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Increasing The Production of Thai Eggplant (*Solanum melongena* L.) Grown at Altitude of 2 Masl Using Mycorrhizal Biofertilizer

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Abstract

This study was aimed to increase the production of Thai eggplant (*Solanum melongena* L) grown at altitude of 2 masl using myccohirzal biofertilizer. The study was conducted in Experimental Farm of Agricultural Faculty of Campus II University of Cokroaminoto Palopo, Batu Pasi Sub-district, Wara Utara District, Palopo City. This research applied the method of Randomized Block Design with four replicants and five treatments; P0 = Without treatment (control), P1 = Mycorrhizal fertilizer of 5 gr/plant, P2 = Mycorrhizal fertilizer of 10 gr/plant, P3 = Mycorrhizal fertilizer of 15 gr/plant, and P4 = Mycorrhizal fertilizer of 20 gr/plant. Research of this study showed that one treatment significantly affected the root length of eggplant, namely P2 with root length of 39.42 cm. In general, application of mycorrhizal fertilizer did not significantly affect the growth and production of eggplant, but several doses resulted in better outcome. Treatment of P3 obtained the best plant height of 9.22 cm, while the best average flowering age was found in P2 and P4 of 31.8 days after planting. Moreover, P3 and P4 produced the most number of flower, namely 3.83 flowers, while the most number of fruits was obtained by P4 of 3.53 fruits. At last, P3 produced the heaviest fresh weight of fruit of 221.13 gram

Keywords: production, mycorrhizal biofertilizer, thai, eggplant

A. Introduction

Eggplant (*Solanum melongena* L.) is one of horticultural plants widely distributed in Indonesia. Eggplant is originated from Sri Lanka and India. Its fruits have a variety of colors, namely purple, green, and white. In Indonesia, eggplant is often served in many kinds of dishes, from vegetable soup to lalap (raw vegetable). Similar to other vegetables, eggplant also provides health benefit to the body as it contains many nutrients. Rukmana (1994), mentioned that eggplant is rich of vitamin C, K, B6, thiamin, niacin, magnesium, phosphorus, copper, fiber, folate acid, potassium, and manganese. However, eggplant production in Indonesia is still considered low despite its abundant nutrient content.

According to Badan Pusat Statistik Kota Palopo (2016), eggplant productivity in Palopo City decreased for the last five years. The production was 248.60 ton in 2011 but drastically declined to 77.40 ton in 2012. Later, there was significant increase of 105.70 ton in 2013, but then again it felt drastically in 2014 (83.10 ton) and 2015 (69.70 ton). Decreasing eggplant production was due to small eggplant farming area and farmers who still considered eggplant cultivation as secondary farming culture thus it was not intensively performed. Furthermore, low production was also caused by inappropriate farming technic and non-optimal eggplant growth, both in the vegetative and generative phases.

One effort to increase eggplant growth and production is conducted by improving root function to absorb nutrient and water available in soil. Improving root function can be done by stimulating or inducing roots with the help of fungi or bioagents that are able to penetrate to plant roots, such as mycorrhizal fungi and bioagents like *Trichoderma* sp., *Pseudomonas Fluorescent Indofit* sp., and *Bacillus Subtilis* sp. Those microorganisms can be obtained in the form of fertilizer for ease of application. One of fertilizers providing microorganisms to improve plant root function is mycorrhizal fertilizer, that is powder fertilizer containing Mycorrhizal fungi, *Trichoderma* sp., *Pseudomonas Fluorescent Indofit* sp., and *Bacillus Subtilis* sp. that are able to improve water transportation to root, transform the form of available nutrient for plant, increase phosphorus availability, and suppress the growth of pathogen.

Imas, T., Hadioetomo, R. S., Gunawan, A. W. & Setiadi, Y. (1989), said that mycorrhiza was also found to increase the production of growth hormone such as auxin, cytokinin, and gibberellin of host plants. Auxin has function to slow the aging process in root, thus root function to nutrient and water will last longer.

