ISSN 2348-313X (Print)
International Journal of Life Sciences Research ISSN 2348-3148 (online)
Vol. 12, Issue 4, pp: (37-43), Month: October - December 2024, Available at: www.researchpublish.com

THE APPLICATION OF ORGANIC FERTILIZER AND MYCORRHIZA ON THE GROWTH OF LOCAL MANGOSTEEN (*Garcinia mangostana* L.) SEEDLINGS IN CENTRAL SULAWESI

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DOI: https://doi.org/10.5281/zenodo.14383254

Published Date: 11-December-2024

Abstract: **Mangosteen (*Garcinia mangostana* L.) is one of the tropical fruit commodities that has high economic value. Currently, mangosteen is an export fruit commodity of Indonesia. Mangosteen abroad is known as the "Queen of Fruits" and "The finest fruit of the tropics", because it has the special color of the skin and flesh of the fruit and a unique taste, namely sweet, sour and refreshing, besides that mangosteen also has high nutritional value. The research was conducted in Labuan Toposo Village, Labuan District, Donggala Regency. 00 32 '52.719" LS and 1190 57' 35.834" BT. This research was conducted from December to April 2024. The design used in this study was a Randomized Block Design (RAK) with two factors, where the first factor was the provision of mycorrhiza consisting of two levels, namely M0 = Without mycorrhiza and M1 = Mycorrhiza 10 g. The second factor is the provision of organic fertilizer consisting of 4 levels, namely P0 = Control, P1 = Rice straw compost, P2 = Banana peel compost, and P3 = Vermicompost. Based on this treatment, 8 treatment combinations were obtained with 7 replications, resulting in 56 experimental units. Each experimental unit used 3 mangosteen seedlings so that the total number of mangosteen seedlings used was 168 seedlings. The results obtained from this study indicate that the provision of 10g/polybag mycorrhiza (M1) has an effect on the increase in plant height at the age of 6 MST, namely 0.25 cm, at the age of 12 MST, namely 0.23 cm, and the increase in stem diameter at the age of 3 MST, namely 0.061 mm. While the observation parameters of leaf greenness, leaf area, fresh weight and dry weight indicate that the treatment of mycorrhiza and organic fertilizer has no significant effect and there is no interaction.**

Keywords: **Mangosteen, organic fertilizer, mycorrhiza.**

I. INTRODUCTION

Mangosteen (Garcinia mangostana L.) is one of the tropical fruit commodities that has high economic value. Currently, mangosteen is an export fruit commodity of Indonesia. Mangosteen is known abroad as the "Queen of Fruits" and "The finest fruit of the tropics", because it has the special color of the skin and flesh of the fruit and a unique taste, namely sweet, sour and refreshing, besides that mangosteen also has high nutritional value.

Mangosteen fruit has high economic value and has good prospects to be developed as an export commodity. In 2020, Indonesia's mangosteen exports reached almost 48 thousand tons. Data from the Central Statistics Agency (BPS) 2021 shows that Indonesia's mangosteen production in 2021 reached 303,934 tons. This illustrates the potential for developing mangosteen plants is quite large because several districts in Central Sulawesi have agroclimates that are suitable for developing mangosteen plants and are one of the leading commodities of Central Sulawesi that are being developed.

According to (Adelina, 2017) there are four groups of mangosteen accessions that are genetically different, but the superior characteristics of each Central Sulawesi mangosteen character are not yet known for certain. This mangosteen has a different genetic composition but its specific superior characteristics are not yet known. In addition, mangosteen producing areas in Central Sulawesi such as Banggai Laut Regency, Poso Regency, Donggala Regency and Sigi Regency have not been included in the list of Indonesian fruit export suppliers, this is due to the low quality and productivity produced due to the cultivation system which is still conventional such as limited fruiting seasons and number of seedlings and slow growth of seedlings, and generally mangosteen in several centers is old, the production system depends on nature and information technology support is still lacking.

The need to fulfill domestic needs and increase exports needs to be done to increase the production and productivity of mangosteen plants through the growth of new production centers and the strengthening of existing production centers. For this reason, mangosteen seedlings from seedlings are needed in large quantities and in a short time.

