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Response Growth and Development of Gambas Plant (*Luffa acutangula* L.Roxb) to Application of Manure and *Trichoderma koningii*

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ABSTRACT

Luffa acutangula a plant that has several advantages. It contains protein, fat, carbohydrate, fiber and sugar which make it beneficial for people who consume it. In order to increase growth and production, fertilizer plays an important role in supplying the minerals or nutrients needed by plants. Manure, which is a mixture of solid dung, urine, and (plant) food waste, plays a very important role as a food source for soil organisms. Due to the various benefits and high economic value of the gambas plant, numerous efforts have been made to increase productivity and suppress the growth of pathogens that can interfere with *gambas* growth, one of which is the use of biological agents. The biological agents commonly used are from the fungi group. *Trichoderma harzianum* is one type of fungi that can be used as a biological agent. This study used a factorial group design consisting of two factors, with a 4x3 factorial pattern and 3 replications. The factors studied included types of manure and doses of *Trichoderma* fertilizer, which consisted of 12 levels, namely K0 = control (without fertilizer), K1 = Goat Manure (2kg/plot), K2 = Chicken Manure (2 Kg/plot), K3 = Cow Manure (2 Kg/plot), while the *Trichoderma* Fertilizer Factor (M) consisted of 3 levels, namely M0 = Control, M1 = *Trichoderma* (5 grams/plant, M2 = *Trichoderma* (10 g/tan). The results showed that the application of manure and *Trichoderma koningii* fertilizer had a significant effect on plant height, number of leaves and fruit weight of the sample/plot, which indicates that the application of both types of fertilizers can increase the content of organic matter in the soil.

Keywords: *Gambas*, manure, *Trichoderma koningii, growth, development*

INTRODUCTION

Luffa acutangula is a plant that has numerous advantages. It thrives in lowland up to an altitude of 1,000 mdpl. One of the advantages of the *gambas* plant is that it can be cultivated in both lowland and highland areas. This is supported further by its nutritional content. The *gambas* plant contains protein, fat, carbohydrate, fiber, and sugar, which make the plant beneficial for people who consume it (Sunarjono, 2010).

Fertilizer plays an important role in increasing growth and production, by supplying the necessary minerals or nutrients for the plant. Manure plays a vital role as a food source for soil organisms, by increasing the number of soil organisms which in turn makes the soil more fertile and increases plant production (Sukamto, 2007).

Manure is a mixture of solid dung, urine, and food waste (from plants). Manure has several advantages compared with inorganic fertilizer, including the ability to: (1) improve soil texture and structure, (2) supply nutrients, (3) increase humus and organic matter content, (4) improve the life of micro-organisms in the soil. In addition, the nitrogen contained in the manure is released slowly which is highly beneficial for plant growth (Samadi, 2005).

Due to the various benefits and high economic value of the *gambas* plant, numerous efforts have been made to increase productivity and suppress the growth of pathogens that can interfere with *gambas* growth, one of which is the use of biological agents. The biological agents commonly used are from the fungi group. *Trichoderma harzianum* is one type of fungi that can be

used as a biological agent. *Trichoderma harzianum* has been found to increase plant growth by 150-250%. *Trichoderma harzianum* can be applied, in either dry or wet form, to the seeds before planting. As a dressing for seeding, it can be mixed with liquid fertilizer, or combined with fertilizer or herbicide through the surface of irrigation channels or embedded into the soil in dry form. The application of *Trichoderma harzianum* has the ability to increase the number of roots and widen the leaves, and its use on diseased avocado plants was found to produce the growth of new leaf shoots after several weeks. *Trichoderma sp.* can produce lytic enzymes and antifungal antibiotics. In addition, *Trichoderma sp.* also has the ability to compete with pathogens and assist plant growth, as well as having a broad inhibition range that can inhibit various types of fungi. *Trichoderma* sp. produces metabolites such as citric acid, ethanol, and various enzymes such as urease, cellulase, glucanase, and chitinase. This metabolite yield is influenced by the nutritional content of the media (Suwahyono et al., 2001).

This research aims to discover the response of gambas plant growth and yield to the application of manure and *Trichoderma* organic fertilizer and the interactions between the two factors.

MATERIALS AND METHODS

The research was conducted in the village of Armed in the district of Delitua. The research activities were carried out from August to October 2021.

