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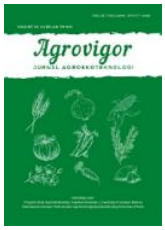

Article

Effect of Granular Organic Fertilizer Dosage on the Growth and Production of Melon Plants (*Cucumis melo* L.)

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ABSTRACT

Melon (*Cucumis melo* L.) is a seasonal fruit commodity that has a short life, can be harvested approximately 60 days after planting and produces throughout the year. In Indonesia, melon has a fairly high commercial value, so it has the potential to be cultivated. However, the decline in production is due to the use of fertilizers that are not optimal in plant cultivation and unpredictable climate. Melon plants require nutrients in large quantities to support their growth and production. The provision of these nutrients can be in the form of an appropriate dose of organic fertilizer for melon growth and production. This research was conducted in the agicultural land of Sana Tengah village, Pasean District, Pamekasan Regency using a randomized block design (RAK) with one factor, namely the dose of fertilizer with 5 treatment levels. The type of fertilizer used is granular organic fertilizer to support the growth of the vegetative phase and the generative phase. The dose of granular organic fertilizer consists of R0: 0 tons / ha; 0 g/ plant, R1: 1.5 tons / ha; 90 g/plant, R2: 3 tons/ha; 180 g/plant, R3: 4.5 tons/ha; 270 g/plant and R4: 6 tons/ha; 360 g/plant. Data analysis used ANOVA and if there was a significant effect, further testing was continued with 5% DMRT. The results showed that the granular organic fertilizer treatment significantly affected plant length, number of leaves, days to male and female flowers, fruit weight per plant, stem diameter, harvest age, fruit diameter, fruit flesh thickness, number of seeds and fruit sweetness level (brix). However, the granular organic fertilizer treatment had no effect on the number of leaves at 14 days after planting, leaf area and thickness of melon rind.

INTRODUCTION

Melon (*Cucumis melo* L.) is a horticultural commodity belonging to the family Cucurbitaceae. It has a relatively short harvesting period of approximately 60 days after planting (DAP) and can be cultivated throughout the year. This crop has a creeping or climbing growth habit and is widely cultivated in tropical regions such as Indonesia due to its high economic value (Rivandy *et al*., 2023). According to Ishak and Daryono (2018), melon is classified into Kingdom *Plantarum*, Division *Spermatophyta*, Sub-division *Angiospermae*, Class *Dicotyledoneae*, Order *Cucurbitales*, Family *Cucurbitaceae*, Genus *Cucumis*, and Species *Cucumis melo* L. Melon plants possess a taproot system consisting of primary, secondary, and fibrous (tertiary) roots. The stems are light green, pentagonal in shape, soft-textured, and covered with fine hairs, requiring stakes for support. Melon is a monoecious plant, while its fruits vary in size and contain light brown seeds (Gunawan & Bengi, 2019).

Melon has a sweet taste, high water content, and is rich in nutrients beneficial to human health. Every 100 g of melon contains 0.6 g protein, 17 mg calcium, 2.4 IU vitamin A, 30 mg vitamin C, 0.045 mg vitamin B1, 0.065 mg vitamin B2, 93 mL water, 0.4 g dietary fiber, and 23 kcal of energy (Purbasari *et al*., 2018). In addition, melon contains sugars, antioxidants, ascorbic acid, minerals, and provitamin A (beta-carotene), which contribute to improving vision, maintaining body hydration, promoting healthy skin and digestion, supporting bone health, helping reduce high blood pressure, and lowering the risk of diseases such as cancer and stroke (Manchali *et al*., 2021; Tara *et al*., 2024).

he growth and yield of melon plants are influenced by environmental conditions. Melon grows optimally in sandy clay soils rich in organic matter with a soil pH of 6.0–6.5, at an altitude of 200–900 m above sea level, annual rainfall of 1,000–2,000 mm, air temperatures ranging from 25–30°C, and daily sunlight exposure of 10–12 hours (Supriyanta *et al*., 2022; Sujono, 2019). High rainfall may cause young fruits to drop and reduce fruit sugar content, whereas temperatures below 18°C increase humidity, making plants more susceptible to pest and disease attacks.

Despite its promising economic prospects, melon production in Indonesia has declined from 129,147 tons in 2021 to 118,696 tons in 2022 and further to 117,794 tons in 2023 (BPS, 2024). One of the contributing factors is suboptimal fertilizer application, resulting in inefficient nutrient uptake and consequently affecting plant growth and yield. In open-field cultivation, successful crop growth largely depends on appropriate fertilization management according to soil conditions. Therefore, the use of organic fertilizers has become an alternative strategy to improve soil fertility, enhance nutrient uptake efficiency, and increase the quality of melon production (Kurniastuti & Faustina, 2019).

