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The Growth of Dragon Fruit Seedling on Several Type and Doses of Mycorrhiza

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Abstract: ***The aims of this study were to find out type and doses of mycorrhiza and its interaction that could gave the best growth on dragon fruit seedling. This study used completely randomized design (CDR), which consists of two factors. The first factor was the type of mycorrhiza which consist 3 type of mycorrhiza (Glomusfasciculatum,Glomusaggregatumand Glomusmosseae) and the second factor was the doses of mycorrhiza which consist of 4 doses (0g plant^{-1}, 1g plant^{-1}, 2g plant^{-1}, 3g plant^{-1}). The result showed that the type of mycorrhizaGlomusfasciculatum provide the highest growth than the other types of mycorrhiza.The highest growth provided by doses 2g plant^{-1} than the other dosages.There was no interaction between type and doses of mycorrhizatoward the growth of dragon fruit seedling. However, the combination treatment of the type of mycorrhizaGlomusfasciculatum and doses 2g plant^{-1}likely provided the best effect on plant height, the number of branches, stem diameter, the number of roots, and root length of dragon fruit seedling.***

Keywords: dragon fruit, Mycorrihiza

1. Introduction

Indonesia is a country that has the lowlands and highlands which have more potential to produce various kinds of fruits. One of them which have more potential to be developed is dragon fruit. Dragon fruit plants is a type of vines. Although the roots in the soil removed, the plant is still alive as epiphytic plants because of the food needs obtained through the aerial roots on the stems. Morphologically, the plant is included into the group of incomplete plants because it does not have leaves (Kris, 2008).

The dragon fruit is plants that produce seeds (*Spermatophyta*), while the seeds are covered by the ovaries that are included in the class of closed seed plants (*Angiospermae*), included in class Dicotyledonae, ordoCactales, family Cactaceae, classified into genus *Hylocereus*and the species name is *Hylocereusundatus* (Kris, 2008). Dragon fruit contains vitamin C, beta carotene, calcium and carbohydrates. The content of vitamin B2 and B1 in dragon fruit is also very good to increase the metabolism and recover the appetite. The dragon fruit has high fiber content as a binding agent of carcinogen and facilitate the digestive system. Dragon fruit is also a good source of antioxidants which can protect against free radicals.Moreover, efficacious for treating various diseases such as balancing blood sugar levels, nourish the oral health, cholesterol-reducing, preventing bleeding, nourish the liver, strengthen the brain works, increase the acuity of eyes, blood stabilizing and Fluor Albus drug. Furthermore, the dragon fruit also useful as a raw material in food processing industries, beverages, cosmetics, and health product.

Data of Planning Directorate General of Food Crops showed an increasing trend domestic market demand for commodities fruit in 2000-2005(average of 6.5% per year), in 2005-2010 (average of 6.8% per year), and in 2010-2015 is estimated to average by 6.9% per year. The overseas market demand for tropical fruit Indonesia tends to increase each year, either fresh fruit or fruit processed (Rukmana, 2003).

To date the need for dragon fruit in Indonesia is quite large. Not only for the local need market but the export opportunities are also no less magnitude. However, the great need has not been able to be met by producers of the country of origin (Taiwan). In Indonesia, dragon fruit imported reaches 200-400 tons / year. Looking the potential of agricultural land area of Indonesia, there are great opportunities to develop these crops in Indonesia. The other condition supporting is the availability of potential land and the experts in the cultivation of these crops.

The Dragon fruit is usually cultivated by cuttings or seed. Plants will thrive if planted in porous media (not wet), nutrient rich, sandy, adequate sunlight and temperatures between 38-40°C.Dragon fruit can be grown in any soil conditions and altitude, however plant is quite greedy for nutrients, so if the soil contains a good fertilizer, then the growth will be very fast. Within a year, the plant can reach a height of 3 meters.

