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Response of Melon (*Cucumis melo* L.) to the application of Bio-slurry fertilizer and *Trichoderma harzianum*

F Ulfa, K Mustari, S N A Rifai, E Syam'un, N E Dungga and N Widiyani

Department of Agronomy, Faculty of Agriculture, Hasanuddin University, Jl. Perintis Kemerdekaan KM 10 Makassar 90245, Indonesia.

E-mail: fachirah.ulfa@yahoo.com

Abstract. This study aims to determine the best combination of bio-slurry and *Trichoderma harzianum* on melon production. The research was conducted in Lassang Village, North Polombangkeng District, Takalar Regency, South Sulawesi from June to August 2020. The experiment was set using a randomized block design with the application of bio-slurry fertilizer as the first factor consisted of control, 25, 50, 75 and 100 mL/L bio-slurry. The second factor was *Trichoderma harzianum* dose consisted of 0, 100, 200, and 300 g / L. The results show that the application of 75 mL/L bio-slurry and 200 g/L *Trichoderma harzianum* resulted in thickest fruit meat (26.47 mm). Melon treated with Bio-slurry of 100 mL/L and 200 g/L *Trichoderma harzianum* produced the highest number of seeds (285.2 seeds) and higher concentration of the microbes of 300 g/L resulted in the highest Brix content (6.0% Brix) and the highest organoleptic test (2.90). The single effect of Bio-slurry treatment of 100 mL/L also produced the earliest flowering age (14.40 days), the highest number of fruits (4.10 pieces), the heaviest fruit weight (205.20 g), and the highest average of fruit diameter (24.22 mm).

1. Introduction

Melon (*Cucumis melo* L.) plant is a globally known horticultural commodity with promising prospects to be developed. In Indonesian, needs for melons has increased due to the benefits from consumption fruit, especially for health. Melons have properties such as contain high fiber, as an anti-cancer, reduce the risk of stroke, heart disease, and prevent blood clots. In addition, the fruit has a delicious, sweet, fragrant, refreshing taste, and rich in vitamins. According to Ari [1], 100 grams of melon contain 23.0 cal calories, 0.6 g protein, 17 mg calcium, 0.4 mg iron, 30 mg vitamin C, 0.4 grams fiber and 6.0g carbohydrates.

Melon plant has been widely cultivated in Indonesia. Data from the Central Statistics Agency [2], shows that the production of melon in Indonesia has reached 137,887 tons in 2015, but in 2016 the production decreased quite drastically from 117,344 tons to 92,434 tons in 2017. In 2018, melon production began to experience an increase to 118,708 tonnes.

Melon is a plant that is responsive to fertilizers. However, one of the main problems in melon cultivation is the difficulty of obtaining better quality yields due to the insignificant use of nutrients. The nutrients most needed by melon plants are nitrogen (N), phosphorus (P), and potassium (K) fertilizers. So far, farmers use inorganic fertilizers as a whole, causing bad impacts on the soil and crops. Although inorganic fertilizers can increase the amount of production in melon plants, the continuous use of inorganic fertilizers can make the soil structure solid and reduce aeration which is needed by plants. In



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addition, the availability of inorganic fertilizers tends to be scarce and expensive, so the organic farming system is expected to be a solution for farmers.

Sudirja [3] suggested that applying organic fertilizers can increase nutrient reserves in the soil, improve soil structure and increase soil organic matter content. The use of organic fertilizers has various advantages over chemical fertilizers, including being able to regulate soil properties and can act as a buffer for nutrient supplies for plants so that this fertilizer can restore soil fertility. One of the organic fertilizers commonly used is Bio-slurry. Bio-slurry is included in organic fertilizers because the constituent ingredients come from organic materials, namely fermented livestock manure. This makes bio-slurry fertilizer very good when used to fertilize agricultural land and also increase crop yields.

Bio-slurry as an organic fertilizer has a high content of organic matter, which is useful for improving soil structure. Soil that is given bio-slurry becomes more crumbly, easily binds nutrients and water and increases the population and activity of soil microorganisms. The average nitrogen content of bio-slurry in liquid form is higher than in solid form. Liquid bio-slurry contains 47.99% C-organic, 2.92% total N, 15.77% C/N, 0.21% P₂O₅, and 0.26% K₂O [4]. As a quality organic fertilizer, Bio-slurry is very relevant to be applied to horticultural commodities, especially melons. Based on the results of Rafiuddin et al. [5] research, melon applied with a concentration of 75 mL L⁻¹ of Bio-slurry resulted in the highest average of plant height, number of leaves, and fruit diameter. This shows that the application of liquid Bio-slurry can alter soil pH, N, P, and K content in the soil as well provide other non-essential elements that can support growth and production of the plants.