Organic fertilizer is produced through the decomposition of organic materials by microorganisms and functions to improve the physical, chemical, and biological properties of the soil while supplying both macro- and micronutrients required for plant growth. The application of organic fertilizers enhances chlorophyll formation, photosynthetic activity, soil productivity, and reduces land degradation, thereby supporting sustainable agricultural systems (Karo *et al*., 2018; Roidah, 2013). One commonly used form is granular organic fertilizer, which consists of granules measuring approximately 3–5 mm in diameter, making it more practical for storage, transportation, and field application. Besides improving fertilizer use efficiency, granular organic fertilizer also enhances soil structure, increases cation exchange capacity (CEC), improves soil water and nutrient retention, and supports the activity of beneficial soil microorganisms (Mardiansyah *et al*., 2020).

The primary advantage of granular organic fertilizer lies in its slow-release characteristic, whereby nutrients are gradually released through the activity of soil microorganisms. This mechanism provides a more stable nutrient supply, allowing more efficient nutrient uptake throughout the plant growth stages. In addition to improving nutrient use efficiency, granular organic fertilizer contributes to better soil conditions and enhances the activity of soil microorganisms involved in the mineralization of organic matter (Adikara & Widyastuti, 2019; Moreno-Lora *et al*., 2023). However, its nutrient content is generally lower than that of inorganic fertilizers, resulting in a slower plant response because time is required for the decomposition process.

Granular organic fertilizer is generally applied as a basal fertilizer by incorporating it into the soil or spreading it around the root zone before planting. The use of well-matured organic fertilizer with a carbon-to-nitrogen (C/N) ratio of approximately 10–20 can improve nutrient availability and support soil microbial activity, thereby enhancing

the mineralization process (Van Der Sloot *et al*., 2022). Applying the fertilizer at a depth of 10–20 cm approximately seven days before planting can also improve the effectiveness of nutrient uptake by plant roots.

Several studies have demonstrated the positive effects of granular organic fertilizer on plant growth and yield. Suryawaty (2015) reported that an application rate of 3 t ha^{-1} produced the best results for melon growth and significantly affected plant height, fruit weight per plant, and fresh fruit weight. Similarly, Alfarisy (2021) stated that different application rates of organic fertilizer significantly influenced the growth and yield of horticultural crops, while Budiono *et al*. (2021) reported that granular organic fertilizer improved nutrient uptake efficiency because of its gradual nutrient release. Nevertheless, information regarding the effective application rate of granular organic fertilizer for melon cultivation remains limited. Dinu *et al*. (2019) Stated that studies on the application of granular organic fertilizer in melon cultivation are still relatively scarce. Therefore, this study was conducted to evaluate the effect of different application rates of granular organic fertilizer on the growth and yield of melon (*Cucumis melo* L.).

MATERIALS AND METHODS

The study was conducted in an agricultural field located in Sana Tengah Village, Pasean District, Pamekasan Regency, East Java, Indonesia, under the supervision of the Faculty of Agriculture, Universitas Trunojoyo Madura, Bangkalan Regency, East Java. The experiment was carried out from October to December 2025.

The materials used in this study consisted of Daviena melon (*Cucumis melo* L.) seeds and granular organic fertilizer.

The experiment was arranged using a Randomized Complete Block Design (RCBD) with a single factor, namely the application rate of granular organic fertilizer, consisting of five treatment levels. Each treatment was replicated five times. The treatment levels were as follows: R0: 0 tons / ha; 0 g/ plant, R1: 1.5 tons / ha; 90 g/plant, R2: 3 tons/ha; 180 g/plant, R3: 4.5 tons/ha; 270 g/plant and R4: 6 tons/ha; 360 g/plant. Each experimental unit consisted of five sample plants, resulting in a total of 125 plants. The spacing between sampled plants was 50 cm, while the spacing between treatments was 120 cm. The plant population was calculated using the following formula population /ha = $\frac{\text{land area}}{\textit{plant spacing}}$ The dose calculation formula was as follows $\frac{\text{dose/ha}}{\textit{land area}}$ = dose/m^2, the fertilizer requirement was calculated using the following formula:

Given : (1)

Cultivated area (0,5 × 0,12 m) = 0,06 m^2

population /ha = $\frac{\textit{land area}}{\textit{Plant spacing}} = \frac{10.000\ m^2}{0{,}06\ m^2}$ = 166.66 plant/ha

Dose 1,5 ton/ha = 1.500 kg/ha

Calculation = $\frac{\text{dose/ha}}{\textit{land area}}$ = dose/m^2 = $\frac{1.500\ kg}{10.000\ m^2}$ = 0,15 kg/ m^2