The materials used in the research were *Panah* brand *gambas* seeds, goat, chicken, and cow manure, *Trichoderma* fertilizer, and Decis 25 EC and Furadan 3G pesticides.

The instruments used in the research included a hoe, rake, cleaver, hand sprayer, measuring tape, watering can, bucket, weighing scales, name pamphlets, writing tools, and so on.

The research used a Factorial Randomized Group Design (RGD) with the factorial pattern of 4x3 and 3 repetitions. The factors studied were types of manure and doses of *Trichoderma* fertilizer with 12 levels, namely K0 = control (without fertilizer), K1 = Goat Manure (2 kg/plot), K2 = Chicken Manure (2 kg/plot), K3 = Cow Manure (2 kg/plot). The *Trichoderma* Fertilizer Factor (M) consisted of 3 levels, namely M0 = Kontrol, M1 = Tricoderma (5 gr/tan), M2 = Tricoderma (10 gr/tan). The parameters observed were plant height, number of leaves, and fruit weight of the sample/plot.

RESULTS AND DISCUSSION

The results of the variance analysis showed that treatments of application of manure and *Trichoderma* fertilizer and their interactions had a significant effect on plant height at all ages of observation (7 DAP, 14 DAP, 21 DAP and 28 DAP).

In table 1 below, it can be seen that the application of manure that produced the tallest *gambas* plant height was treatment K3 (cow manure), namely 69.01 cm, compared with the three other treatments. The shortest plant height was seen with treatment KO (control), namely 48.75 cm. In the treatments with different doses of *Trichoderma* fertilizer, the tallest *gambas* plant height was achieved with treatment M2 (dose of *Trichoderma* 10 gr/plot), namely 78.99 cm, and the shortest plant height was found with treatment M0 (control/without fertilizer), namely 33.42 cm. In the interactions between the two treatments carried out in this research, the tallest *gambas* plant height was obtained with the treatment K3M2 (cow manure 2 kg/plot and *Trichoderma* fertilizer dose 10 gr/plot), namely 93.75 cm, and the shortest *gambas* plant height was found with the treatment K0M0 (without fertilizer), namely 28.59 cm. According to Syarif, 1986, Manure containing macro and micro elements can be considered as complete fertilizer. Manure has several properties that are better than other natural fertilizers. Among other things is humus that can maintain / maintain soil structure, as a source of nutrients N, P and K which are very important for plant growth and development, increase water holding capacity and contain many microorganisms that can synthesize

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certain compounds so that they are useful for plants.

Fgure 1 below, with the regression equation y = 4.557x + 34.682, R^2 = 0.9909, shows that the application of *Trichoderma* fertilizer had a significant effect on plant height, where the *Trichoderma* dose of 10gr/plot was able to increase *gambas* plant height to the highest level of 78.99 cm. The graph of average *gambas* plant height with application of *Trichoderma* fertilizer doses can be seen in figure 1 below.

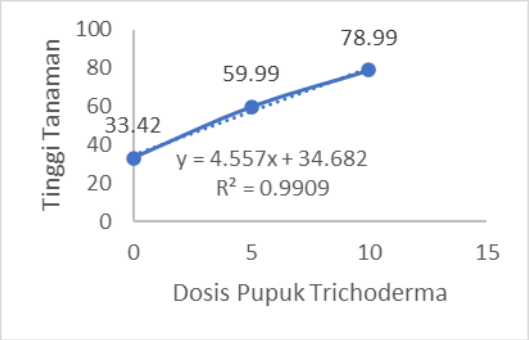

Fig 1. Graph of Average Plant Height of *Gambas* with Application of Doses of *Trichoderma* koningii Fertilizer

Table 1. Average *Gambas* Plant Height (cm) with Application of Manure Types (K) and *Trichoderma* Doses (M) at Ages 7, 14, 21 and 28 DAP

