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The Influence of Cow Manure and Mycorrhiza Application in Oil Palm (*Elaeis guineensis* Jacq.) Growth on Pre Nursery

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Abstract: The objective of this study was to know the influence of cow manure and mycorrhiza dosages on growth of oil palm seedling in pre nursery. This study has been done in INSTIPER (Educational and Research Garden in Stiper Agricultural Institute) at Maguwoharjo, Depok, Sleman, Yogyakarta, Indonesia in March until December 2021. The experimental design used was Completely Randomized Design with two factors. The first factor was 4 dosages of cow manures with volume comparison of subsoil: C1 (30% of cow manure), C2 (40 % of cow manure), C3 (50% of cow manure). The second factor was 3 dosages of mycorrhiza consist of M0 (no mycorrhiza), M1 (10 g mycorrhiza) and M2 (20 g mycorrhiza). The study used five replications. Data were analyzed by ANOVA (Analysis of Variance) followed by DMRT (Duncan Multiple Range Test) at 5% significant level. The result showed no significant interaction between cow manure and mycorrhiza dosages application. Mycorrhiza significantly influenced plant height, sum of leaves, stem diameter, crown dry weight and root dry weight. Mycorrhiza on 20 g was the best.

Key words: Cow manure, mycorrhiza, oil palm.

1. Introduction

1.1 Research Background

Oil palm (*Elaeis guineensis* Jacq) is one of orchard commodities that is very important for Indonesian economy and gives a big portion on country devisa (foreign exchange). Besides that, Indonesia has the largest area of oil palm in the world which is about 15.08 million hectares [1].

Availability of good plant medium for seedling nursery (top soil) is limited because of more extensive oil palm orchards, therefore subsoil is chosen after topsoil although it has low fertility physically, chemically, and biologically. So, by giving fungus mycorrhiza and cow manure application in medium, the optimization of element absorption and increase in quality of seedling growth can be achieved. From this study it can be found big inoculum of mycorrhiza can affect root seedling and organic fertilizer application in subsoil, can change physic, chemical and biologic characteristics on subsoil, and can increase seedling growth of oil palm in pre nursery.

1.2 Literature Review

Oil palm is a monocotyl plant that does not have branches and has fibrous roots. The plant roots are about 8 m long with 8-10 cm diameter, and assemble near by the stem and branchy. Roots of oil palm do not have hair roots so it can be assumed that nutrient uptake is done by a quarter of roots called food roots. The development of roots determines the ability of plant in nutrient uptake [1-5]. Content of organic fertilizer mycorrhiza is nutritious that is very essential for increasing macro and micro element absorption. In addition, root plant with mycorrhiza can absorb elements that are bound and unavailable for plants [6]. The colonization of a complex thalloid liverwort with *Arbuscular mycorrhizal* Fungus significantly promotes photosynthetic carbon uptake, growth and asexual

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production. Plant fitness increased through fungus, which enhanced acquisition of P and N from soil [7].

1.3 Research Objective

The objective of this research was to know the influence of cow manure and mycorrhiza dosages on growth of oil palm seedling in pre nursery. By this study hopefully the best dosage of cow manure and mycorrhiza to the growth of oil palm seedling can be applied.

2. Materials and Methods

2.2 Materials

The study was conducted in Instiper Education and Research Garden at Maguwoharjo village, Yogyakarta, Indonesia. The location was on 118 m above sea level. This study used Completely Randomized Design with two factors. The first factor was M0 = no mycorrhiza (control), M1 = 10 g mycorrhiza/plant and M2 = 20 g mycorrhiza/plant. The second factor was K0 = no cow manure (control), K1 = 30% cow manure + 70% sub soil, K2 = 40% cow manure + 60% subsoil and K3 = 50% cow manure + 50% subsoil. There were 12 combinations with 5 replications for a total of 60 experimental units. ANOVA (Analysis of Variance) was used to test treatment effect. DMRT (Duncan Multiple Range Test) test of mean separation was done at the 0.5% level of probability to determine significance among the variable tested.

2.2 Experimental Running

2.2.1 Media Preparation

Medium was prepared according to the treatments and were completely filled in poly bags of 20 × 20 cm size.

2.2.2 Shading

Shading was made from bamboos and plastic transparent with 4 m long and 2 m wide. Height of shading was 1.5 m on west and 2 m on east. Plastic was used to protect seedling from rainfall.

