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Effectivity of Manure at Various Dose Added Agrobost to The Growth of Mango Seedlings

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Abstract

One of the efforts to increase mango production in Southeast Sulawesi is to produce high quality and high quantity mango seeds. Manure contains macro and micro nutrients that are important for plant growth and development as well as play a role in maintaining nutrient balance in the soil to improve soil properties. The aim of this study was to obtain the best manure doses applied with agrobost in improving the growth of Arumanis mango seedlings. This research was conducted in Kemaraya Sub-District of West Kendari District, Kendari City. The study design used was a randomized block design (RBD) with 6 treatments, namely: control (T_0), 100 g (T_1); 150 g (T_2); 200 g (T_3); 250 g (T_4); and 300 g (T_5) of manure per polybag. Each treatment was added with agrobost of 17 ml/polybag and replicated 5 times. The variables observed were plant height, stem diameter; number of leaves, and leaf area, at ages 1, 2, and 3 months after planting. The results showed that the manure added agrobost influenced the growth of Arumanis mango seedlings. The manure treatment with a dose of 150 g per polybag (T_2) was the best treatment in improving the growth of Arumanis mangoes at 1, 2 and 3 months after planting. This was indicated by the plant height of 28,40; 30,94; and 32,82 cm, stem diameter of 0,44; 0,70; and 0,99 cm; and number of leaves 6,60; 7,20 and 9,00 strands were significantly higher compared to other treatments during the study

Keywords: agrobost, arumanis seedlings, manggo, manure doses

A. Introduction

Mango plants (*Mangifera indica L.*) are annual fruit plants originating from India, then spread to Southeast Asia including Malaysia and Indonesia. Mango is a type of tropical fruit that is loved by the world community and is a trade commodity between countries. These horticultural commodity has good prospects if it is developed intensively and on an agribusiness scale. From year to year the demand for tropical fruit is increasing at home and abroad, both in the form of fresh and processed products.

Mango is very good to consume because the nutritional content is quite complete as a source of vitamins and minerals. Nutrients contained in Arumanis cultivar mangoes: calories, protein, fat, calcium, phosphorus, iron, vitamins A, C, B_1, and water (BPTP, 2010).

In Indonesia, mango is the second largest fruit commodity after bananas. Even Indonesia is the fourth largest mango producer in the world after India, China and Thailand with production of 2.4 million tons year^{-1}. This potency has still big opportunity to be developed because currently the planting area is only 165.000 ha, while the land area for the development of mango plants is still available (Hardiyanto, 2017). However, this plant can only produce well in areas that have certain dry season.

Southeast Sulawesi Province does not include as the mango production center in Indonesia. Southeast Sulawesi mango production is still low at 14.769 tons (BPS, 2014). The low production of mangoes in Southeast Sulawesi is caused by among others; mango cultivation is still a non-commercial plant, various varieties or cultivars, poor quality seeds, less intensive cultivation, cultivated in soil types dominated by soils that have developed further with low soil fertility conditions and inappropriate cultivation techniques application.

One of the efforts to increase mango production in Southeast Sulawesi is to produce high quality and high quantity mango seeds. Seeds are one of the determinants of successful plant cultivation. Plant cultivation has actually begun since the selection of plant seeds because the seeds are the main object that will be developed in the next cultivation process. In order to produce high quality mango seedlings in land classified as marginal soils with low soil fertility, it is necessary to add technological inputs in the form of manure added agrobost.

Manure is fertilizer originating among others from; cows, goats, and chickens, in the form of solid feces which mix with food waste or urine. Manure contains macro and micro nutrients that are important for plant growth and development as well as play a role in maintaining nutrient balance in the soil. While Agrobost fertilizer is a biological fertilizer which contains several types of important microbes that function to improve soil properties. These microbes include: *Azospirillum*, *Azotobacter*, phosphorus solvent microbes, *Lactobacillus*, cellulose degrading microbes, *Indole Acetic Acid* (IAA), and cellulase enzymes. These types of microbes and enzymes can work optimally in improving soil properties, hence savings in the utilization of chemical fertilizers (Hamzah, S., S. Utami & M.A. Cholik. 2011). Based on the benefits of the two fertilizers in supporting the availability of high quality mango seedlings, it is necessary to do research on the growth of mango seedlings with the treatment of manure added agrobost.