The obstacle in fulfilling quality mangosteen seedlings is the relatively long time required to obtain seedlings ready for planting, this is due to the slow growth of mangosteen seedling roots. If seedling root growth can be accelerated, then the procurement of seedlings from seedlings can be developed and the growth of new production centers can be carried out (Salim et al., 2010).

One effort that can be made is by providing mycorrhiza for plants. According to (Muryati et al., 2016) mycorrhiza is one of the soil organisms that helps in the nutrient cycle. The long and fine hyphae structure can explore into the soil to absorb water, macro and micro nutrients that cannot be reached by the roots (Simanungkalit, 2006).

Mycorrhiza has been successfully tested on several types of plants such as mangosteen, cocoa and rubber. Arbuscular mycorrhizal fungi are one of the obligate fungi from the Glomeromycota phylum that can live and form symbiosis with plant roots. This fungus can increase nutrient absorption, stimulate growth, and increase plant resistance to water stress and pathogen attacks (Fortuna et al., 1996).

Adding organic matter to the soil is one of the efforts to increase the organic C content of the soil, and support environmentally friendly agricultural programs towards organic farming. Compost is organic material that comes from various sources that has undergone a decomposition process under mesophilic and thermophilic conditions (Sutanto, 2002). Compost is one source of organic fertilizer for plants. It has been proven that the use of compost up to a certain dose can increase crop yields.

Based on the description above, it can be seen that it is necessary to conduct research that aims to examine the effect of giving mycorrhizal doses to the palolo mangosteen genotype source on the growth of mangosteen seedlings.

II. METHODOLOGY

This research was carried out in Labuan Toposo Village, Labuan District, Donggala Regency. 00 32' 52.719" South Latitude and 1190 57' 35.834" East Longitude. This research was carried out from December to April 2024.

The tools used include a tub of sprouts, sieve, shovel, hoe, poly bag 25 cm x 30 cm, ruler, meter, UFE 400 memmert oven, analytical scale type HCB 3001 Max=300g d=0.1 g, 100 ml measuring cup, tarpaulin, cell phone camera for research documentation and stationery.

The materials used in this research include mangosteen seeds of the palolo genotype, approximately one month old which have been maintained in the nursery location, mycorrhiza, banana peels, rice straw, rice husks, rice bran, sometimes chicken fertilizer, vermicompost fertilizer, brown sugar, water. , EM-4, sand, and soil.

The design used in this research was a Randomized Group Design (RAK) with two factors, where the first factor was the administration of mycorrhiza which consisted of two levels, namely M0 = No mycorrhiza M1 = Mycorrhiza 10 g The second factor is the provision of organic fertilizer which consists of 4 levels, namely P0 = Control P1 = Rice straw compost P2 = Banana peel compost P3 = Vermicompost fertilizer.

Based on these treatments, 8 treatment combinations were obtained with 7 replications, resulting in 56 experimental units. Each experimental unit used 3 mangosteen plant seeds so that a total of 168 mangosteen plant seeds were used.

The observation variables used as indicators of success are as follows:

Plant Height Increase (cm). Observations were made by measuring the height of the plant as high as one cm from the base of the root to the point of growth of the plant crown and were carried out five times, namely in weeks 3, 6, 9, 12, and 15 MST. This measurement was carried out using a ruler in centimeters

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Stem Diameter Increase (mm). Diameter observations were carried out five times, namely in weeks 3, 6, 9, 12 and 15 MST, by measuring the root neck that had been marked previously. Measurements were made using a vernier caliper. Stem diameter increase was obtained from the results of subtracting the diameter at the end of the study from the stem diameter at the beginning of the study. This value is expressed in millimeters (mm).

Leaf Number Increase (strands). The number of leaves is counted in weeks 3, 6, 9, 12 and 15 MST. The leaves counted are those that have fully opened and are dark green in color, because they are thought to be actively carrying out photosynthesis which supports plant growth.

Leaf Greenness Value. Calculation of leaf greenness value was carried out in weeks 3, 6, 9, 12, and 15 MST. Measurement of leaf greenness value using chlorophyll meter/SPAD (Soil Plant Analysis Development) is a tool for measuring leaf chlorophyll expressed in units.