2.2.3 Mycorrhiza Application

Holes were made on medium in poly bags with depth 3-4 cm and then mycorrhiza was applied according to the treatments.

2.2.4 Seedling Planted

Seedlings were planted on the position of radicule on beneath and plumule on top side.

2.2.5 Cultivation

Watering was applied 2 times with 50 mL in the morning and 50 mL in the evening. Weeding was done every day.

3. Result and Discussion

3.1 Plant Height

ANOVA showed that mycorhiza affected plant height. Mycorhiza dosage 20 g/seedling had the highest plant height, but 0 dosage had the lowest (Table 1 and Fig. 1). Medium composition did not affect the plant height. There was no interaction between medium composition and mycorhiza dosage.

Table 1 The effect of mycorrhiza and medium cow manure composition on plant height (cm).

Medium composition	Mycorrhiza (g/plant)			Average
	0	10	20	
No cow manure	16.90	20.56	21.92	19.80^{p}
Cow manure 30%	17.70	21.28	23.42	20.80^{p}
Cow manure 40%	16.70	20.10	22.80	19.86^{p}
Cow manure 50%	17.20	21.00	20.56	19.58^{p}
Average	17.12^{c}	20.73^{b}	22.17^{a}	(-)

Means with the same letter in the same column and row are not significantly different by DMRT at 0.05.

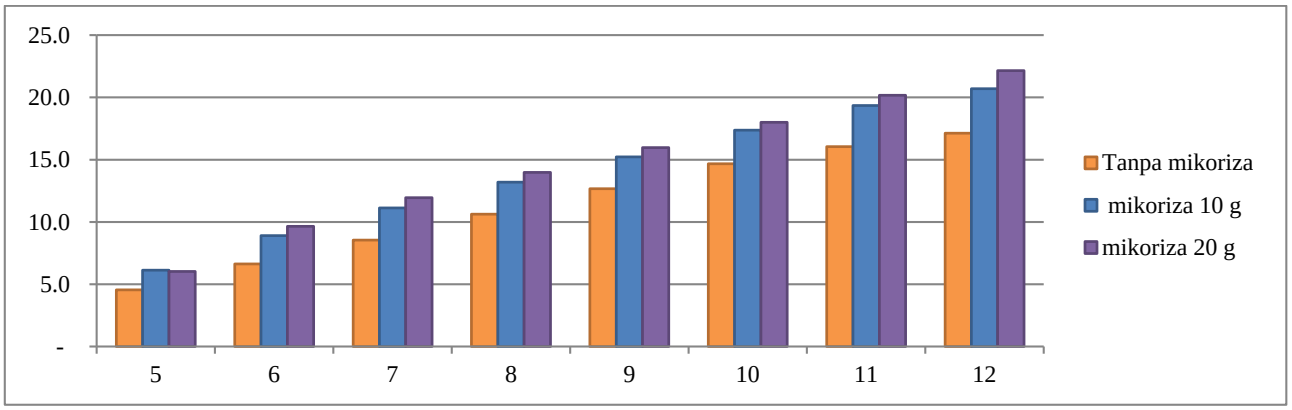

Fig. 1 Graphic effect of mycorrhiza dosages on plant height (cm).

3.2 The Sum of Leaves

ANOVA showed that medium composition did not affect the sum of leaves, but mycorrhiza affected (Table 2). Mycorrhiza 20 g affected significantly the most sum of leaves. No mycorrhiza was the least.

3.3 Stem Diameter (cm)

ANOVA showed that mycorrhiza affected stem diameter. Mycorrhiza dosage 20 g/seedling had the highest stem diameter, but 0 dosage had the lowest (Table 3). Medium composition did not affect the stem diameter. There was no interaction between medium composition and mycorrhiza dosage.

3.4 Crown Dry Weight (g)

ANOVA showed that mycorrhiza affected crown dry weight. Mycorrhizal dosage 20 g/seedling had the highest crown dry weight, but 0 dosage had the lowest (Table 4). Medium composition did not affect the crown dry weight. There was no interaction between medium composition and mycorrhizal dosage.

3.5 Root Dry Weight (g)

ANOVA showed that mycorrhiza affected root dry weight. Mycorrhiza dosage 20 g/seedling had the highest root dry weight, but 0 dosage had the lowest (Table 5). Medium composition did not affect the root

Table 2 The effect of mycorrhiza and medium cow manure composition on sum of leaves (a counter).