= 0,15 kg/ m^2 × 0,06 m^2 = 0,009 kg/plant

= 90 g/plant

Dose 3 ton/ha = 3.000 kg/ha (2)

Calculation = $\frac{\text{dose/ha}}{\textit{land area}}$ = dose/ m^2 = $\frac{3.000\ kg}{10.000\ m^2}$ = 0,3 kg/ m^2

= 0,3 kg/ m^2 × 0,06 m^2 = 0,0018 kg/plant

= 180 g/plant

Dose 4,5 ton/ha = 4.500 kg/ha (3)

Calculation = $\frac{\text{dose/ha}}{\textit{land area}}$ = dose/ m^2 = $\frac{4.500\ kg}{10.000\ m^2}$ = 0,45 kg/ m^2

= 0,45 kg/ m^2 × 0,06 m^2= 0,027 kg/plant

=270 g/plant

Dose 6 ton/ha = 6.000 kg/ha (4)

Calculation = $\frac{\text{dose/ha}}{\textit{land area}}$ = dose/ m^2 = $\frac{6.000\ kg}{10.000\ m^2}$ = 0,6 kg/ m^2

= 0,6 kg/ m^2 × 0,06 m^2= 0,036 kg/plant

= 360 g/plant

The observed growth and yield parameters included plant length (cm), number of leaves, leaf area (cm²), days to the appearance of male and female flowers, stem diameter (mm), fruit weight per plant (kg), days to harvest, fruit diameter (mm), fruit flesh thickness (mm), fruit rind thickness (mm), number of seeds, and total soluble solids (°Brix). The data were analyzed using analysis of variance (ANOVA) at the 5% significance level. When significant differences among treatments were detected, mean comparisons were performed using Duncan's Multiple Range Test (DMRT) at the 5% significance level.

RESULTS AND DISCUSSION

Analysis of variance (ANOVA) at the 5% significance level showed that the application rates of granular organic fertilizer significantly affected melon plant length throughout all observation periods.

Table 1. Average plant height (cm) for each treatment and observation period

Treatment	Average plant height (cm) at age (DAP)				
	7	**14**	**21**	**28**	**35**
R0	8.33 a	12.49 a	19.69 a	36.18 a	82.78 a
R1	9.34 b	14.60 b	23.02 b	42.44 a	96.96 b
R2	9.93 b	15.65 bc	26.61 c	52.81 b	99.24 b
R3	8.46 a	15.09 bc	27.18 c	50.60 b	101.20 b
R4	10.02 b	16.07 c	28.71 c	68.44 c	113.84 c
ANOVA 5%	*	*	*	*	*

Note: Values followed by the same letter within the same column are not significantly different according to Duncan's Multiple Range Test (DMRT) at the 5% significance level. * = significant at the 5% level; DAP = days after planting.

Based on the data presented in Table 1, the plant length parameter showed that the highest values at all observation periods were obtained under the R4: 6 tons/ha; 360 g/plant treatment, whereas the lowest values were consistently recorded in the R0: 0 tons / ha; 0 g/plant treatment.

Plant growth is a quantitative and irreversible process characterized by increases in size, number, and volume at the cellular, tissue, organ, and whole-organism levels (Renita & Satria, 2025). In the present study, plant length was used as an indicator of growth because it reflects the plant's ability to absorb nutrients efficiently. In addition to genetic factors, plant elongation is also influenced by environmental conditions, including rainfall and soil characteristics (Prasetio, 2022). The results presented in Table 1 indicated that plant length was not significantly different at 7 days after planting (DAP), but significant differences were observed at 28 and 35 DAP. This result was presumably attributed to the slow-release characteristic of granular organic fertilizer, which gradually releases nutrients through the decomposition of organic matter by soil microorganisms. Consequently, nutrients remain available in the soil for a longer period, reducing nutrient losses through leaching and denitrification while improving fertilizer use efficiency (Febrianti *et al*., 2024; Savana, 2018). The R4: 6 tons/ha; 360 g/plant and R3: 4.5 tons/ha; 270 g/plant treatments tended to produce greater plant length than the other treatments due to the adequate nutrient supply supporting photosynthesis, cell division, and cell elongation. According to Manurung *et al*. (2019), the application of granular organic fertilizer at an appropriate rate enhances nutrient uptake, particularly nitrogen, thereby promoting plant growth and yield. Conversely, excessive fertilizer application may cause plant wilting and inhibit plant growth.

