. The study found 14 morfotipe of spore and 2 genus, there are *Glomus* and *Acaulospora*. Genus *Glomus* has found 7 morfotipe and *Acaulospora* has found 7 morfotipe. (Tabel 3). The research was same with Sibarani (2011), Siregar (2014) with the object of plant is *Elaeis Guineensis Jacq* in North Sumatera and Kartika (2012a) in Jambi, they found genus *Glomus* and *Acaulospora*. The result of identification populastion VAM spore more diversity than Nurhalisyah (2012) in palm oil plantatin East Kalimantan found 7 morfotipe spore there consisting from 2 morfotipe *Acaulospora* and 5 morfotipe *Glomus*.

Recommendation

According to our result we have strongly recomendation to aplication VAM spore for begin in pre nursery and main nursery with soil contain c-organic 1-2%.

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