In the cultivation of organic melons, it is inseparable from the use of organic fertilizers and organic pesticides. One of the microbes that can be applied is *Trichoderma* sp. that is known to have a role in maintaining soil fertility as a control agent for pathogenic organisms [6]. *Trichoderma* sp. is able to produce phytohormones such as Indole Acetic Acid (IAA) that plays a role in helping accelerate growth, both stem and root growth, accelerating germination, helps in the process of cell division, accelerates fruit ripening and can reduce the number of seeds in fruit and hormone like.

Application of *Trichoderma harzianum* into the soil can accelerate the process of decomposition of organic matter [7] because this fungus can produce three enzymes, namely 1) the enzyme celobiohidrolase (CBH), which actively breaks down natural cellulose; 2) the active endoglyconase enzyme remodeled dissolved cellulose; and 3) the enzyme glucosidase which is active in hydrolyzing cellobiose units into glucose molecules [8]. This enzyme works synergistically, so that the digestion process can take place more quickly and intensively. Previous study has shown that application of 200 g L⁻¹ of *Trichoderma* sp. increased fruit weight and diameter of melon [9].

2. Methodology

The research was conducted in Lassang Lage, North Polombangkeng District, Takalar Regency, South Sulawesi with coordinates 508'12 "SL - 119031'10" EL from June to August 2020. The experiment was conducted using a randomized block design (RBD) as the design of the environment. The experiment consisted of two factors, namely: concentration of Bio-slurry fertilizer as the first factor consisted of five levels, namely: B0 = control (0 mL/L), B1 = Bio-slurry 25 mL/L, B2 = Bio-slurry 50 mL/L, B3 = Bio-slurry 75 mL/L, and B4 = Bio-slurry 100 mL/L. The second factor is application of *Trichoderma harzianum* consisted of four levels, namely: T0 = control (0 g/L), T1 = *Trichoderma harzianum* 100 g/L, T2 = *Trichoderma harzianum* 200 g/L, and T3 = *Trichoderma harzianum* 300 g/L. Each treatment combination was repeated 3 times in order to obtain 60 experimental units.

2.1. Seeds nursery and planting.

Prior to sowing, seeds were soaked in warm water for 12 hours to accelerate germination and then placed on wet tissue paper and covered with newspaper. After the seeds germinate, the seeds are sown in the media of banana stems that have been cut into 2x 3cm sizes. The seedlings were maintained for 14 days or until had two pairs of true leaves. The seeds then were transplanted into 40 x 40 cm polybags with the planting medium consisting of soil, roasted rice husks and cow manure with a ratio of 1: 1: 1.

2.2. Treatment application

The application of *Trichoderma harzianum* was carried out by watering the planting medium according to the 0 g / L, 100 g / L, 200 g / L, and 300 g / L treatments. The application of the *Trichoderma harzianum* was carried out at 7 days prior to planting. Fertilization is done after the plants are at 14 days after sowing (DAS). The fertilizer used was bio-slurry fertilizer. The application of bio-slurry fertilizer was conducted by applying it directly on the soil media according to the treatment combination. Fertilization is applied in the afternoon, which is around 16.00 - 17.00.

2.3. Observation

Observations were made on growth parameters, namely: flowering age, number of fruits, fruit weight, and fruit diameter. In addition, observations were made on the production quality parameters, namely the thickness of the fruit flesh, the number of seeds, and the brix content.

2.4. Data analysis

The data collected was then analysed using analysis of variance (ANOVA). When there is a significant effect of the treatment, a further difference test of the average values was conducted using Tukey's test at 5%.

In addition to the ANOVA test, an organoleptic test also was carried out to determine the level of consumer preference for the taste of the fruit. The method of the organoleptic test was based on scoring consisting of 1 to 3 on as many as 10 panellists. The scores given to the panellists for the taste of the melon fruit were based on the fruit sweetness, namely 1 for poor taste, 2 for fair taste, and 3 for good taste.

3. Results

3.1. Effect of Bio-slurry and *Trichoderma* on growth

The analysis of variance show application of Bio-slurry and *Trichoderma harzianum* significantly increased the average values of growth parameters of melon. Bio-slurry and *Trichoderma* treatments independently affected the parameters of days to flowering, number of fruit, fruit weight and diameter of melon. Higher concentration of Bio-slurry resulted on earlier flowering, more fruit number and heavier and bigger fruits (table 1). Similarly, these parameter values also increased with the concentration of *Trichoderma* applied.