Analysis of variance (ANOVA) at the 5% significance level for the number of leaves at 7, 21, 28, and 35 days after planting (DAP) indicated that the application rates of granular organic fertilizer had a significant effect on the number of leaves of melon plants. The mean number of leaves under different application rates of granular organic fertilizer is presented in Table 2. Based on the results of Duncan's Multiple Range Test (DMRT) at the 5% significance level presented in Table 2, the number of leaves showed that the highest values at all observation periods were obtained under the R4: 6 tons/ha; 360 g/plant treatment, except at 7 days after planting (DAP), where the highest value was recorded under the R2: 3 tons/ha; 180 g/plant treatment. In contrast, the lowest number of leaves at all observation periods was consistently observed under the R0: 0 tons / ha; 0 g/plant treatment.

Table 2. Average number of leaves (count) for each treatment and observation period

Treatment	Average number of leaves (count) at days after planting (DAP)				
	7	14	21	28	35
R0	2.04 a	5.08	15.12 a	34.44 a	52.08 a
R1	2.32 ab	6.28	18.88 b	39.44 ab	59.24 b
R2	2.88 c	7.44	20.76 bc	44.00 b	66.12 c
R3	2.68 bc	7.44	21.44 c	44.20 b	68.60 c
R4	2.80 c	9.04	24.76 d	53.60 c	78.96 d
ANOVA 5%	*	Ns	*	*	*

Note: Values followed by the same letter within the same column are not significantly different according to Duncan's Multiple Range Test (DMRT) at the 5% significance level. * = significant at the 5% level; DAP = days after planting

The number of leaves is one of the parameters used to evaluate plant growth. It was determined by counting the leaves that had fully expanded (Fauzi *et al*., 2022). As shown in Table 2, the number of leaves of melon plants was significantly affected by the application rate of granular organic fertilizer, with the R4: 6 tons/ha; 360 g/plant treatment producing a greater number of leaves than the other treatments. This result was attributed to the nitrogen content of granular organic fertilizer, which is available for plant uptake and stimulates shoot and leaf formation while increasing protein synthesis. Nitrogen is particularly required during the early growth stage when plants are developing vegetative organs and subsequently supporting the formation of reproductive organs such as fruits and seeds. An increased number of leaves enhances the photosynthetic process, resulting in greater photosynthate production. Among the essential nutrients, nitrogen plays the most important role in leaf growth and development, and higher nitrogen availability generally promotes the formation of more leaves.

According to Palmasari *et al*. (2022), a greater number of leaves is an indicator of good plant growth because leaves are the primary organs responsible for photosynthesis and energy production. Furthermore, Laili (2022) reported that organic matter not only serves as a source of macronutrients such as nitrogen (N) and phosphorus (P), but also supplies micronutrients, including iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), boron (B), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), and molybdenum (Mo). These nutrients are gradually released through decomposition and mineralization processes, thereby supporting plant growth. Analysis of variance (ANOVA) at the 5% significance level indicated that the application rates of granular organic fertilizer had no significant effect on leaf area per plant. The mean leaf area per plant is presented in Table 3.

Table 3. Average leaf area per plant (cm^2) for each treatment

Treatment	Leaf area per plant (cm^2)
R0	137.84
R1	85.76
R2	131.57
R3	124.34
R4	164.44
ANOVA 5%	Ns

Note: Values followed by the same letter within the same column are not significantly different according to Duncan's Multiple Range Test (DMRT) at the 5% significance level. * = significant at the 5% level; DAP = days after planting

Based on the mean leaf area per plant presented in Table 3, the highest leaf area was obtained under the R4: 6 tons/ha; 360 g/plant treatment, with a value of 164.44 cm^2. In contrast, the lowest leaf area per plant was recorded under the R1: 1.5 tons / ha; 90 g/plant treatment, with a value of only 85.76 cm^2.

Leaf area is an important parameter for evaluating plant growth and physiological performance because leaves are the primary organs where photosynthesis takes place. A larger leaf area enables the plant to intercept more

sunlight, thereby producing greater amounts of chemical energy in the form of carbohydrates required for plant growth and development (Umam *et al*., 2023). As presented in Table 3, leaf area per plant did not differ significantly among the treatments, although numerical variations were observed. Nevertheless, the R4: 6 tons/ha; 360 g/plant treatment tended to produce a larger leaf area than the other treatments, indicating a greater potential for photosynthetic activity despite the absence of statistically significant differences. These findings suggest that leaf expansion was more strongly influenced by environmental factors, such as light intensity and water availability during the growth period, than by the initial application rate of granular organic fertilizer. According to Pramitasari (2016), adequate availability of nitrogen, phosphorus, and potassium from fertilizer promotes leaf development, allowing leaves to expand and produce a larger leaf area. A larger leaf surface increases the interception of sunlight required for photosynthesis. As photosynthesis proceeds more efficiently, greater amounts of photosynthates are produced and subsequently translocated to the vegetative organs, thereby supporting the formation of new plant organs.