Leaf Area (mm^2). Leaf area measurements were conducted at the end of the study. Leaf area measurements were taken using a leaf area meter in the laboratory.

Fresh Weight of Plants (g). Fresh weight of plants was measured at the end of the study. Fresh weight was measured by weighing each treatment sample. The weight was weighed using an analytical balance and expressed in grams.

Plant Dry Weight (g). Plant dry weight measurement was conducted at the end of the study. Dry weight was obtained by weighing each treatment sample after drying. The weight was weighed using an analytical balance and expressed in grams.

III. RESULTS

Plant Height Increase. The results of the analysis of variance showed that mycorrhizal treatment had a significant effect on plant height increase, but organic fertilizer treatment did not have a significant effect on plant height increase. The average increase in plant height is presented in Table 1.

Table 1. Average increase in height of mangosteen plants (cm)

Perlakuan	Tinggi Tanaman (cm)	
	6 MST	12 MST
M0	0.19 a	0.18 a
M1	0.25 b	0.23 b
BNJ 5%	**0.05**	**0.03**

Keterangan : Angka-angka yang diikuti huruf yang sama pada kolom yang sama, masing-masing perlakuan tidak berbeda nyata

The results of the BNJ 0.05 test (Table 1) on the provision of mycorrhiza and organic fertilizer on the increase in plant height at the age of 6 MST showed that the treatment (M_1) Mycorrhiza 10 g/polybag resulted in an increase in plant height of 0.25 cm, different from the treatment (M_0) without mycorrhiza. While the increase in plant height at the age of 12 MST showed that the treatment (M_1) mycorrhiza 10 g/polybag resulted in a plant height of 0.23 cm, different from the treatment (M_0) without mycorrhiza.

Stem Diameter Increase. The results of the analysis of variance showed that mycorrhizal and organic fertilizer treatments had a very significant effect on the increase in stem diameter at the age of 3 MST, but organic fertilizer treatment did not have a significant effect on the increase in stem diameter. The average increase in stem diameter is presented in Table 2.

Table 2. Average Increase in Mangosteen Stem Diameter (mm)

Perlakuan	Diameter Batang (mm)
	3 MST
M0	0.054 a
M1	0.061 b
BNJ 5%	**0.005**

Keterangan: Angka-angka yang diikuti huruf yang sama pada kolom yang sama, masing-masing perlakuan tidak berbeda nyata

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The results of the BNJ 0.05 test (Table 2) on the provision of mycorrhiza and organic fertilizer on the increase in stem diameter at the age of 3 MST showed that the treatment (M_1) of 10 g/polybag mycorrhiza resulted in an increase in stem diameter of 0.061 mm, different from the treatment (M_0) without mycorrhiza, which was 0.054 mm.

Leaf Greenness Value. The results of the analysis of variance showed that mycorrhizal and organic fertilizer treatments did not affect the leaf greenness value. While the interaction of the two did not affect the leaf greenness value. The average leaf greenness value is presented in Figure 1.