Medium composition	Mycorrhiza (g/plant)			Average
	0	10	20	
No cow manure	3.40	4.00	4.20	3.86^{p}
Cow manure 30%	3.60	4.00	4.60	4.06^{p}
Cow manure 40%	3.40	4.20	4.40	4.00^{p}
Cow manure 50%	3.40	4.00	4.20	3.86^{p}
Average	3.45^{c}	4.05^{b}	4.35^{a}	(-)

Means with the same letter in the same column and row are not significantly different by DMRT at 0.05.

Table 3 The effect of mycorrhiza and medium cow manure composition on stem diameter (cm).

Medium composition	Mycorrhiza (g/plant)			Average
	0	10	20	
No cow manure	0.43	0.48	0.66	0.52^{p}
Cow manure 30%	0.48	0.59	0.70	0.59^{p}
Cow manure 40%	0.48	0.66	0.63	0.59^{p}
Cow manure 50%	0.42	0.58	0.68	0.56^{p}
Average	0.45^{c}	0.58^{b}	0.67^{a}	(-)

Means with the same letter in the same column and row are not significantly different by DMRT at 0.05.

Table 4 The effect of mycorrhiza and medium cow manure composition on crown dry weight (g).

Medium composition	Mycorrhiza (g/plant)			Average
	0	10	20	
No cow manure	0.37	0.47	0.44	0.42[p]
Cow manure 30%	0.31	0.54	0.60	0.48[p]
Cow manure 40%	0.23	0.43	0.56	0.40[p]
Cow manure 50%	0.20	0.45	0.42	0.35[p]
Average	0.28[b]	0.47[a]	0.51[a]	(-)

Means with the same letter in the same column and row are not significantly different by DMRT at 0.05.

Table 5 The effect of mycorrhiza and medium cow manure composition on root dry weight (g).

Medium composition	Mycorrhiza (g/plant)			Average
	0	10	20	
No cow manure	0.17	0.23	0.28	0.22[p]
Cow manure 30%	0.18	0.23	0.32	0.24[p]
Cow manure 40%	0.11	0.20	0.32	0.21[p]
Cow manure 50%	0.11	0.23	0.23	0.19[p]
Average	0.14[c]	0.22[b]	0.28[b]	(-)

Means with the same letter in the same column and row are not significantly different by DMRT at 0.05.

Table 6 The effect of mycorrhiza and medium cow manure composition on root infection level percentage (%).

Mycorrhiza dosage (g) and cow manure (%)	Sum of mycorrhiza infected root	Percentage of infected root
0 g + 0%	0	0
0 g + 30%	0	0
0 g + 40%	0	0
0 g + 50%	0	0
10 g + 0%	4	40
10 g + 30%	6	60
10 g + 40%	5	50
10 g + 50%	6	60
20 g + 0%	6	60
20 g + 30%	7	70
20 g + 40%	8	80
20 g + 50%	8	80

Myicoriza treatment on any cow manure.

dry weight. There was no interaction between medium composition and mycorrhiza dosage.

3.6 Root Oil Palm Seedling Infection Level Percentage

Mycorrhizal infection level on root tissue oil palm seedling analysis can be seen in Table 6. Table 6 showed that there was not mycorrhizal infection on 0 g on root oil palm. On mycorrhizal treatments with 10 g and 20 g dosage all roots were infected by mycorrhiza. On dosage 20 g with 40% cow manure and 20 g and 50% cow manure, the infection by mycorrhiza was highest significantly. Longitudinal root spread horizontally and vertically infected fungus mycorrhiza (arbuscular) are presented in Figs. 2 and 3.

ANOVA showed there was no interaction on cow manure composition of media with mycorrhizal dosages application on all parameter observation. It showed 2 factor treatments separately affected oil palm plant growth.