Table 1. Effect of Bio-slurry fertilizer and *Trichoderma* sp. on days to flowering, number of fruit, fruit weight, and fruit diameter of Melon.

Treatment	Days to flowering (days)	Number of fruit (fruits)	Fruit weight (g)	Fruit diameter (cm)
<i>Bio-slurry</i> (B)				
0 mL/L (b0)	16.75 a	3.13 b	130.80 b	20.94b
25 mL/L (b1)	16.40 a	3.47 ab	170.66 ab	22.22ab
50 mL/L (b2)	15.85 ab	3.85 a	197.36 a	22.53ab
75 mL/L (b3)	14.87 bc	3.76 a	201.61 a	23.99ab
100 mL/L (b4)	14.40 c	4.02 a	205.20 a	24.22a
Tukey's _{0.05} [B]	1.14	0.59	53.35	3.16
<i>Trichoderma harzianum</i> (T)				
0 g/L (t0)	16.20 p	3.11 q	118.77 r	19.16 r
100 g/L (t1)	15.87 pq	3.61 p	176.20 q	22.17 q
200 g/L (t2)	15.40 pq	3.77 p	194.07 pq	23.97 pq
300 g/L (t3)	15.14 q	4.10 p	235.46 p	25.82 p
Tukey's _{0.05} [T]	0.95	0.49	44.58	2.64

Number followed by the same letter is not significantly different in the Tukey's test with a confidence level of 5%.

The results of Tukey's $s_{0.05}$ test in table 1 show that Bio-slurry treatment of 100 mL/L (b4) resulted in earliest flowering age of 14.40 days compared to control and other concentration except for the 75 mL/L (b3) bio-slurry treatment. Melon plants that were not applied with Bio-slurry (control) showed the latest flowering age (16.75 days). On the other hand, application of earliest flowering age showed by melon plants applied with *Trichoderma harzianum* of 300 g/L treatment that was significantly different from control, but was not significantly different from dose of 100 g/L and 200 g/L treatments.

Observation on fruit development parameters also showed similar response of the melon plants to Bio-slurry and Trichoderma treatments. The higher the concentration of either Bio-slurry fertilizer or *Trichoderma harzianum* the better the fruits produced. Table 1 shows that the highest number of fruit, fruit weight and diameter obtained by plants applied with Bio-slurry treatment of 100 mL/L or treated with *Trichoderma harzianum*, but not the parameters values were not significantly different with other Bio-slurry and Trichoderma treatments.

3.2. Effect of Bio-slurry and Trichoderma on fruit quality

The analysis of variance show that Bio-slurry fertilizer and Trichoderma treatments were interacted significantly in affecting the quality of Melon fruits produced. Table 2 shows the average values of parameters of fruit flesh thickness, number of seeds per fruit, and sweetness level of the melon fruits.

Table 2. Effect of Bioslurry and Trichoderma on fruit flesh thickness, number of seeds, and sweetness level of Melon.

Bio-slurry (B)	<i>Trichoderma harzianum</i> (T)				Tukey's $s_{0.05}$
	0 g/L (t0)	100 g/L (t1)	200 g/L (t2)	300 g/L (t3)	
Fruit flesh thickness (mm)					
0 mL/L (b0)	16.83 d	19.30 bcd	22.33 abcd	22.50 abc	5.56
25 mL/L (b1)	18.40 cd	22.67 abc	22.57 abc	22.27 abcd	
50 mL/L (b2)	18.80 bcd	24.33 ab	21.10 abcd	26.60 a	
75 mL/L (b3)	18.90 bcd	22.53 abc	26.47 a	21.23 abcd	
100 mL/L (b4)	22.20 abcd	21.20 abcd	24.00 ab	25.17 a	
Number of seeds (seeds)					
0 mL/L (b0)	73.5 k	114.2 hij	121.3 ghi	204.3 de	35.99
25 mL/L (b1)	83.3 jk	129.8 ghi	129.1 ghi	182.3 ef	
50 mL/L (b2)	97.0 ijk	194.1 de	152.2 fg	223.4 cd	
75 mL/L (b3)	141.4 gh	200.2 de	268.3 ab	248.0 bc	
100 mL/L (b4)	184.2 ef	269.4 ab	285.2 a	220.3 cd	
Sweetness level (% brix)					
0 mL/L (b0)	3.2 d	3.7 cd	4.1 bc	4.3 bc	0.89
25 mL/L (b1)	3.9 bcd	4.1 bc	4.4 bc	4.1 bc	
50 mL/L (b2)	3.9 bc	4.2 bc	4.3 bc	4.8 b	
75 mL/L (b3)	4.1 bc	4.5 bc	4.1 bc	4.5 bc	
100 mL/L (b4)	4.1 bc	4.1 bc	4.8 b	6.0 a	

Number followed by the same letter is not significantly different in the Tukey's test with a confidence level 5%.