Prasasti, O. H., Purwani, K. I. & Nurhatika, S. (2013), reported that mycorrhizal treatment affected plant height, root dry weight, and canopy dry weight of peanut plant (Domba variety) infected with pathogenic *Sclerotium rolfsii*. Treatment of mycorrhiza at dose of 50 gram resulted in the highest effect on vegetative growth of peanut plant, both the height and dry weight of plant. According to those findings, the objective of this study was to investigate production increase of Thai eggplant (*Solanum melongena* L) grown at altitude of 2 masl and treated with mycorrhizal biofertilizer.

B. Methodology

1. Research Design

The study was conducted in Experimental Farm of Agricultural Faculty of Campus 2 University of Cokroaminoto Palopo, Jln. Lamaranginang, Batupasi Sub-district, Wara Utara District, Palopo City.

The materials used in this study were seeds of Thai eggplant, plastic, basic fertilizer, and Mycorrhizal Fertilizer. Tools used in this research included hoe, scale, , bamboo, container or bucket, stationery, and camera.

2. Experimental Methods

The mycorrhizal dose treatment applied was :

P0 : Without treatment (control)
P1 : 5 gram/plant
P2 : 10 gram/plant
P3 : 15 gram/plant
P4 : 20 gram/plant

Data of observation were analyzed by ANOVA (Analysis of Variance). Any significant results were further analyzed using Tukey's Honest Significant Difference test at level of 5%.

3. Application Methods

a. Land Preparation

Land preparation was conducted 1-2 weeks before seed transplanting. Preparation was carried out by cleaning the land, loosening the soil, and creating planting beds (*bedengan*) at length of 1 meter, width of 40 cm, and height of 15-30 cm. Land preparation was followed by spreading of basic fertilizer, that was chicken manure amounted to 1.5 sacks for 3x7 meter of planting area.

b. Seed Sowing, Preparation of Planting Hole, and Planting

Planting media used for eggplant seedling in this study was soil mixed with husk charcoal. After seeds reached the age of 1-1.5 months or had 4 leaves, they were ready to be transplanted.

Preparation of planting hole was done using *tugal* (traditional planting tool), then planting holes were made at planting distance of 30x40 cm and depth of 3-5 cm (adjusted to the length of seed roots) with planting beds length of 1 meter and width of 40 cm. The seeds used were of 1-1.5 months old or had 4 leaves. Seeds were further put into the hole following the rule of 1 seed/planting hole. Moreover, seed roots (*collum*) had to be completely planted and seed covering was further performed to prevent stress in plants due to direct exposure of sunlight. Later, plants were watered to moisture the soil.

c. Application of Mycorrhizal Fertilizer

Mycorrhizal fertilizer was firstly applied in Thai eggplant at the age of 7 Days After Planting (DAP). The next application was done after flowering at the age of 35 Days After Planting (DAP). Mycorrhizal fertilizer application was conducted by digging the soil around plant stem until plant roots were seen. Mycorrhizal fertilizer was spread around plant roots. The amount of mycorrhizal fertilizer applied in this study was 1,120 gram.

d. Harvest

The first harvest of eggplant was conducted in about 63 DAP or 15-18 DAP after flowering. Eggplant is harvested when the fruit flesh is still tender, the fruit color is shiny, and the fruit size is not too big or too small.

e. Observation

Observation of plant height (cm), number of leaves (leaf), and stem diameter (cm) was done 1 WAA (Week After Application), that was in the morning. Later, observation was conducted once a week until the first flower bloomed. The next observation process that was performed after the eggplant fully bloomed included flowering age (DAP), number of flower (flower), number of fruit (fruit), and harvest to determine the fresh weight of fruit, root length and root diameter of plant.

f. Parameter of Observation

The parameter observed in this study included: Plant height (cm), Flowering age (day), Number of flower (flower), Number of fruit (fruit), Fresh weight of fruit (gr), and Root length (cm).

C. Results and Discussion

1. Findings

a. Plant Height (cm)

The diagram below shows that the height of eggplant plants given mycorrhizal fertilizer 15 grams / plant (P3) shows the best plant height of all existing treatments with an average plant height of 9.22 cm while the lowest plant height is found in plants given mycorrhizal fertilizer 10 gram / plant (P2) with plant height of 8.82 cm.