Dragon fruit cultivation on the marginal lands face biophysical constraints such as the bad physical properties, nutrient deficiency, toxicity elements, pests and diseases, and so on. Unavailability of nutrients is not only due to poor soil, but also occurs due to erosion and high nutrient fixation so that the nutrients are not available to plants. Causes of degraded land due to erosion are very common. Erosion tends to carry relatively fertile soil layer and leave the poor subsoil. Considering the breadth of critical land and the increasingly high rate of land degradation, then efforts for restoration and reduce the rate of degraded land has become an urgent need. Soil and water conservation efforts through physical, chemical and biological have been many done, but the results are not optimal.

Therefore, another effort must be arranged as a complement the efforts that have been done.One of them is the use of mycorrhiza are believed to be able to improving the condition of the soil and promote the plant growth.To accelerate the growth of plant then needs to improved ability of root to absorb the nutrients and water. The one way to

improve the roots to absorb the nutrient and water plants is the use of mycorrhizal fungi.

The use of mycorrhizal fungi as biological tools in agriculture could improve growth, productivity and quality of plans without lowering the quality of the plant ecosystem.Mycorrhizal fungi symbiotic with the roots of plants that are beneficial for plant growth because it can increase the absorption of nutrients.The formed structure as a result of mutually beneficial cooperation between mycorrhizal fungi with plant roots have the ability to increase the input of water and nutrients from the soil into the plant tissue.Mycorrhizae also have the specific ability to enhance the absorption of P from P soluble form, either naturally occurring P or are derived from fertilizer on the marginal lands which are low P availability.

Mycorrhiza is a typical structure that reflects the mutual functional interactions between an autobionor certain plants with one or more strains of mikobion in time and space. Formed structure from these associations are arranged irregularly and showed highly wide spectrum, both in terms of host plants, fungi and spread.Mycorrhizae spread from arctic tundra to the tropics and from the desert to the rain forestry that involves 80% of plant species. The ability of mycorrhizal symbiotic with the roots is determined by the amount of mycorrhiza that was around the roots and types of mycorrhiza. Each mycorrhiza have different of tissue hifa that affect to the mycorrhiza activity (Nuhamara, 1993).Therefore, this study was conducted to find out the growth of dragon fruit seedling on the various types and doses of mycorrhiza.

2. Materials and Methods

This study used completely randomized design (CDR), which consists of two factors. The first factor was the type of mycorrhiza which consist 3 type of mycorrhiza (*Glomusfasciculatum* (M_1),*Glomusaggregatum*(M_2), and*Glomusmosseae* (M_3)) and the second factor was the doses of mycorrhiza which consist of 4 doses (0g plant^{-1}(D0), 1g plant^{-1}(D1), 2g plant^{-1}(D2), 3g plant^{-1}(D3).Based on the number that tested it was obtained 12 combined treatment.Each combination consists of three replications, and each replication consisted of three units so that overall there were 108 experimental units.

Preparation
The study was begun with prepared the area of 5 m x 3 m = 15 m2 that would be use to put the polybag experimental plant.The area was cleaned of weeds manually and subsequently flattened so that polybag could sit well then made the fence to avoid the plants from damage caused by pets. The media was prepared a mixture of soil, manure and sand in the ratio 2: 2: 1. The media was blended until smooth than loaded into polybag measuring 20 cm x 30 cm. Polybag subsequently was saturated, and left for ± 3 days. The distance between the polybag arranged so that easily distinguish between treatments and between replications.

Cultivation and Treatment of Mycorrhiza
Plantating was made by making a planting hole in the upper surface of polybag.Mycorrhiza was planted which adjusted each treatment following by planting dragon fruit seedling which have been ± 3 months old transferred from the polybag that has been prepared.Further, plants was watered with water.

Maintenance
Maintenance was done by watering the plant any time (adjusted for humidity of media in polybag). The control of weeds and cleaning that could affect on plant growth was done manually. Fertilization was done by NPK when the plant was 2 weeks after treatmentwith each dose of 1 gram per polybag with drill around the root system.

The Observation Variables
The observation of the plant growth was done at the end the experiment. The parameter components of thisstudy wereplant height, the number of branches, stem diameter, the number of roots, and root length of dragon fruit seedling.