The results of the Tukey's $s_{0.05}$ test in table 2 show that application of 75 mL/L Bio-slurry and 200 g/L *Trichoderma harzianum* resulted in the thickest fruit flesh (26.47 mm) compared to control of both treatments (0 mL/L Bio-slurry and 0 g/L *Trichoderma harzianum*). Most number of seeds (285.2 seeds) was obtained by the plants applied with 100 mL/L Bio-slurry fertilizer combined with 200 g/L

Trichoderma harzianum. While the use of higher dose of *Trichoderma* of 300 g/L resulted in fruits with highest level of sweetness (6.0% brix).

3.3. Organoleptic test.

Analysis of variance results show that there is a significant interaction between the Bio-slurry treatment and *Trichoderma harzianum* on the taste of the Melon fruits produced. Table 3 shows the scoring of organoleptic results as results of different concentration of Bio-slurry and *Trichoderma*.

Table 3. Scoring of organoleptic test of melon fruit applied with Bio-slurry dan *Trichoderma harzianum*.

Bio-slurry (B)	<i>Trichoderma harzianum</i> (T)				Tukey's _{s0.05}
	0 g/L (t0)	100 g/L (t1)	200 g/L (t2)	300 g/L (t3)	
0 ml/L (b0)	1.10 e	1.33 de	1.50 bcde	1.67 bcde	0.59
25 ml/L (b1)	1.47 de	1.53 bcde	1.57 bcde	1.87 bcd	
50 ml/L (b2)	1.63 bcde	1.50 bcde	1.57 bcde	1.57 bcde	
75 ml/L (b3)	1.50bcde	1.57 bcde	2.00 bc	2.07 b	
100 ml/L (b4)	1.63 bcde	1.60 bcde	2.07 b	2.90 a	

Number followed by the same letter is not significantly different in the Tukey's test with a confidence level of 5%.

The results of the Tukey's_{s0.05} test in table 3 show that fruits obtained highest score from the panellists were from plants applied with 100 mL/L Bio-slurry and 300 g/L of *Trichoderma harzianum* compared to other treatments. This is consistent with the result on the sweetness level shown by the treatment combination (table 2). Melon fruits produced by plants that were not applied with Bio-slurry and *Trichoderma* show the lowest score in the organoleptic test.

26 Discussion

The results of this recent study have shown that the provision of Bio-slurry and *Trichoderma* had a significant effect on all observed parameters. Bio-slurry fertilizer treatment of 100 mL/L and *Trichoderma harzianum* of 300 g/L seems to be the optimum concentration that resulted in highest average values of fruit development and quality.

Based on the soil analysis prior to application, the addition of 100 mL/L Bio-slurry, given once a week, is thought to provide additional nutrients into the soil, and increases physical and biological soil fertility, hence can support plant growth and development including fruit development. Bio-slurry contains nutrients (macro and micro nutrients) which are very important for plant growth and can improve the physical structure of the soil and neutralize acidic soil properly [10, 11, 12]. Adding 10-12% of humus will make the soil more nutritious and able to store water, and also can support the activity of soil microbes.

13 Application of 100 mL/L Bio-slurry to the planting media of melon plants can accelerating the flowering age, the number of fruits, fruit weight and diameter. This is presumably because the N, P and K nutrients derived from Bio-slurry greatly affect the generative growth of plants. According to Marschner [13], in addition to N, the elements of P and K in plants help in the photosynthesis process where the results of photosynthesis can be used for flower formation, so that if the plant is deficient in these elements, the photosynthesis process will be reduced. Furthermore, phosphate plays an active role in transferring energy in cells and also converting carbohydrates into sugar and can increase the work efficiency of chloroplasts, the more phosphate is absorbed, the faster the formation of flowers and fruit will be.