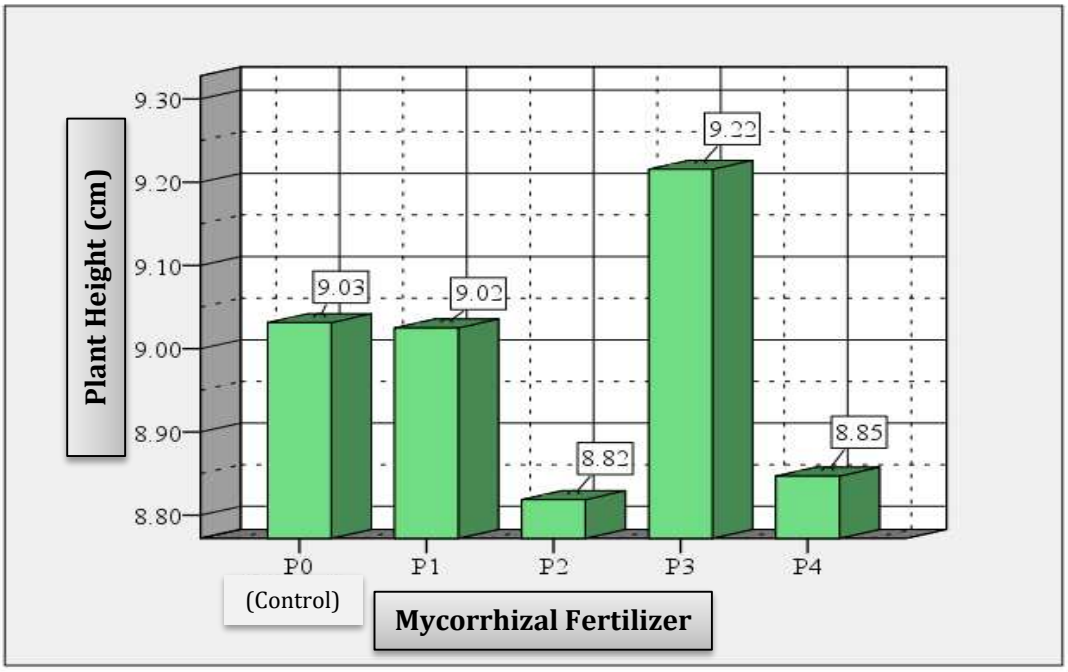

Figure 1.Measurement of Thai eggplant height at the age of 4 Weeks After Planting

b. Flowering Age (Day)

The picture below shows a difference in flowering time for each plant given or not given mycorrhizal fertilizer, where there are two treatments that show the same flowering time fast compared to other treatments, namely in plants given 10 grams of mycorrhizal fertilizer / plant (P2) and 20 gram / plant (P4) with flowering age which is 31.8 days after planting (HST) while plants without mycorrhizal fertilizer / control (P0) are plants with the longest flowering time among all treatments with flowering age which is 35 days after planting (HST).