Objectives and Benefits

This study aims to determine the growth rate of mango seedlings in various doses of manure added agrobost. The results of this study are expected to be a reference for those who want to cultivate mango nurseries commercially, also expected to be a source of information and as a comparison for the further study.

B. Methodology

The study was conducted in Kemaraya, West Kendari District, Kendari City for 5 months. The materials used in this study were black polybag size 20 cm x 30 cm, Arumanis mango seedlings, Ultisol soil from Nanga-Nanga, sand, rice hulls, manure, and Agrobost. The tools used were hoes, machetes, sand sieves (3 mm), scales, caliper, ruler, sprayer, string, camera and stationery.

The design used in this study was a randomized block design (RBD) with one treatment factor, namely manure doses added agrobost (17 ml per polybag). The dosage of manure (T) consists of 6 treatments, namely : without manure (T_0), 100 g (T1), 150 g (T_2), 200 g (T_3), 250 g (T_4), and 300 g (T_5) manure per polybag. Each treatment was replicated 5 times, so there were 30 experimental units.

Research Implementation

The land was cleaned and blended. The soil was mixed with sieved rice hulls and sand, then manure was added according to the treatment dose and put into each polybag. Mango seeds were selected based on relatively uniform seed height criteria. Seeds were planted as deep as 15 cm and 1 seed per polybag. Then proceed with the administration of agrobost (15 ml of agrobost dissolved in 500 ml of water) sprayed into the mango seedlings with dose of 17 ml per polybag each application. Plant maintenance in the form of watering and weed control. Watering was carried out every morning with a volume of 250 ml per polybag and weed control was done twice.

Components observed include soil and plants. Land variables include: Nitrogen-Total (H_2SO_4 wet ashing method), Phosphat-Available (Olsen method), and Potassiun-Available (25% HCl Method). Assessment criteria for the results of soil analysis (BPT, 2009 BPT) are VL = very low; L = low; M = medium; H = high and VH = very high. All plant populations were used as sample. Observations were made at 0, 1, 2, and 3 months after planting (MAT). Observation variables were : plant height (cm) is measured from the base of the stem to the edge of the growing point; stem diameter (cm) was measured on the lower stem about 5 cm from the ground using caliper; the number of leaves (strands) was calculated as the total leaf; leaf area (cm^2) by measuring the length and width of the leaf, leaf length (cm) was measured from the base of the leaf to the tip of the leaf, leaf width was measured on the widest width of the leaf. Leaf area is calculated by the formula:

$$\text{Leaf area} = \text{leaf length} \times \text{leaf width} \times \text{constant } (\alpha = 0.6)$$

The constants obtained from sampling some leaves are then drawn on graph paper (Sitompul & Guritno, 1995).

Data were analyzed using variance, if F-count is greater than F-table, then proceed with least significance difference test (LSD) at the 95% confidence level.

C. Results and Discussion

1. Results

Soil Analysis

The results of soil analysis at the beginning of the study are presented in Table 1.

Table 1. Results of soil analysis at the beginning of the study

Treatment	N-total (%)	Phosphorus (P) (mg/100 g)	Potassium (K) (mg/100 g)
T_0	0,07 (VL)	10,83 (VL)	0,012 (VL)
T_1	1,00 (H)	64,17 (H)	0,525 (H)
T_2	0,53 (H)	21,25 (M)	0,451 (L)
T_3	0,13 (L)	25,83 (M)	0,390 (L)
T_4	0,40 (M)	11,33 (VL)	0,401 (L)
T_5	0,07 (VL)	14,50 (VL)	0,281 (L)

Description: VL = very low; L = low; M = medium; H = high and VH = very high

In Table 1, it can be seen that manure treatment can increase the levels of N-total, P-available and K-available, starting from very low to high for total N (0,07 – 1,00%) and P- available (10,83 – 64,17 mg/100 g), and from very low to high for K-available (0,012 - 0,525 mg/100 g).