Analysis of variance (ANOVA) at the 5% significance level indicated that the application rates of granular organic fertilizer significantly affected the days to the appearance of male and female flowers in melon plants. The mean number of days to the appearance of male and female flowers under different application rates of granular organic fertilizer is presented in Table 4.

Table 4. Average days for male and female flowers to appear in each treatment

Treatment	Flowering (Days)	
	Jantan	Betina
R0	28.40 d	32.64 d
R1	26.56 c	31.88 c
R2	24.88 b	31.04 bc
R3	24.24 b	30.52 b
R4	22.04 a	27.92 a
ANOVA 5%	*	*

Note: Values followed by the same letter within the same column are not significantly different according to Duncan's Multiple Range Test (DMRT) at the 5% significance level. * = significant at the 5% level; DAP = days after plantin.

Based on the mean values presented in Table 4, the R4: 6 tons/ha; 360 g/plant treatment resulted in the earliest appearance of both male and female flowers, with mean values of 22.04 and 27.92 days after planting (DAP), respectively. In contrast, the R0: 0 tons / ha; 0 g/plant treatment produced the latest appearance of male and female flowers, with mean values of 28.40 and 32.64 DAP, respectively.

Flowering represents the transition from the vegetative to the reproductive growth stage and is characterized by the emergence of flower buds. During this stage, the availability of phosphorus (P) and potassium (K) plays a crucial role in flower and fruit formation. Therefore, phosphorus is an essential nutrient influencing the flowering process of melon plants (Annisa & Gustia, 2018). As shown in Table 4, the application of granular organic fertilizer significantly affected the days to the appearance of both male and female flowers. The earliest flowering was observed under the R4: 6 tons/ha; 360 g/plant treatment, with male and female flowers appearing at 22.04 and 27.92 DAP, respectively, whereas the latest flowering occurred under the R0: 0 tons / ha; 0 g/plant treatment, with male and female flowers appearing at 28.40 and 32.64 DAP, respectively. This finding suggests that the application of granular organic fertilizer promoted the transition to the reproductive stage by providing an adequate and balanced supply of nutrients required for physiological processes. In addition, the availability of organic matter together with sufficient levels of nitrogen (N), phosphorus (P), and potassium (K) under the granular organic fertilizer treatments may have accelerated the flowering process. These findings are supported by Riyanti (2011), who reported that the transition from the vegetative to the reproductive stage is influenced by the type and application rate of fertilizer. However, environmental factors such as temperature, water availability, nutrient status, and light intensity also affect flowering. Furthermore, Sayekti (2016) reported that high light intensity stimulates the formation of female flowers, whereas low light intensity tends to promote the development of male flowers.

Analysis of variance (ANOVA) at the 5% significance level indicated that the application rates of granular organic fertilizer significantly affected the stem diameter of melon plants. The mean stem diameter under different application rates of granular organic fertilizer is presented in Table 5.

Table 5. Average stem diameter (mm) for each treatment

Treatment	Stem diameter (mm)
R0	11.58 a
R1	13.86 b
R2	11.05 a
R3	13.98 c
R4	15.90 d
ANOVA 5%	*

Note: Values followed by the same letter within the same column are not significantly different according to Duncan's Multiple Range Test (DMRT) at the 5% significance level. * = significant at the 5% level; DAP = days after planting

Based on the mean values presented in Table 5, the R4: 6 tons/ha; 360 g/plant treatment produced the largest stem diameter, with a mean value of 15.90 mm. In contrast, the smallest stem diameter was recorded under the R0: 0 tons / ha; 0 g/plant treatment, with a mean value of 11.58 mm. Stem diameter is one of the growth indicators used to describe early plant development, particularly in relation to the transport of nutrients from the soil and the translocation of photosynthetic products (Ayu *et al*., 2017). As presented in Table 5, the application of granular organic fertilizer significantly affected stem diameter, with the R4: 6 tons/ha; 360 g/plant treatment producing the greatest stem diameter. This result suggests that the nutrients supplied by granular organic fertilizer promoted stem growth. In particular, nitrogen (N) and potassium (K) contribute to the thickening of supporting tissues (sclerenchyma), resulting in stronger stems with larger diameters that are less prone to lodging and more resistant to pest and disease attacks (Ramadhan *et al*., 2024). Plants generally continue to grow both vertically and laterally. The strong apical dominance of the terminal bud stimulates continuous upward growth. According to Pane *et al.* (2013), when the terminal shoot grows rapidly, the plant produces inhibitory substances that are translocated toward the stem. Pruning the shoot apex can stimulate xylem development, thereby promoting stem thickening as a consequence of reducing apical dominance.