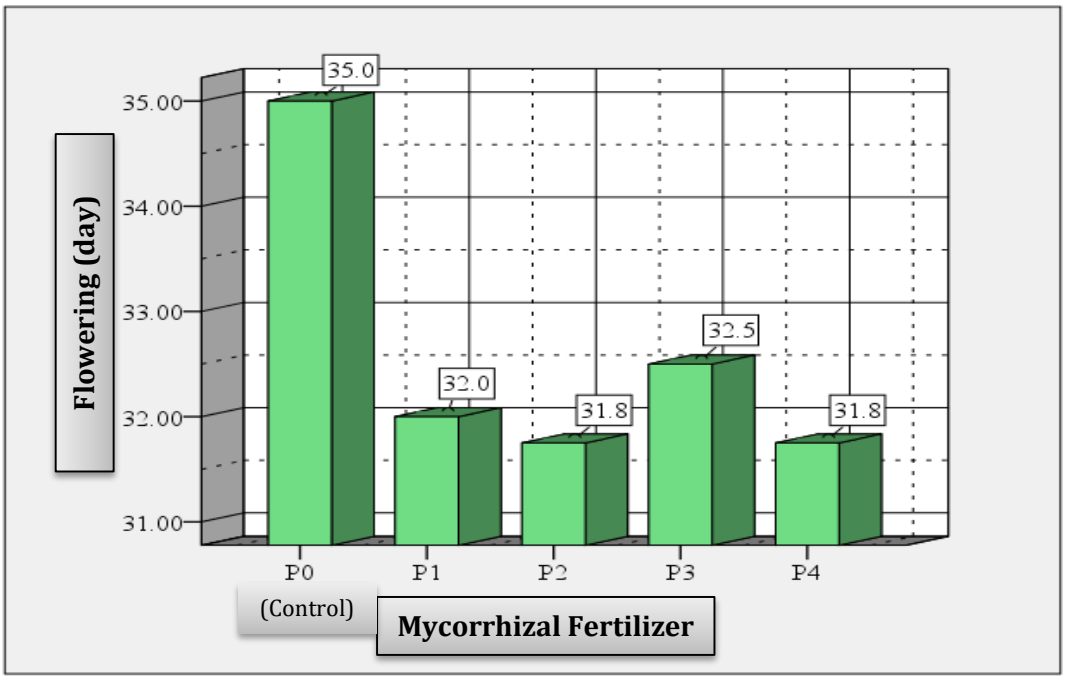

Figure 2. Diagram of eggplant flowering age

c. Number of Flower (Flowers)

The diagram above shows the number of round green eggplant plant flowers with the treatment of mycorrhizal fertilizer gives better results than round green eggplant plants without the application of mycorrhizal fertilizer / control (P0), where the results of the analysis of variance shown in figure above show that there are two treatments that have the highest number of flowers with the same value, namely P3 and P4 with the number of flowers as much as 3.83 while plants that have the lowest amount of flowers from all plants are found

in plants that are not given mycorrhizal / control fertilizer (P0) with the amount of interest 2.78 pieces.

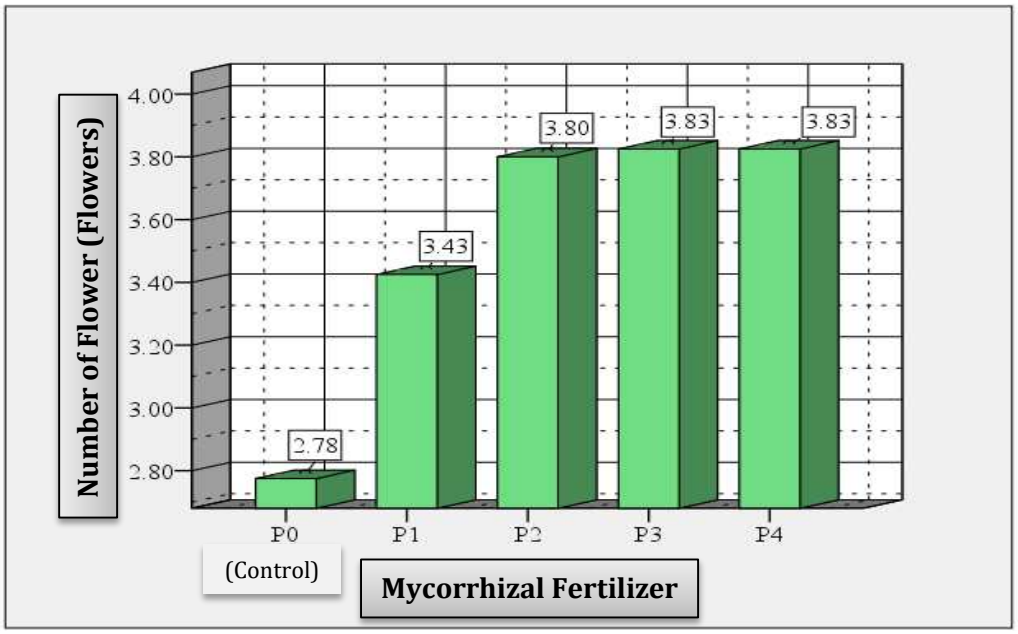

Figure 3. Diagram of flower number of Thai eggplant at the age of 5-9 WAP.

d. Number of Fruit (Fruits)

The average number of round green eggplant fruit plants shown in the diagram shows differences in the number of fruits between plants given mycorrhizal fertilizers and plants that were not given mycorrhizal fertilizers, where analysis of variance showed that plants were given 20 grams of mycorrhizal fertilizer / plant (P4) has the highest number of fruit, which is 3.53 while plants that are not given mycorrhizal / control fertilizer (P0) are plants that have the lowest number of fruits of all plants with a number of fruits which is 1.94 fruits.