Growth of Mango Seedlings

The results of observations and variance showed that manure added agrobost had a very significant effect on plant height, stem diameter, leaf number, and leaf area during the study except for the number of leaves significantly affected at 1BST. The recapitulation of the results of variance in all observation variables is presented in Table 2.

Table 2. Recapitulation of results of variance (anova) on effect of manure added agrobost to all variables of mango seedling observation

No.	Time of observation	Variables of observation	Description
1	1 BST	Plant height	**
		Stem diameter	**
		Number of leaves	*
		Leaf area	**
2	2 BST	Plant height	**
		Stem diameter	**
		Number of leaves	**
		Leaf area	**
3	3 BST	Plant height	**
		Stem diameter	**
		Number of leaves	**
		Leaf area	**

Description: * = significant effect,
** = very significant effect

Mango seedlings height

The results of variance showed that the dose of manure added agrobost had a very significant effect on the height of mango seedlings during the study. The avergae plant height at ages 1, 2, and 3 BST and the least significance difference test (LSD) results are presented in Table 3.

Table 3 Average height of mango seed (cm) at ages 1, 2, and 3 BST

Treatment	Average height of mango seedlings at x month observation time		
	1	2	3
T0	25,82 b	26,98 b	28,42 b
T1	24,46 b	26,06 b	27,60 b
T2	28,40 a	30,94 a	32,82a
T3	24,74 b	26, 34 b	27,60 b
T4	23,54 b	25,24 b	26,98 b
T5	24,20 b	25,58 b	26,62 b
LSD 5%	2,46	2,86	2,53

Description: Numbers followed by the same letter in the same column was not significantly different at the 95% confidence level

Based on further tests (Table 3), the best dosage of manure is T_2 treatment (150 g of manure + 17 ml of agrobost per polybag) both at age 1, 2, and 3 months after planting with average height of mango seedlings 28,40; 3,.94; and 32,82 cm, respectively. The height growth dynamics of mango seedlings are presented in Figure 1.

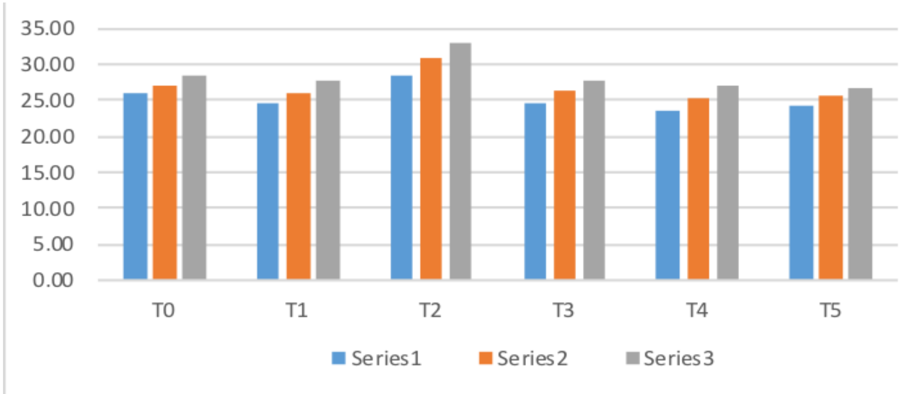

Figure 1. Height growth dynamics of mango seedlings at the age of 1,2 and 3 BST

Figure 1 shows that the average height of mango seedlings at observations 1, 2, and 3 months after planting was obtained at T_2 treatment followed by T_0, T_1, T_3, T_4, and T_5.

Stem diameter of mango seedlings

The results of variance showed that the dose of manure added agrobost had a very significant effect on the stem diameter of mango seedlings during the study. The average stem diameter of mango seedlings at ages 1, 2, and 3 BST and least significance difference test (LSD) results are presented in Table 4.