Trichoderma harzianum 16 produces chemical compounds that can stimulate plant growth. *Trichoderma harzianum* is able to stimulate plants to produce the hormone gibberellin acid (GA3), indole acetic acid (IAA), and benzylaminopurine (BAP) in larger quantities [14], so that plant growth is

more optimum, fertile, healthy, sturdy, and ultimately affects plant resistance. The hormones gibberellin and auxin play a role in the elongation of roots and stems, stimulate flowering and fruit growth and increase plant growth.

The *Trichoderma harzianum* treatment of 300 g/L significantly affected the number of fruit parameter. This is thought due to the optimal nutrients can stimulate the growth of melon plants. Marianah [15] stated that *Trichoderma* functions to break down organic materials such as N contained in complex compounds so that this nitrogen will be used by plants to stimulate plant growth and plant development during vegetative and generative periods, especially in the development of the number of fruits, fruit weight, fruit length and provide green color on the leaves. Higher production of fruit number in the melon plants applied with *Trichoderma* is also influenced by the presence of nutrient content the form of nitrogen (N) and phosphorus (P) around the roots. The role of *Trichoderma* is considered to be able to remodel and accelerate the decomposition process of organic matter, nutrients in the form of nitrogen and phosphorus play an important role in the generative development period namely the time of fruit formation.

In this recent study also show that there is a significant interaction between the Bio-slurry fertilizer and *Trichoderma* treatments with the use of Bio-slurry of 100 mL/L and *Trichoderma harzianum* of 300 g/L had a significant effect on the parameters of fruit flesh thickness, number of seeds, brix content, and scores from the organoleptic tests on melon plants. From the two treatments, Bio-slurry and *Trichoderma harzianum*, both produce N in plants so that it helps in the formation of fruit and seeds in melons. Organic compounds in the form of fat and protein produced by the nutrient N cause the formation of stems, leaves and fruit in melon plants to be developed significantly. Oktaviyanto et al. [16] stated that one of the highest effects of active fertilizer of *Trichoderma harzianum* is being able to increase the availability of nutrients, especially N. This is also in line with the opinion of the BIRU team [4] which suggested that Bio-slurry contains essential (macro) nutrients which are required by the plants such as NPK (nitrogen, phosphorus and potassium) and non-essential nutrients (micro) such as magnesium (Mg), calcium (Ca), and sulfur (S) in stimulating plant growth.

The need for nitrogen in melons is very important because if the N in the melon is not sufficient, it will affect the plant growth system, especially in the leaves and fruit of the melon. This is in accordance with the opinion of Duan et al. [17] which states that N is a limiting factor for plant productivity. Lack of N will cause plants not to grow optimally in terms of growth of roots, stems, leaves, flowering phases and fruits and seeds, while excess N will not only inhibit plant growth but also cause pollution to the environment.

Other interactions that arise in the use of Bio-slurry and *Trichoderma harzianum* treatments are that they both act as biological agents to produce growth hormones that are useful for plants. This opinion is corroborated by the statements of Heydari and Pessaraki [18] and Kotasthane et al. [19], that *Trichoderma* is able to produce a type of hormone. This is in accordance with the opinion of Martínez-Medina et al. [20] and Rubio et al. [21] which stated that *Trichoderma harzianum* can stimulate plant growth, because this fungus secretes plant growth regulatory factors such as phytohormones, one of which is the IAA hormone. Gallavotti [22] explained that the auxin hormone, especially IAA, can have an effect on the growth of roots and stems of plants. Likewise with Bio-slurry which also produces growth hormone according to its function through the formation of macro and micro nutrients in plants.

Conclusion

Based on the results of the study, it can be concluded as follows:

- Interaction between 75 mL/L of Bio-slurry and 200 g/L *Trichoderma harzianum* resulted in the highest average fruit flesh thickness (26.47 mm). Bio-slurry treatment of 100 mL/L and *Trichoderma harzianum* of 200 g/L produced the highest number of seeds (285.2 seeds). Bio-slurry treatment of 100 mL/L and *Trichoderma harzianum* of 300 g/L produced the highest Brix levels (6.0% Brix) and the highest organoleptic test score (2.90).

- The Bio-slurry treatment of 100 mL/L resulted in the earliest flowering age (14.40 days), the highest number of fruits (4.10 pieces), the heaviest fruit weight (205.20 g) and the highest average fruit diameter (24.22 cm).
- The use of *Trichoderma harzianum* 300 g/L treatment resulted in the earliest flowering age (15.14 days), the highest number of fruits (4.10 pieces), the heaviest fruit weight (235.46 g) and the highest average of fruit diameter (25.82 cm).

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