Analysis showed organic mycorrhizal fertilizer on 10 g and 20 g dosage application on plant affected significantly plant height, sum of leaves, stem diameter,

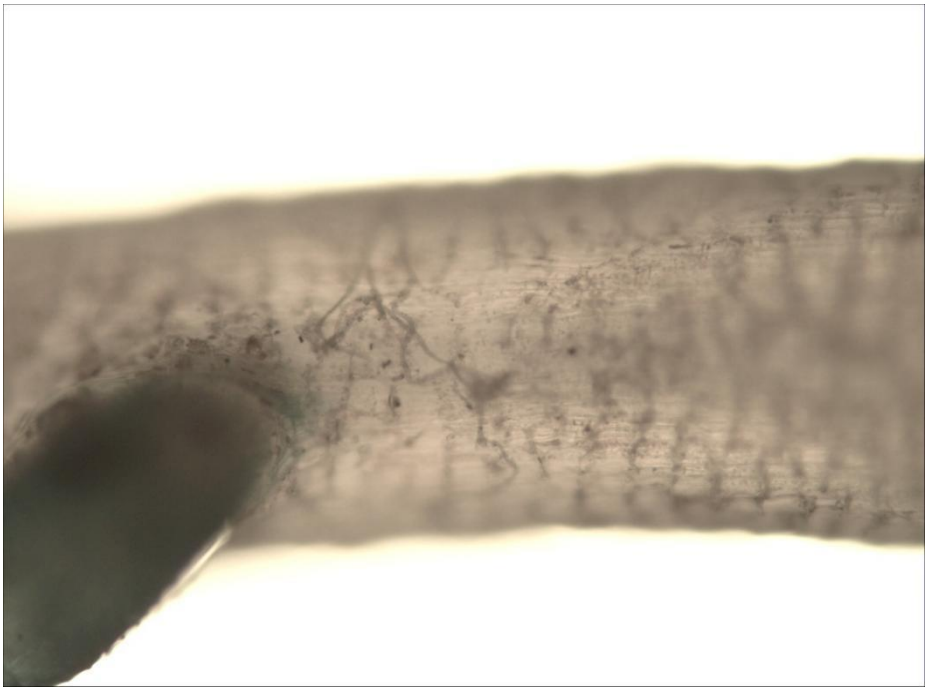

Fig. 2 Longitudinal root spread horizontally infected by fungus mycorrhiza.

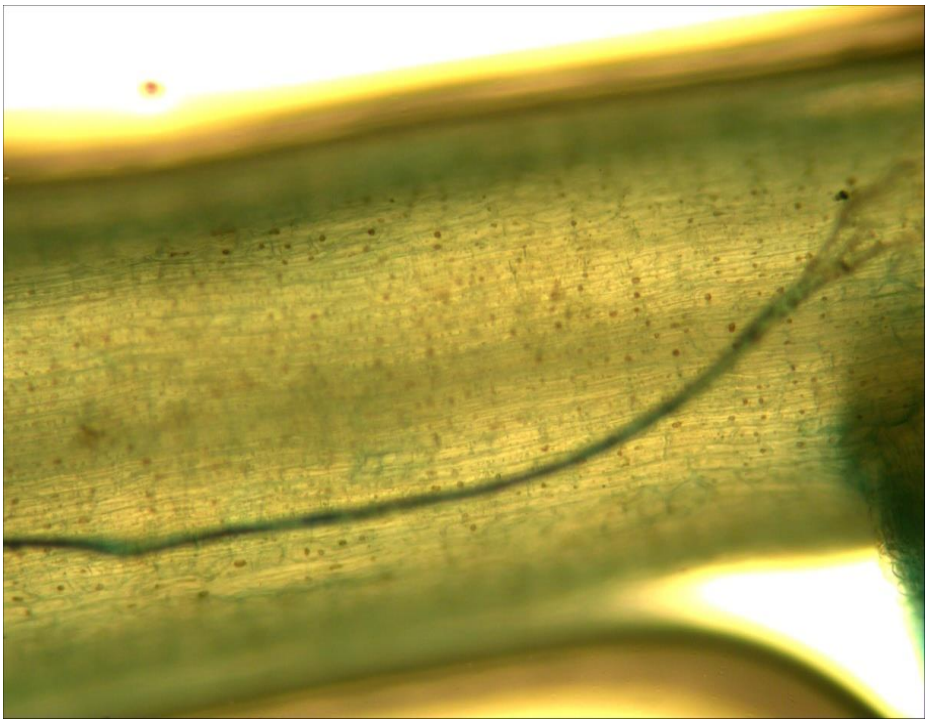

Fig. 3 Longitudinal root spread vertically infected fungus mycorrhiza (arbuscular).