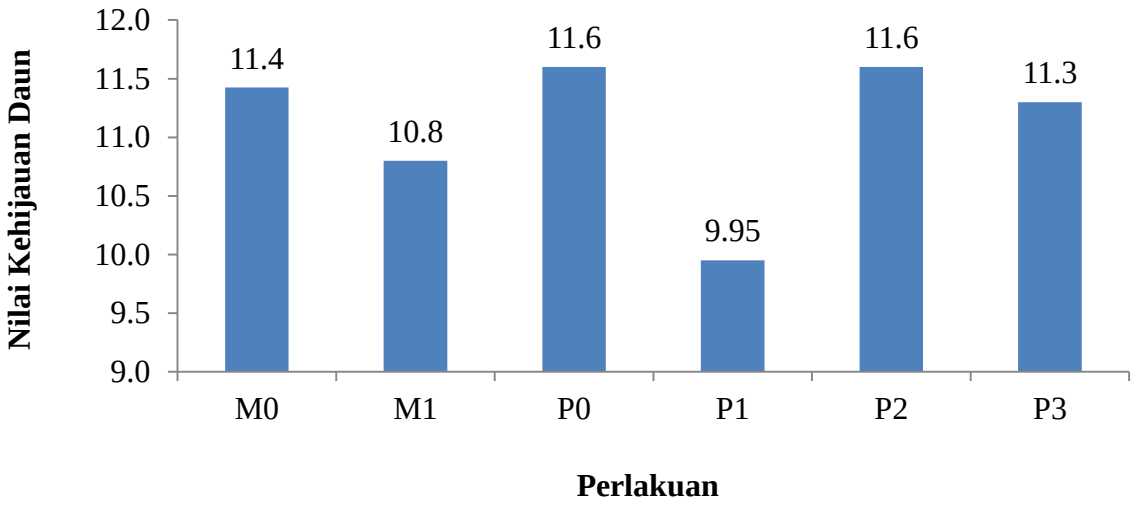

Figure 1. Average Greenness Value of Mangosteen Leaves at 15 MST Based on Provision of Mycorrhiza and Organic Fertilize

Figure 1 shows that the greenness value of mangosteen leaves based on mycorrhizal and organic fertilizer treatments at the age of 15 MST, in the treatment (M_0) without mycorrhizal gave the highest value of 11.4. While for the organic fertilizer treatment (P_0) control and (P_2) banana peel compost gave the highest value of 11.6.

Leaf Area. The results of the analysis of variance showed that mycorrhizal and organic fertilizer treatments did not affect leaf area. While the interaction of the two did not affect leaf area. The average leaf area is presented in Figure 2.

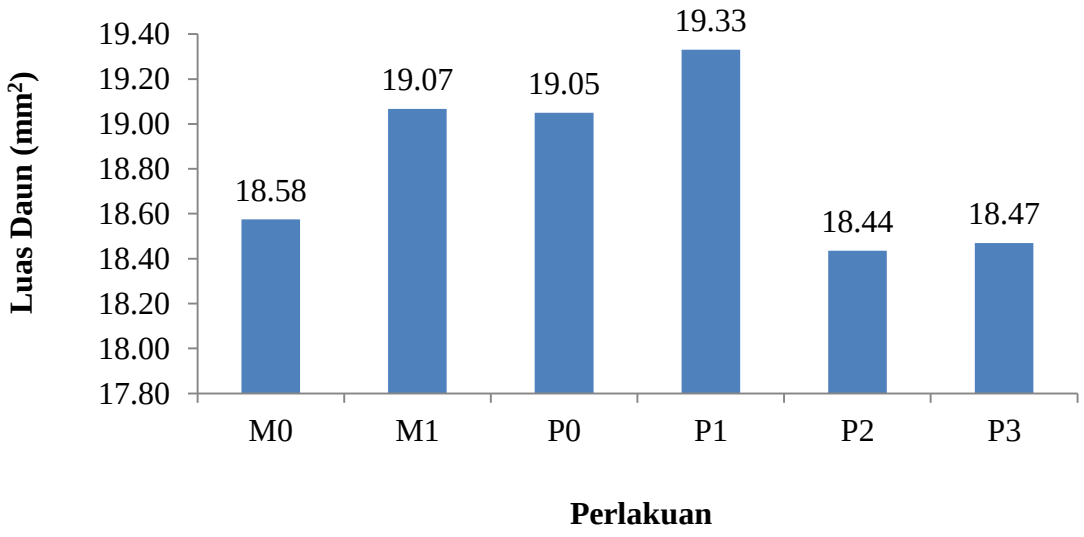

Figure 2. Average Leaf Area of Mangosteen Plants at 15 MST Based on Provision of Mycorrhiza and Organic Fertilizer

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Figure 2 shows that the leaf area of mangosteen plants based on mycorrhizal and organic fertilizer treatments at the age of 15 MST, in the treatment (M_1) mycorrhizal 10 g/polybag gave the highest value of 19.07 mm^2. While for the organic fertilizer treatment (P_1) rice straw compost gave the highest value of 19.33 mm^2.