Table 4. Average stem diameter of mango seedlings (cm) at ages 1, 2, and 3 BST

Treatment	Average stem diameter of mango seedling at x month observation time		
	1	2	3
T_0	0,41 ab	0,53 bc	0,66 c
T_1	0,38 bc	0,60 b	0,74 bc
T_2	0,44 a	0,70 a	0,99 a
T_3	0,35 c	0,53 c	0,68 bc
T_4	0,35 c	0,59 bc	0,79 b
T_5	0,35 c	0,53 c	0,71 bc
LSD 5%	0,05	0,07	0,11

Description: Numbers followed by the same letter in the same column was not significantly different at the 95% confidence level

Based on further tests (Table 4), the best dosage of manure is T_2 treatment (150 g of manure + 17 ml of agrobost per polybag) both at 1, 2 and 3 months after planting with the average stem diameter of mango seedlings 0,44; 0,70; and 0,99 cm, respectively.

a. Number of leaves of mango seedlings

The results of variance showed that dosing of manure added agrobost effect was significant on the number of leaves of mango seedlings at 1 BST and very significant at ages 2 and 3 BST. The average number of leaves of mango seedlings at ages 1, 2, and 3 BST and least significance difference test (LSD) results are presented in Table 5.

Based on further tests (Table 5), the best dosage of manure is T_2 treatment (150 g of manure + 17 ml of agrobost per polybag) both at 1, 2 and 3 months after planting with the average number of leaves of mango seedlings 6,60; 7,20; and 9,00 strands, respectively. The dynamic growth in the number of leaves of mango seedlings is presented in Figure 2.

Table 5. Average number of leaves of mango seedlings at age 1, 2 and 3 BST

Treatment	Average number of leaves of mango seedlings at x month observation time		
	1	2	3
T_0	5,60 ab	6,60 a	7,40 b
T_1	5,60 ab	6,60 a	7,60 ab
T_2	5,60 ab	7,20 a	9,00 a
T_3	3,80 b	5,00 b	5,40 c
T_4	6,00 a	7,00 a	7,00 b
T_5	4,20 ab	4,60 b	5,20 c
BNT 5%	1,84	1,47	1,53

Description: Numbers followed by the same letter in the same column was not significantly different at the 95% confidence level

Figure 2 shows that the average number of leaves of mango seedlings in observations 1, 2, and 3 months after the highest planting was obtained in T_2 treatment followed by T_1, T_0, T_4, T_3 and T_5.

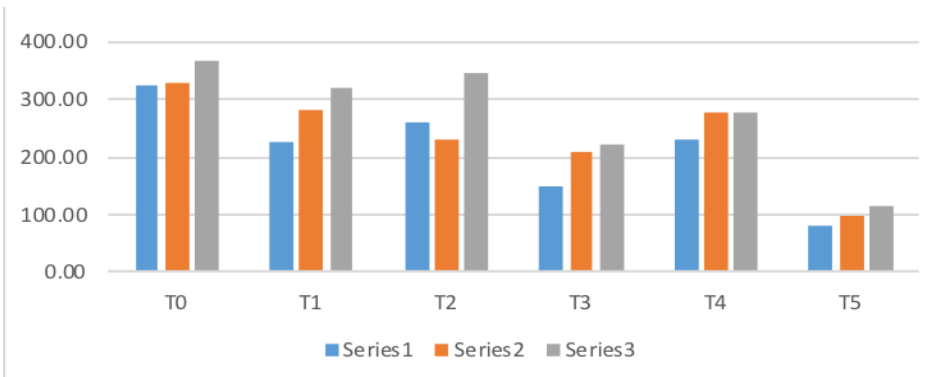

Figure 2. Growth dynamics in the number of leaves of mango seedlings at the age of 1.2, and 3 BST

Leaf area of mango seedlings

The results of variance showed that dosing of manure added agrobost effect was very significant for the leaf area of mango seedlings at ages 1, 2 and 3 BST. The average leaf area of mango seedlings at ages 1, 2, and 3 BST and least significance difference test (LSD) results are presented in Table 6.