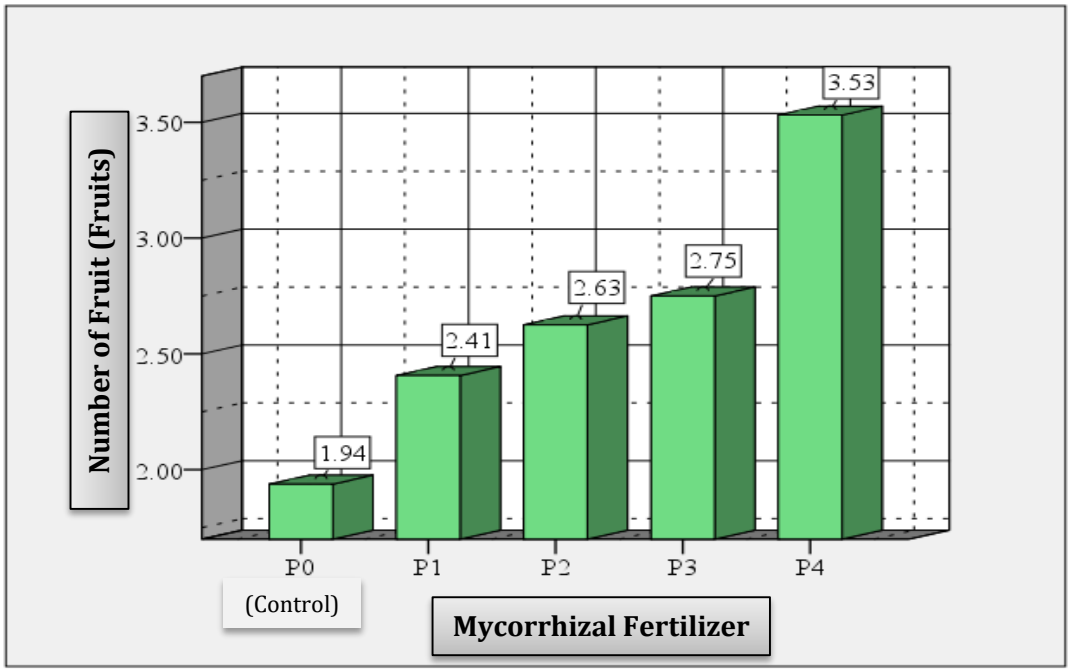

Figure 4. Diagram of fruit number of Thai eggplant at the age of 6-9 WAP

e. Fruit Fresh Weight (gr)

The picture below shows that the treatment of mycorrhizal fertilizer on round green eggplant plants shows the best fresh weight of fruit found in the treatment of mycorrhizae with a dose of 15 grams / plant (P3) that is 221.13 grams while the plants with the lowest fresh

weight are found in plants that are given mycorrhizal fertilizer with dose of 5 grams / plant with an average fresh fruit weight of 150.75 grams.