Fresh Weight of Plants. The results of the analysis of variance showed that mycorrhizal and organic fertilizer treatments did not affect the fresh weight of plants. While the interaction of the two did not affect the fresh weight of plants. The average fresh weight of plants is presented in Figure 3.

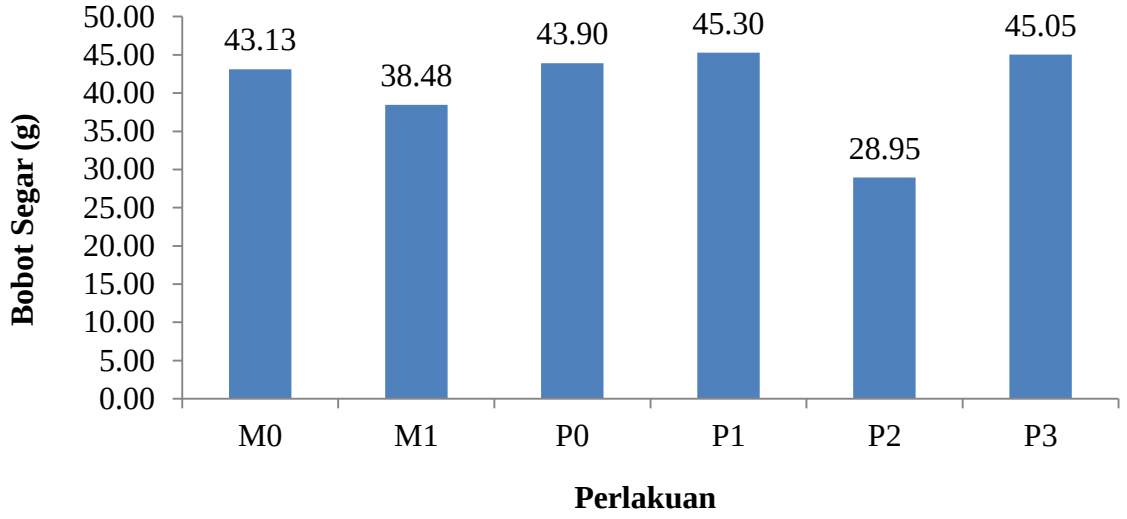

Figure 3. Average Fresh Weight of Mangosteen Plants at 15 MST Based on the Provision of Mycorrhiza and Organic Fertilizer

Figure 3 shows that the fresh weight of mangosteen plants based on mycorrhizal and organic fertilizer treatments at the age of 15 MST, in the treatment (M_0) without mycorrhizal gave the highest value of 43.13 g. While for the organic fertilizer treatment (P_1) rice straw compost gave the highest value of 45.30 g.

Plant Dry Weight. The results of the analysis of variance showed that mycorrhizal and organic fertilizer treatments did not affect plant dry weight. While the interaction of the two did not affect plant dry weight. The average plant dry weight is presented in Figure 4.