Analysis of variance (ANOVA) at the 5% significance level indicated that the application rates of granular organic fertilizer significantly affected fruit weight per plant in melon. The mean fruit weight per plant under different application rates of granular organic fertilizer is presented in Table 6. Based on the mean values presented in Table 6, the R4: 6 tons/ha; 360 g/plant treatment produced the highest fruit weight per plant, with a mean value of 1.37 kg. In contrast, the lowest fruit weight per plant was recorded under the R0: 0 tons / ha; 0 g/plant treatment, with a mean value of 0.80 kg.

Fruit development and maturation require an adequate and balanced supply of nutrients. The most essential nutrients for melon growth are nitrogen (N), phosphorus (P), potassium (K), and calcium (Ca), all of which can be supplied through granular organic fertilizer. Calcium plays a vital role in cell division and cell membrane permeability; therefore, calcium deficiency may result in suboptimal fruit development. As shown in Table 6, the application of granular organic fertilizer significantly affected fruit weight, with the R4: 6 tons/ha; 360 g/plant treatment producing the greatest fruit weight. This result indicates that the appropriate application rate of granular organic fertilizer enhances both fruit weight and fruit size. Adequate availability of macronutrients promotes the development of a well-established root system, enabling plants to absorb water and mineral nutrients more efficiently. According to Simanungkalit *et al*. (2013), potassium (K) plays an essential role in biochemical and physiological processes that regulate plant growth and productivity. Potassium improves plant tolerance to environmental stress, participates in photosynthesis, supports the enzymatic activities involved in photosynthetic processes, and facilitates the translocation of photosynthates from the leaves through the phloem to reproductive and storage organs, including fruits and seeds. Consequently, insufficient nutrient availability may limit fruit development and reduce fruit weight.

Analysis of variance (ANOVA) at the 5% significance level indicated that the application rates of granular organic fertilizer significantly affected the harvest age of melon plants. The mean harvest age under different application rates of granular organic fertilizer is presented in Table 7.

Table 6. Average fruit weight per plant (kg) for each treatment

Treatment	Fruit weight per plant (kg)
R0	0.80 a
R1	0.94 b
R2	1.10 c
R3	1.23 d
R4	1.37 e
ANOVA 5%	*

Note: Values followed by the same letter within the same column are not significantly different according to Duncan's Multiple Range Test (DMRT) at the 5% significance level. * = significant at the 5% level; DAP = days after planting.

Table 7. Average harvest age (days) for each treatment

Treatment	Harvest age (days)
R0	64.44 d
R1	64.12 b
R2	63.68 c
R3	62.48 d
R4	61.32 a
ANOVA 5%	*

Note: Values followed by the same letter within the same column are not significantly different according to Duncan's Multiple Range Test (DMRT) at the 5% significance level. * = significant at the 5% level; DAP = days after planting.

Based on the data presented in Table 7, the harvest age parameter showed that treatment R4: 6 tons/ha; 360 g/plant differed significantly from treatments R0:0 tons/ha; 0 g/plant, R1: 1,5 tons/ha; 90 g/plant, R2: 3 tons/ha; 180 g/plant, and R3: 4,5 tons/ha; 270 g/plant. However, treatments R0: 0 tons/ha; 0 g/plant and R1: 1,5 tons/ha; 90 g/plant did not differ significantly. Treatment R0 had the longest average harvest age, at 64.44 days, whereas treatment R4 had the shortest average harvest age, at 61.32 days.

Harvest age is the period calculated from planting or flowering until the fruit reaches physiological maturity. The harvest age of a crop is closely associated with the flowering process; therefore, earlier flowering generally results in earlier harvest (Surtinah, 2017). As shown in Table 7, the application of granular organic fertilizer significantly affected the harvest age of melon plants, with the R4: 6 tons/ha; 360 g/plant treatment producing the earliest harvest at 61.32 days. The accelerated harvest observed under the higher application rate was likely due to the continuous and balanced supply of macro- and micronutrients provided by the slow-release characteristics of granular organic fertilizer. Phosphorus (P) plays an important role in accelerating the flowering stage and early fruit development. During fruit maturation, plants are less likely to experience nutrient starvation because nutrients are retained by soil colloids and released gradually, ensuring a continuous nutrient supply throughout the reproductive stage. According to Ayu *et al.* (2017), fruit development is physiologically associated with the differentiation of axillary buds from vegetative to floral buds, followed by flower initiation stimulated by nutrient availability. As a result, fruit development proceeds more efficiently, leading to earlier physiological maturity and harvest.