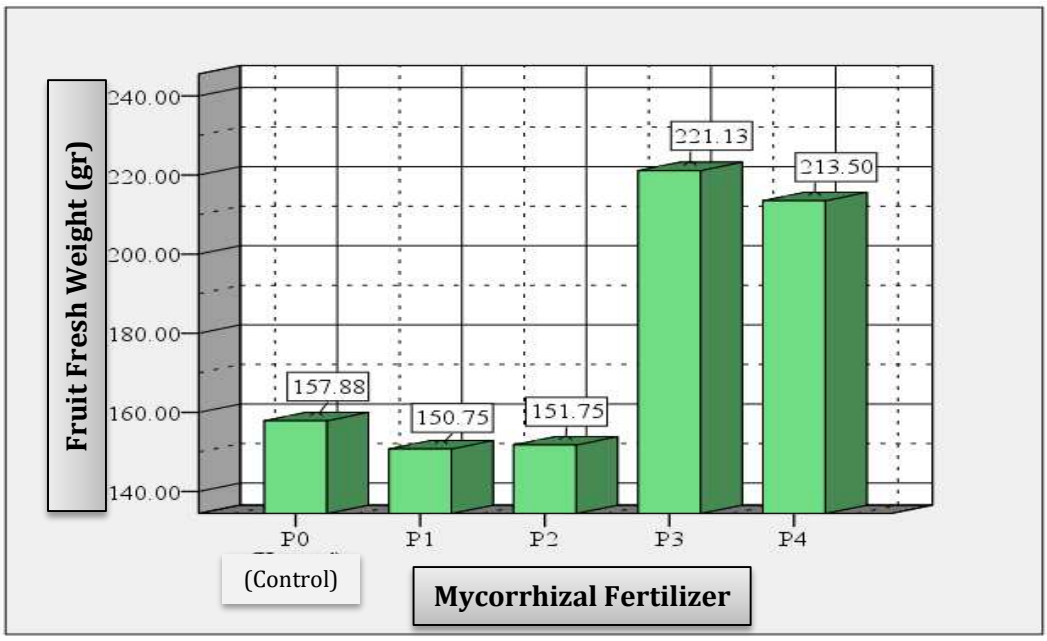

Figure 5.Diagram of fruit fresh weight measurement (gr) of Thai eggplant

f. Root Length (cm)

The root length of the round green eggplant plant shown in the diagram shows that round green eggplant plants with mycorrhizal fertilizer treatment gave better results than round green eggplant plants without treatment / control, (P0) eggplant plants were given 10 grams of mycorrhizal fertilizer / plant (P2) shows the highest value of the root length of the round green eggplant plant is 39.42 cm while the treatment shows the lowest value of all treatments, namely in plants without the application of mycorrhizal fertilizer / control (P0) with a root length value of 28.18 cm.

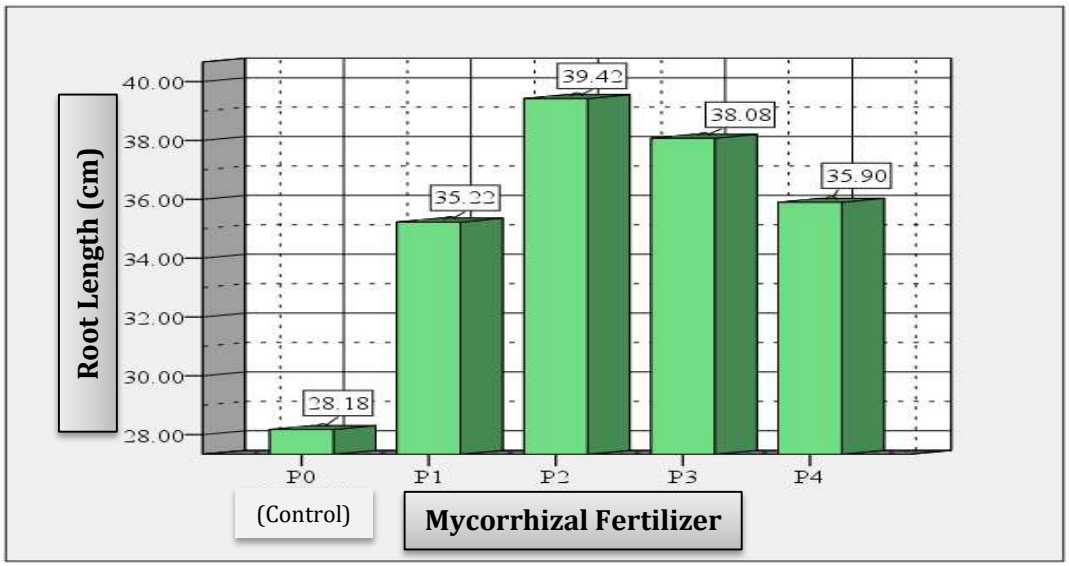

Figure 6. Diagram of root length (cm) of Thai eggplant

2. Discussion

Application of mycorrhizal fertilizer in eggplant did not significantly affect several parameters of observation since significant result was only found in root length, that was treatment at dose of 10 gram/plant (P2) which resulted in root length of 39.42 cm. There are several doses that show better results, treatment of P3 obtained the best eggplant height of 9.22 cm, while the best average flowering age of 31.8 Days After Planting (DAP) was found in P2 and P4. Moreover, both P3 and P4 produced the most flower of 3.83 flowers, and the most

fruits of 3.53 fruits was found in P4. Treatment P3 resulted in the best fruit fresh weight of 221.13 gram.