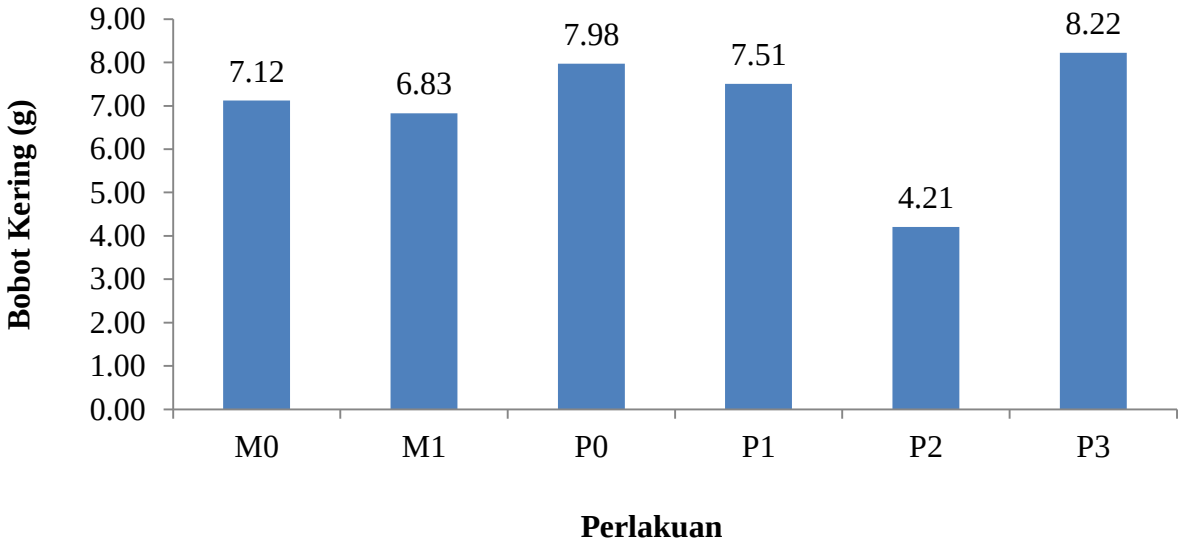

Figure 4. Average Dry Weight of Mangosteen Plants at 15 MST Based on the Provision of Mycorrhiza and Organic Fertilizer

Figure 4 shows that the dry weight of mangosteen plants based on mycorrhizal and organic fertilizer treatments at the age of 15 MST, in the treatment (M0) without mycorrhizal gave the highest value of 7.13 g. While for the organic fertilizer treatment (P3) vermicompost gave the highest value of 8.22 g.

IV. DISCUSSION

Based on the results of the study, it was found that the increase in plant height at the age of 6 and 12 MST, in the provision of mycorrhiza to the growth of mangosteen plants had a significant effect on the increase in plant height. It is known that the increase in plant height at the age of 6 MST showed the largest value of 0.25 cm and at the age of 12 MST showed a value of 0.23 cm. This is the ability of mycorrhiza to help absorb nutrients in the soil with the help of hyphae that develop on the roots.

According to Salibury (1992), the parts of the plant that are infected by fungi are generally fine young roots. Root absorption increases due to the presence of mycorrhizal fungal hyphae, so that these hyphae can function as a substitute for root hairs in absorbing nutrients.

Furthermore, Fakuara (1990) stated that the main advantage of mycorrhiza is that the absorption of certain nutrients such as phosphorus can be increased. Likewise, other nutrients such as N, K and micro elements Zn and Cu, mycorrhiza can take nutrients in the soil where the roots can no longer take them (Husin, 1992).

Based on the research results, it was obtained that the increase in stem diameter at the age of 3 MST showed that the largest diameter was 0.061 mm. This condition is thought to occur because the mangosteen plant is an annual plant or a long-lived perennial plant with a stem that has cambium, as a long-lived plant, the growth of the stem and roots is slow (Rahmawati, 2005).

The stem is a place of accumulation of plant growth, especially in younger plants, so that the presence of nutrients can encourage vegetative plant growth, including the formation of chlorophyll in the leaves used for photosynthesis. Photosynthesis produces photosynthate which is used by plant organs to grow, including the stem (Jumin, 1986). Mangosteen is a perennial plant with a hard stem, long-lived with cambium so that stem growth is slow.

The use of soil microorganisms or biological fertilizers serves to add certain nutrients or facilitate the availability of nutrients in the soil for plants. The provision of nutrients occurs through symbiotic or non-symbiotic relationships. One of the widely used biological fertilizers is Arbuscular Mycorrhiza which forms a symbiotic association with plant roots and functions to help P absorption by plants. The benefits of mycorrhiza for the development of plants that are their hosts, namely increasing nutrient absorption from the soil, as a biological barrier against root pathogen infections, increasing host resistance to drought, increasing growth-promoting hormones (Noli, et al. 2011).

V. CONCLUSION

Based on the research results, the following conclusions are drawn:

1. The provision of mycorrhiza (M1) has an effect on the increase in plant height at the age of 6 MST, namely 0.25 cm, and at the age of 12 MST, namely 0.23 cm. The provision of mycorrhiza has an effect on the increase in stem diameter at the age of 3 MST, namely 0.061 mm.

2. The observation parameters for leaf greenness, leaf area, fresh weight and dry weight showed that mycorrhizal and organic fertilizer treatments had no significant effect and there was no interaction.

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