Analysis of variance (ANOVA) at the 5% significance level indicated that the application rates of granular organic fertilizer significantly affected the fruit diameter of melon plants. The mean fruit diameter under different application rates of granular organic fertilizer is presented in Table 8.

Table 8. Average fruit diameter (mm) for each treatment

Treatment	Fruit diameter (mm)
R0	104.73 a
R1	111.02 b
R2	119.54 c
R3	129.01 d
R4	137.36 e
ANOVA 5%	*

Note: Values followed by the same letter within the same column are not significantly different according to Duncan's Multiple Range Test (DMRT) at the 5% significance level. * = significant at the 5% level; DAP = days after planting.

Based on the mean values presented in Table 8, the R4: 6 tons/ha; 360 g/plant treatment produced the largest fruit diameter, with a mean value of 137.36 mm. In contrast, the smallest fruit diameter was recorded under the R0: 0 tons / ha; 0 g/plant treatment, with a mean value of 104.73 mm.

Fruit diameter is a morphological parameter used to evaluate fruit size and volume. It was measured at harvest by determining the transverse diameter across the middle portion of the melon fruit (Muhammad *et al*., 2024). As presented in Table 8, the application of granular organic fertilizer significantly affected fruit diameter, with the R4: 6 tons/ha; 360 g/plant treatment producing the largest fruit diameter. Fruit development is influenced by the accumulation of assimilates within the plant, which are synthesized using nutrients absorbed from the soil. Adequate nutrient availability from granular organic fertilizer enhances plant metabolic activity, thereby promoting cell division and fruit development. Prayoda *et al*. (2015) reported that fruit weight is positively correlated with fruit diameter. Phosphorus (P) plays an important role in vegetative growth, including root development and cell division, while also stimulating flowering, seed formation, and increasing plant resistance to pests and diseases. According to Susilo *et al*. (2020), phosphorus accelerates flowering and fruit filling, thereby improving crop productivity. In addition, fruit weight and fruit diameter are influenced by water availability; insufficient water supply may limit optimal fruit development. Rezky (2018) reported that fruit weight is closely associated with the water content of the fruit. As metabolic activity increases, plants require greater amounts of water, resulting in increased water uptake to support growth and fruit development. One of the physiological processes most sensitive to water deficiency is cell division.

Analysis of variance (ANOVA) at the 5% significance level indicated that the application rates of granular organic fertilizer significantly affected the fruit flesh thickness of melon plants. The mean fruit flesh thickness under different application rates of granular organic fertilizer is presented in Table 9.Based on the mean values presented in Table 9, the R4: 6 tons/ha; 360 g/plant treatment produced the greatest fruit flesh thickness, with a mean value of 24.58 mm. In contrast, the lowest fruit flesh thickness was recorded under the R0: 0 tons / ha; 0 g/plant treatment, with a mean value of 14.64 mm.

Assimilates produced through photosynthesis are stored in the fruit as food reserves. Therefore, larger fruits generally develop thicker fruit flesh. As presented in Table 9, the application of granular organic fertilizer significantly affected fruit flesh thickness. This result is likely attributed to the phosphorus (P) and potassium (K) supplied by granular organic fertilizer at higher application rates, which promote mesocarp cell division during the early stage following pollination. Consequently, greater accumulation of water and sugars within the cells results in thicker and denser fruit flesh. Fruit thinning is also an important cultivation practice that can improve melon fruit quality. According to Nursyamsi *et al*. (2023), retaining fewer developing fruits allows a greater proportion of assimilates to be allocated to each fruit, thereby improving melon fruit quality. In addition, adequate photosynthetic activity contributes to increased fruit flesh thickness by enhancing assimilating production and translocation to the developing fruit (Prayuda *et al*., 2024).

Analysis of variance (ANOVA) at the 5% significance level indicated that the application rates of granular organic fertilizer had no significant effect on fruit rind thickness. The mean fruit rind thickness under different application rates of granular organic fertilizer is presented in Table 10

Table 9. Average flesh thickness (mm) for each treatment

Treatment	Flesh thickness (mm)
R0	14.64 a
R1	14.94 ab
R2	15.99 b
R3	22.93 c
R4	24.58 d
ANOVA 5%	*

Note: Values followed by the same letter within the same column are not significantly different according to Duncan's Multiple Range Test (DMRT) at the 5% significance level. * = significant at the 5% level; DAP = days after planting.