Table 6. Average leaf area of mango seedlings (cm^2) at ages 1, 2, and 3 BST

Treatment	Average leaf area of mango seedlings at x month observation time		
	1	2	3
T0	322,46 a	325,97 a	365,08 a
T1	227,18 ab	280,05 ab	319,07 ab
T2	258,31 a	288,83 ab	346,97 ab
T3	150,40 cb	209,10 b	223,39 c
T4	229,60 ab	277,78 ab	278,18 bc
T5	82,28 c	96,58 c	115,11 d
LSD 5%	96,55	100,67	81,04

Description: Numbers followed by the same letter in the the same column was not significantly different at the 95% confidence level

Based on further tests (Table 6), the best dosage of manure is T_0 treatment (without manure + 17 ml agrobost per polybag) both at 1, 2 and 3 months after planting with the average leaf area of the mango seedlings 322,46; 325,97; and 365,08 cm^2, respectively. The growth dynamics of leaf area of mango seedlings is presented in Figure 3.

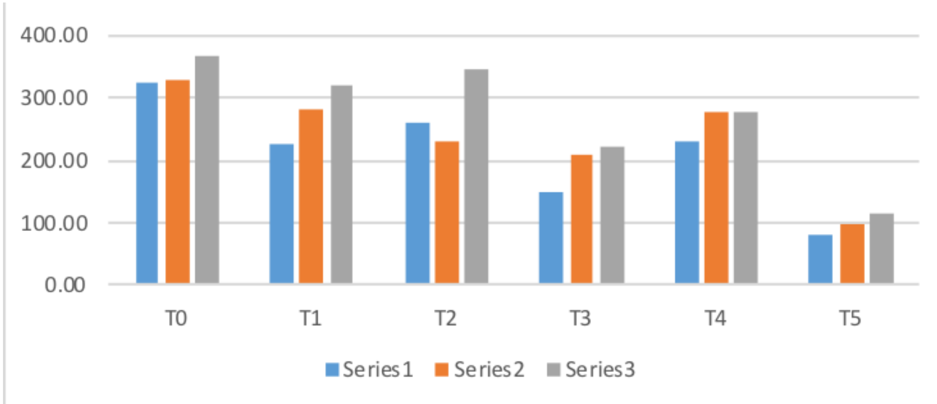

Figure 3. Growth dynamics of the area of mango seedlings at 1, 2 and 3 BST

2. Discussion

Manure can increase nutrient availability such as nitrogen, phosphorus and potassium (Table 1). These nutrients will be absorbed by the plant roots and used to stimulate photosynthesis. The results of photosynthesis will be translocated to all parts of the plant for plant growth and development (Gardner, Pearce & Mitchell, 1991).

The role of nitrogen for plants is to stimulate overall growth, particularly the stems, branches and leaves; plays an important role in the formation of chlorophyll which functions in photosynthesis process; forming proteins and enzymes, fats and various organic compounds (Lingga, 2007; Damanik, Hasibuan, Fauzi, Sarifuddin & Hanum, 2010). as well as cytokine and auxin hormones (Lakitan, 1993). Phosphorus for plants is useful for transporting metabolic energy, stimulating root formation; stimulates plant cell division and enlarges cell tissue; as an ingredient for certain proteins formation, supporting assimilation and respiration; and nucleic acid components (DNA and RNA) (Lingga & Marsono, 2005). Potassium plays an important role for plants because the K function is; helps translocate sugar in proteins and carbohydrates formation; help the process of opening and closing the stomata; expand root growth; plays a role in strengthening the plant's body, thus the stems and leaves are strong and is a source of strength for plants to deal with drought, pests and diseases (Marsono, 2007). Potassium in photosynthesis directly increases leaf growth and leaf area index, thereby increasing CO_2 assimilation and improving photosynthetic translocation into phloem (Gardner *et al*., 1991).

According to Novizan (2004), manure is fertilizer derived from animal manure mixed with food waste and urine which contains nutrients N, P, and K which can be utilized to improve soil fertility. Furthermore Winarso (2005), explained that the provision of manure will improve soil structure, increase water holding capacity, and improve soil biological life. The selection of manure type that will be used as organic material can be determined by the nutrient content. The value of nutrient content of cow manure is relatively better compared to chicken manure.