Treatment	Plant Height			
	7 DAP	14 DAP	21 DAP	28 DAP
K0M0	8.63 f	16.89f	28.59e	28.59f
K0M1	7.84 g	17.26e	29.78e	29.78ef
K0M2	8.27 f	17.90cd	29.88e	29.88e
K1M0	11.71 e	36.23d	45.44d	45.44cd
K1M1	12.57 cd	37.40d	47.90d	47.90d
K1M2	12.31 d	49.52c	56.32c	56.32c
K2M0	16.20 c	55.57bc	67.29bc	67.29bc
K2M1	16.81 bc	56.87bc	68.47b	68.47bc
K2M2	17.23 b	58.80bc	69.75b	69.75b
K3M0	17.50 ab	66.83b	69.87b	69.87b
K3M1	17.81 ab	75.27ab	82.59ab	82.59ab
K3M2	18.50 a	86.25a	93.75a	93.75a
Manure				
K0 = control	12.81d	37.69d	48.53d	48.75d
K1 = Goat Manure (2 kg/plot)	12.37c	44.54c	51.99c	51.78c
K2 = Chicken Manure (2 kg/plot)	13.92b	49.58b	59.92b	59.72b
K3 = Cow Manure (2 kg/plot)	15.50a	59.78a	69.01a	69.01a
Trichoderma Fertilizer				
M0 = control	9.11c	21.95c	33.24c	33.42c
M1 = 5 gr/plot	14.47b	49.84b	59.82b	59.99b
M2 = 10 gr/plot	17.76a	71.79a	78.99a	78.99a

Note: The numbers followed by the same letter in the same column and row are not significantly different at a level of 5%

The results of the variance analysis showed that treatments of manure and *Trichoderma* fertilizer application, and their interactions, had a significant effect on the number of *gambas* plant leaves at all ages of observation.

In table 2 below, it can be seen that the application of manure produced the highest number of *gambas* plant leaves with treatment K3 (cow manure), namely 19.89 leaves, compared with the other three treatments. The lowest number of leaves was obtained with treatment K0 (control), namely 18 leaves. In the treatment with application of *Trichoderma* fertilizer doses, the number of leaves was highest with treatment M2 (*Trichoderma* dose of 10 gr/plot), namely 20.92 leaves, and lowest with treatment M0 (control/without fertilizer), namely 17.42 leaves. The interactions between the applications of the two treatments carried out in this research showed that the highest number of *gambas* plant leaves was achieved with treatment K3M2 (cow manure 2 kg/plot and a *Trichoderma* fertilizer dose of 10 gr/plot), namely 22.67 leaves, and the lowest number of leaves was obtained with treatment K0M0 (without fertilizer), namely 17 leaves.

Of the various types of manure tested, the best growth and yield of gambas was found in the type of manure derived from cow dung (K3). The increase in growth and yield of gambas due to the application of cow dung type of manure is thought to be because the application of cow manure provides a higher average soil organic-C content when compared to other types of manure. This is because cow manure is a cold fertilizer, which means that overhaul by soil microorganisms occurs slowly, less heat is formed so that nutrients are released gradually. In addition, according to Raihan and Nurtirtayani (2001), stated that the organic C-content of cow manure was initially higher than the others, it contains a lot of water, mucus and when exposed to air it becomes solid/crust so that air and water are difficult to enter. Thus, because it is difficult to mineralize, the C-organic content of the soil is higher when compared to other types of organic fertilizers.

The use of *Trichoderma* fertilizer in the study had a significant effect on all the parameters used. The dose of *Trichoderma* fertilizer 10 g/plot showed the highest amount (M2) on plant height, number of leaves, fruit length, number of fruits and fruit weight of gambas. The *Trichoderma* fertilizer used in this study is a biological fertilizer derived from the multiplication of the *Trichoderma* fungus which has been propagated so that it is obtained in a dry form (fertilizer) that can be applied to plants. *Trichoderma* fertilizer is a type of biological fertilizer which in addition to reducing pest and disease attacks can also be used as an addition to soil organic matter. According to Suwahyono et al, 2001 *Trichoderma* sp was able to increase 150-250% plant growth. *Trichoderma* sp can be applied in dry or wet form to the seeds before planting. For seeding as a dressing mixed with liquid fertilizer or can be mixed with fertilizer or herbicide through the surface of irrigation canals or planted in dry form to the ground, *Trichoderma* sp is able to increase the number of roots and leaves to be wider. *Trichoderma* sp can produce lytic enzymes and antifugal antibiotics. In addition, *Trichoderma* sp can also compete with pathogens and can help plant growth, and has a wide range of inhibition because it can inhibit various types of fungi.