The role of mycorrhizal fertilizer in plant height, flowering age, number of flower, number of fruit, and fruit fresh weight of eggplant did not show an optimal result. However, it indicated a good result in root length of plant. Mutual relationship between eggplant roots and mycorrhizal fungi will lead to a positive impact on root growth, in which mycorrhizal fungi that associate with eggplant root will facilitate roots absorbing nutrient, particularly nutrients required by eggplant roots, such as phosphorus (Khan, 2005).

Mycorrhizal fungi are able to break down P element bound in soil to be absorbed by plants. Moreover, high phosphorus absorption by plant infected with mycorrhizal fungi is caused by phosphatase enzyme produced by mycorrhizal fungal hyphae, thus P in soil will be dissolved and available for plants. The hyphae of mycorrhizal fungi in soil absorb phosphorus and transport it to colonized roots where phosphorus is transferred to the host plant. Furthermore, the performance of mycorrhizal fungal hyphae could go beyond the distance reached by the root hair of host plant. Thus, when phosphorus around the root hair is depleted, hyphae will help the process by absorbing phosphorus in areas unreached by root hair (Musfal, 2010).

The average of the best root length with a dose of 10 grams of mycorrhizal / plant shown in P2 with a value of 39.42 cm and the lowest root length at P0 (control) with a root length of 28.8 cm This is due to the symbiosis between the mycorrhizal fungus and the root of the eggplant plant which results in the effective addition of root length. Muzar (2006), states that the high and low percentage of CMA infection in plant roots is influenced by the amount of CMA given. Application of mycorrhizal fertilizer in eggplant indicated the lowest average result in which plant did not administered with mycorrhizal fertilizer/control (P0) resulted in the lowest measurement of root length (28.18 cm), root diameter (1.27 cm), flowering age (35 days longer), number of flower (2.78 flowers), and number of fruit (1.94 fruits). Application of mycorrhizal fertilizer at dose of 5 gram/plant (P1) obtained the lowest result in fresh weight of fruit (150.75 gr).

The lowest value obtained due to the application of mycorrhizal fertilizer in eggplant is because mycorrhizal fungi no longer properly associate with eggplant root, thus hinder nutrient absorption benefits for the growth and production of eggplant. Performance of mycorrhizal fungi in absorbing nutrient in soil will lead to optimal result if nutrient requirement for fungi is fulfilled. Therefore, the existence of mycorrhizal fungi in eggplant roots depends on mutual relationship between plants and mycorrhizal fungi as well as nutrient availability for mycorrhizal fungi obtained from its host. If nutrient availability for mycorrhizal is fulfilled by the host plant, mycorrhizal will continuously exist in plant roots. Mycorrhizal fungi need carbohydrate in the form of simple sugars, e.g. glucose and carbon (C) from plant/host as nutrient. Furthermore, through the external hyphae, mycorrhizal fungi will distribute water, mineral, and nutrients in soil to facilitate metabolism activity of the host plant. This situation is in line with Nusantara (2008), who mentioned the life and association of mycorrhizal fungi depend on passive carbon flow from host plants that provide nutrient for mycorrhizal fungi.

D. Conclusion

1. Application of mycorrhizal fertilizer in to the growth and production of green eggplant plants gave a significant effect, namely root length through the administration of mycorrhizal fertilizer at dose of 10 gram/plant (P2) which resulted in the best root length of 39.42 cm.
2. The average result showed that plant given treatment of mycorrhizal fertilizer of 10 gram/plant was able to provide the best result of flowering age (31.8 DAP). Moreover, plant given mycorrhizal fertilizer of 15 gram/plant (P3) showed best result in plant height (9.22 cm), number of flower (3.83 flowers), and fresh weight of fruit (221.13 gram). In addition, plant administered with mycorrhizal fertilizer of 20 gram/plant (P4) obtained the best result in number of flower (3.83 flowers) and number of eggplant fruit (3.53 fruits).

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