Statistical Analysis
All quantitative data were subjected to ANOVA analysis by using SPSS statistics. A test of least significant differences was used to separate means; differences between means were considered statistically significant $P<0.05$.

3. Result

The Plant Height

As presented in Figure 2, the highest plant of dragon fruit seedling was showed by treatment combination for type of mycorrhizaeGlomusfasciculatum with the doses 2g plant^{-1} (M1D2).

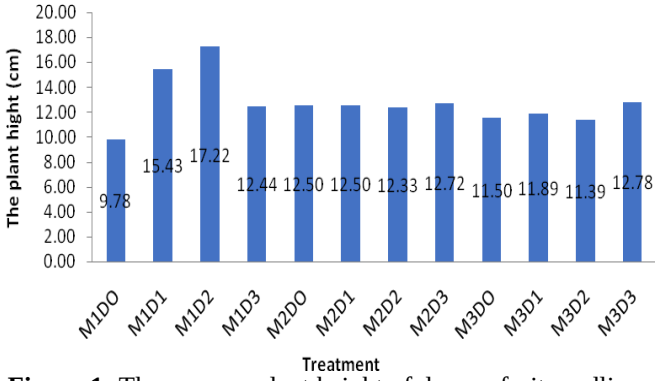

Figure 1: The average plant height of dragon fruit seedlings

The Number of Branches

Figure 2. presented the number of branches. the number of branches of dragon fruit seedlings were generated on a treatment combination of type mycorrhiza *Glomusfasciculatum* with a doses of 2 g plant^{-1} (M_1D_2).

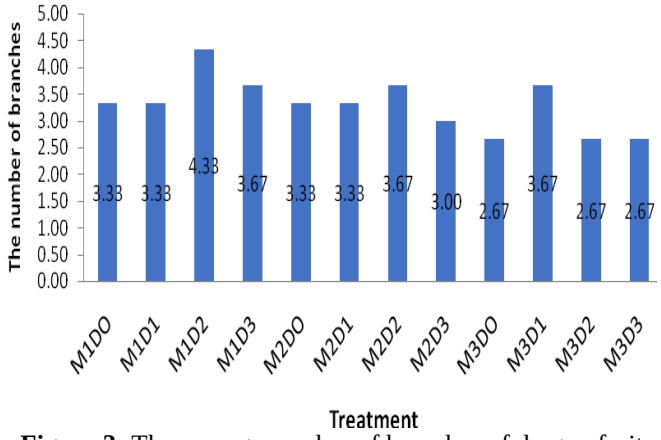

Figure 2: The average number of branches of dragon fruit seedlings

Stem diameter

Table 1. showed that the treatment of type mycorrhiza*Glomusfasciculatum* (M_1) provides the highest stem diameter that significantly different with treatment of types mycorrhiza*Glomusmosae* (M_3), however, it was not significantly different with treatment of type mycorrhiza*Glomusaggregatum* (M_2).Similarly, at treatment doses of mycorrhiza seen the highest stem diameter resulted at treatment doses of mycorrhiza 2 g plant^{-1} (D_2) that significantly different with the dosage of 0g plant^{-1}(D_0), 1g plant^{-1} (D_1), and 3g plant^{-1} (D_3).

Table 1: The average of stem diameter of dragon fruit seedlings

Types Mycorrhiza	*Doses of Mycorrhiza*				Means	NP BNJ α = 0.05
	D_0	*D_1*	*D_2*	*D_3*		
M_1	10.66	9.91	13.95	7.88	10.60^{a}	
M_2	10.00	11.35	10.81	8.80	10.24^{a}	1.58
M_3	8.42	9.90	11.35	3.47	8.29^{b}	
Means	9.69^{b}	10.39^{b}	12.04^{a}	6.72^{bc}		
NP BNJ α = 0.05 (1.58)						

Note: Means in the same row and column with different superscripts differ significantly (P<0.05).