crown dry weight and root dry weight. Mycorrhizal treatment on 20 g had the best on the plant height, sum of leaves and stem diameter. The plant growth with infection by mycorrhiza relatively was better than no mycorrhizal infection. This happens because the plants that were infected by mycorrhiza had ability to absorb elements higher than plant without mycorrhiza [8]. Increasing on plant height, sum of

leaves, stem diameter, crown dry weight and root dry weight is because of increase in nutrition of firstly P element which is very necessary for plant to stimulate vegetative growth. Content of organic fertilizer mycorrhiza is nutritious that is very essential for increasing macro and micro elements absorption. In addition, root plant with mycorrhiza could absorb elements that are bound and unavailable for plants [6]. Mycorrhiza application affected the sum of leaves, dry weight and P absorption on oil palm crown, but did not on plant growth 20 weeks after planting [9]. The colonization of a complex thalloid liverwort, with AMF (*Arbuscular mycorrhizal* Fungi) significantly promotes photosynthetic carbon uptake, growth and asexual reproduction. Plant fitness increased through fungus that enhanced acquisition of phosphorus and nitrogen from soil [7].

The observation on no mycorrhizal application showed root infection did not happen, but for mycorrhizal treatments of 10 g and 20 g in all plants infected by mycorrhiza, the best was on dosage 20 g application. Higher dosage mycorhiza application had better performance in the plant growth because for the infected plant host (roots), the fungus mycorrhiza needed 50-100 spore/g to infect plant root. To infect root plants needed 2 weeks; with more than 2 weeks microorganism on mycorrhiza will die [10]. Organics matter will affect soil structure, pH, elements, water holding capacity directly or undirectly to develop and efficiency fungus mycorrhiza [11]. Mycorrhizal fungi that are associated with plant roots increase nutrition uptake, especially P, and so increase plant and tree growth. Vesicular arbuscular mycorrhiza happened to about 90% for all plant vascular including most of agricultural species that are important but ectomycorrhiza is found in the most of tree species that are economically important in tropical and subtropical climate in the world [12]. Arbuscular mycorrhizal fungi as well as certain soil bacteria provide ecosystem services related to plant growth, nutrition and quality parameters. Positive impact of abuscular mycorrhizal fungi and plant promoted bacteria on crop quality traits (e q nutritional, value, organoleptic properties) [13]. An analysis of 696 patents showed that AMF has been consistently a bio fertilizer and bio mediator over 2 decades, although an upsurge was noted in propagation technologies, next-generation production methods, and formulation technologies [14]. AMF plays the key role in enhancement of plant nutrition, health and product quality. The services provided by AMF often are facilitated by large and diverse beneficial bacterial communities, closely associated with spores, spore carps, and extra radical mycelium, showing different functional activities such as N_2 fixation, nutrient mobilization and plant hormones, antibiotic and siderophore production and also mycorrhizal establishment promotion, leading to enhancement of host plant performance [15]. It was found that AMF and plant growth promoting pseudomonads positively affected the flower and fruit production and the concentrations of sugars and vitamins in tomato fruits. The most important effect of AMF was improvement of citric acid concentration, while bacteria positively modulated sugar production and the sweetness of tomatoes [16]. AMF increased phosphate (P) uptake by plants, and organic phosphate accounts for 30%-80% of total P in most agricultural soil [17].

Analysis showed composition media with subsoil and cow manure did not affect all parameters. It is assumed that cow manure dosage application was did not enough because the media was dominated by regusol. This means that regusol subsoil was physically fertile that was not too different from topsoil, that soil was dominated with soft sand therefore soil aeration was good enough to support root respiration. Therefor the process elements absorption actively in this regusol subsoil. Subsoil is under top soil with enough weathering, little organic matter, low chemical fertility, low pH. Application of fertilizer on subsoil can add elements. When organic matter decomposed, elements will be released to land

in the form that can be used by oil palm seedling [18].

4. Conclusion

Composition of mycorhiza and cow manure with subsoil application did not interact to oil palm growth on pre nursery. Mycorrhiza affected plant height, sum of leaves, stem diameter, crown dry weight, root dry weight. The best plant growth was in 20 g mycorrhizal application and the worst was no mycorrhizal application. Composition of cow manure with subsoil did not affect plant growth in pre nursery.

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