Manure has natural properties and does not damage the soil, provides macro elements (nitrogen, phosphorus, potassium, calcium and sulfur) and micro (iron, zinc, boron, cobalt, and molybdenum). In addition, manure functions to increase water resistance, soil microbiological activity, value of cation exchange capacity and improve soil structure. The effect of giving manure indirectly makes it easier for the soil to absorb water. The utilization of cow manure can increase the permeability and organic matter content in the soil, and can reduce soil erodibility value which ultimately increases soil resistance to erosion (Santoso, Purnomo, Wigena, & Tuherkih, 2004).

Manure can increase the pH of the acidic soil, thus it increases cation exchange capacity (CEC). Thus nutrients released into soil solutions are quickly absorbed by plants, particularly during the vegetative growth phase. This is proved by the increase in plant height, stem diameter, number of leaves, and leaf area. In the vegetative growth phase, plants need nutrients, namely protein sourced from nitrogen to support plant growth, therefore in the vegetative phase plants need N in sufficient quantities. The main role of nitrogen is to stimulate vegetative growth of plants (Marsono, 2007).

Provision of cow manure on acid soils can increase Ca availability in the soil so that Ca availability in the soil increases and subsequently functions to accelerate plant growth and development. Buckman & Brady (1982), stated that the administration of cow manure with agrobost contained nutrient balance is suitable to the vegetative and generative growth of the mango plant, therefore the photosynthate produced could be translocated well throughout the plant body. The addition of organic material in the form of manure has significant effect on the growth of mango plants because there are compounds that influence biological activity, namely growth stimulating compounds (auxin) and vitamins (Atmojo & Wongso, 2003).

Based on the results of variance showed that manure added agrobost had a very significant effect on plant height, stem diameter, number of leaves, and leaf area at 1, 2 and 3 months after planting. However, the addition of manure doses above 150 g per polybag did not increase the vegetative growth of Arumanis mangoes. Observations on vegetative growth of plants showed that the treatment of manure with a dose of 150 g per polybag + Agrobost 17 ml per polybag (T_2) was the best treatment in increasing Arumanis mango seedlings growth during the study with the highest plant height, stem diameter and leaf number (Table 2, 3 and 4), while the widest leaf area was obtained in treatment T_0 but not significantly different from T_1 and T_2 (Table 5). This finding shows that with the manure treatment at a dose of 150 g per polybag + Agrobost 17 ml per polybag (T_2), it is sufficient for the availability of macro and micro nutrients that are required for the growth and development of mango seedlings. Prolongation and enlargement of the stem of the mango seed results in the plant to grow higher, more and more segments are formed, thus the number of leaves is increasing and the leaf area is wider. The more leaves are formed, the more active leaf surface photosynthesis is, because intercepted radiation by the leaves increasing as well. Thus, if it is supported by sufficient nutrient uptake by plants, the photosynthesis process will take place smoothly.

The addition of manure to 300 g per polybag did not improve the vegetative growth of Arumanis mangoes. This is presumably because the higher dose manure is given, the higher the drainage (excess) so that nutrients are carried by drainage water.

D. Conclusions

Based on the results of the study, it can be concluded as follows: (a) Manure added agrobost treatment had a very significant effect on vegetative growth, particularly in plant height, stem diameter, and number of leaves of Arumanis mango seedlings and (b) Manure treatment with a dose of 150 g per polybag + 17 ml agrobost (T_2) was the best treatment to improve Arumanis mango seedlings growth during this study, this was indicated by plant height of 28,40; 30,94; and 32,82 cm, stem diameter of 0,44; 0,70; and 0,99 cm; and the number of leaves of 6,60; 7,20 and 9,00 strands were significantly higher compared to other treatments during the study.

Further research is recommended to conduct research on a field scale with the aim of providing quality seeds on commercial scale. The dosage of manure is recommended only 150 g + 17 ml agrobost per polybag.

E. Acknowledgement

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