The Number of Roots

Table 2. showed that the treatment of doses mycorrhiza2 g plant^{-1} (D_2)provides the highest number of roots that significantly different with treatment of doses 0g plant^{-1}(D_0), and 3g plant^{-1} (D_3). However, it was not significantly different with treatment of1g plant^{-1} (D_1).

Table 2: The average number of roots of dragon fruit seedlings

Doses of Mycorrhiza	Means	NP BNJ α = 0.05
D_0	16.89^{b}	2.50
D_1	18.39^{a}	
D_2	20.63^{a}	
D_3	17.11^{b}	

Note: Means in the same column with different superscripts differ significantly (P<0.05).

Root Length

As presented at Figure 3, the highest root length of dragon fruit seedlingsprovides at treatment combination of type mycorrhiza*Glomusfasciculatum*with with the doses 2g plant^{-1} (M_1D_2).

4. Discussion

Statistical analysis showed that the type of mycorrhiza have significant effect onstem diameter of dragon fruit seedlings, however, it was not significant on plant height, the number of branches, the number of roots, and root length of dragon fruit seedling. The test of least significant differences showed that the type of mycorrhiza*Glomusfasiculatum*was significant on stem diameterof dragon fruit seedlings that significantly different with the type of mycorrhiza*Glomusmosae*. However,it was not significantly different with the type of mycorrhiza*Glomusagregatum*.

The highest influence shown on treatment by inoculation with type of mycorrhiza*Glomusfasciculatum*. It is thought due to the type of mycorrhizal symbiosis can be good with dragon fruit seedlings root system so that the rooting section could more effectively absorb nutrients, especially phosphorus nutrient to stimulate growth and development. It was in line with Simanungkalit (2001), that the present of mycorrhizain root system of the plant was its ability to increase the uptake of plant nutrients, especially phosphorus elements. The absorption of phosphorus transported through external hyphae in the form of polyphosphates. Further by Tinker (1975) regarding the absorption of phosphorus was the mycorrhiza colonization change the morphology of the roots resulting enlargement of the root system thereby root surface area to absorb phosphorus become become more widely.

The test of least significant differences showed that the doses of mycorrhiza2g plant^{-1}(D_2)showed significantly different with thedoses of mycorrhiza0g plant^{-1}(D_0), and 3g plant^{-1} (D_3). However, it was not significantly different with treatment of 1g plant^{-1} (D_1). It is thought due tothe doses of mycorrhiza2g plant^{-1}highly appropriate and effectively to change the metabolism of the plants and the growth environment so that it can absorb the nutrients quickly.Tinker (1975), revealed that mycorrhiza colonization alter the metabolism of the host plant so that the absorption or utilization of phosphorus by the roots colonized improved, it was increasing the absorption power of individual roots.Hyphae absorb phosphorus in the soil and transport it to the roots colonized, where phosphorus was transferred to the host mycorrhizal resulting increase in the volume of soil that could reached by the root system of plants.

Furthermore, the results of analysis of variance showed no interaction between treatment types of mycorrhiza with dosage. However, the combination of type mycorrhiza *Glomusfasciculatum* and dosage of 2 g plant-1 showed the highest results in all parameters were observed. It is thought due to the type and dose of mycorrhiza were very good for dragon fruit seeds and the environment, especially the root system becomes better so that more effective absorption of

phosphorus elements to stimulate the growth of dragon friut. According to Hardjowigeno (2002), phosphorouswas used to cell replication, establishment of albumin, flower formation, fruits and seeds and accelerate the ripening.

5. Conclusion

The type of mycorrhiza Glomusfasciculatum provide the best and the highest growth of the dragon fruit seedlings than the type of mycorrhiza Glomusmosae and Glomusaggregatum. Doses 2g plant-1 of mycorrhiza provides the best and the highest growth of dragon fruit seedlings than the other doses of mycorrhiza. There was no interaction between the type and doses of mycorrhiza on the growth of dragon fruit seedlings. However, treatment combined of type mycorrhizaGlomusfasciculatum with doses 2g plant-1 tends to give the best effect on plant height, number of branches, stem diameter, number of roots and root length of dragon fruit seedlings.

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