Application of cow manure (K3) and *Trichoderma* fertilizer had a significant effect on fruit weight (grams) per sample of *gambas* plants (Table 3). The highest fruit weight of *gambas* plants was achieved with treatment K3M2 (1376.67 grams) and the lowest fruit weight was obtained with the control K0M0 (1050 grams). The application of cow manure (K3) showed the highest fruit weight, namely 1219.22 grams, while the lowest fruit weight was obtained with treatment K0 (without fertilizer), namely 1128.67 gram. The application of *Trichoderma* fertilizer showed the highest fruit weight of *gambas* plants with treatment M2 (*Trichoderma* dose of 10 gr/plot), namely 1326.67 grams, while the lowest fruit weight was seen with treatment M0 (control/without fertilizer), namely 1048.33 grams. According to Suwahyono et al, 2001, *Trichoderma* sp. has been found to increase plant growth by 150-250%. *Trichoderma* sp. can be applied in dry form or wet form to seeds before planting. As a dressing for seeding, it can be mixed with liquid fertilizer or combined with fertilizer or herbicides through the surface of irrigation channels, or embedded in dry form into the soil.

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Table 2. Average Number of *Gambas* Plant Leaves with Application of Manure Types (K) and Doses of T. koningii Fertilizer at Ages 7, 14, 21, and 28 DAP

Treatment	Number of Leaves			
	7 HST	14 HST	21 HST	28 HST
K0M0	3.00c	7.00d	13.33ef	17.00e
K0M1	3.00c	7.00d	13.00f	17.33de
K0M2	3.00c	7.00d	13.00f	17.33de
K1M0	3.00c	7.33cd	14.00e	18.00d
K1M1	3.00c	7.33cd	14.00e	18.00d
K1M2	3.00c	8.00c	14.00e	18.00d
K2M0	3.00c	8.00c	15.00d	19.00c
K2M1	3.67b	8.67bc	15.00d	19.00c
K2M2	4.00a	9.00b	16.00cd	19.00c
K3M0	4.00a	9.00b	16.33c	21.00b
K3M1	4.00a	11.00ab	17.67bc	21.00b
K3M2	4.00a	11.67a	18.33c	22.67a
Manure				
K0 = control	3.15b	7.78d	14.44c	18.00d
K1 = Goat Manure (2 kg/plot)	3.16b	8.00c	14.44c	18.78c
K2 = Chicken Manure (2 kg/plot)	3.33a	8.67b	15.22b	19.11b
K3 = Cow Manure (2 kg/plot)	3.33a	9.22a	15.78a	19.89a
Trichoderma Fertilizer				
M0 = control	2.85c	7.08c	13.33c	17.42c
M1 = 5 gr/plot	3.17b	8.00b	14.50b	18.50b
M2 = 10 gr/plot	4.00a	10.17a	17.08a	20.92a

Note: The numbers followed by the same letter in the same column and row are not significantly different at a level of 5%

The addition of *Trichoderma* sp. has the ability to increase the number of roots and widen the leaves. *Trichoderma* can produce lytic enzymes and antifungal antibiotics. In addition, *Trichoderma* can compete with pathogens and assist plant growth. It also has a broad range of inhibition as it can inhibit various kinds of function.

From the various doses of manure tested, the best growth and yield of gambas was found at a dose of 2 Kg/tan (K3) of manure. According to Raihan and Nurtirtayani (2001) the application of manure into the soil can improve the physical condition of the soil to become looser, better aeration so that nutrient absorption is better. Furthermore, in this case Sukamto (2007) explained that manure has the ability to change various factors in the soil so that they become factors that ensure soil fertility.

Tabel 3. Average Fruit Weight Per Sample (grams) of *Gambas* Plants with Application of Manure Types (K) and Doses of T. koningii

Trichoderma Fertilizer	Manure				Average
	K0	K1	K2	K3	
M0	1050.00d	1040.00d	1036.67ab	1066.67b	1048.33c
M1	1109.33e	1126.67cd	1203.33ab	1214.33b	1163.42b
M2	1226.67e	1350.00c	1353.33ab	1376.67a	1326.67a
Average	1128.67c	1172.22b	1197.78b	1219.22a	

Note: The numbers followed by the same letter in the same column and row are not significantly different at a level of 5%

CONCLUSIONS

Application of manure had a significant effect on plant height, number of leaves, number of fruit, fruit length, and fruit weight.

The application of *Trichoderma* fertilizer in this research had a significant effect on plant height, number of leaves, fruit length, number of fruit, and fruit weight per sample.

The interactions between the applications of manure and T. koningii fertilizer had a highly significant effect on *gambas* plant yield, including fruit length, number of fruit, and fruit weight per sample.

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