Table 10. Average fruit peel thickness (mm) for each treatment

Treatment	Fruit peel thickness (mm)
R0	7.53
R1	8.88
R2	8.85
R3	8.97
R4	9.26
ANOVA 5%	Ns

Note: Values followed by the same letter within the same column are not significantly different according to Duncan's Multiple Range Test (DMRT) at the 5% significance level. * = significant at the 5% level; DAP = days after planting

Based on the data presented in Table 10, the R4: 6 tons/ha; 360 g/plant treatment tended to produce the greatest mean fruit rind thickness, with a value of 9.26 mm. In contrast, the lowest fruit rind thickness was recorded under the R0: 0 tons / ha; 0 g/plant treatment, with a mean value of 7.53 mm. Fruit rind thickness is one of the physical characteristics used to evaluate fruit quality. As presented in Table 10, the application of granular organic fertilizer had no significant effect on fruit rind thickness. Although no statistically significant differences were observed among treatments, the greatest fruit rind thickness was obtained under the R4: 6 tons/ha; 360 g/plant treatment, whereas the thinnest rind was recorded under the R0: 0 tons / ha; 0 g/plant treatment. The optimum harvest age of melon generally ranges from 65 to 75 days after planting (Nainggolan *et al*., 2020). Since the fruits in the present study were harvested before reaching this optimal harvest period, the fruit rind may have remained relatively thick because the fruits had not yet reached full physiological maturity. In addition, several environmental and cultivation factors may have influenced fruit quality, including high rainfall, which can increase nutrient losses through leaching, fertilizer application practices, pruning, and pest and disease incidence (Rahmi, 2002). Pest and disease attacks may interfere with fruit enlargement, resulting in suboptimal fruit development. Consequently, impaired fruit growth can reduce fruit quality attributes, including fruit weight, fruit diameter, fruit flesh thickness, fruit rind thickness, and fruit sweetness (Prayoda *et al*., 2015).

Analysis of variance (ANOVA) at the 5% significance level indicated that the application rates of granular organic fertilizer significantly affected the number of seeds per fruit in melon plants. The mean number of seeds per fruit under different application rates of granular organic fertilizer is presented in Table 11. Based on the mean values presented in Table 11, the R2: 3 tons/ha; 180 g/plant treatment produced the highest number of seeds, with a mean value of 414.08 seeds per fruit. In contrast, the lowest number of seeds was recorded under the R0: 0 tons / ha; 0 g/plant treatment, with a mean value of 243.00 seeds per fruit. Melon seeds are the reproductive structures of the plant and serve as propagules for the development of new plants. As presented in Table 11, the application of granular organic fertilizer significantly affected the number of seeds, with the R2: 3 tons/ha; 180 g/plant treatment producing the highest number of seeds. This result is likely associated with the adequate availability of nutrients, particularly phosphorus (P) and potassium (K), supplied by granular organic fertilizer.

Table 11. Average number of seeds per fruit for each treatment

Treatment	Number of seeds per fruit
R0	243.00 a
R1	317.72 b
R2	414.08 c
R3	261.80 a
R4	403.72 c
ANOVA 5%	*

Note: Values followed by the same letter within the same column are not significantly different according to Duncan's Multiple Range Test (DMRT) at the 5% significance level. * = significant at the 5% level; DAP = days after planting

These nutrients play important roles in flower formation, pollination, fertilization, and seed development. Well-developed seeds are capable of producing endogenous auxin and gibberellin, which enhance the translocation of assimilates to the cells surrounding the placenta of the developing melon fruit. Seed number is influenced by both genetic and environmental factors; however, photosynthetic activity also plays a crucial role in seed formation and seed filling, which are closely associated with seed weight. According to Sobari *et al*. (2019), environmental temperature and air humidity are important factors influencing seed formation. Low temperatures may inhibit pollen tube growth, whereas excessively high temperatures can cause stigma desiccation, preventing pollen grains from adhering to the stigma and reducing fertilization success.

Analysis of variance (ANOVA) at the 5% significance level indicated that the application rates of granular organic fertilizer significantly affected the total soluble solids (°Brix) of melon fruits. The mean total soluble solids (°Brix) under different application rates of granular organic fertilizer are presented in Table 12.

Table 12. Average fruit sweetness level (Brix) for each treatment

Treatment	Sweetness level (Brix)
R0	10.28 a
R1	10.56 ab
R2	10.76 b
R3	10.72 b
R4	11.36 c
ANOVA 5%	*

Note: Values followed by the same letter within the same column are not significantly different according to Duncan's Multiple Range Test (DMRT) at the 5% significance level. * = significant at the 5% level; DAP = days after planting.

Based on the mean values presented in Table 12, the R4: 6 tons/ha; 360 g/plant treatment produced the highest total soluble solids (°Brix), with a mean value of 11.36 °Brix. In contrast, the lowest total soluble solids were recorded under the R0: 0 tons / ha; 0 g/plant treatment, with a mean value of 10.28 °Brix. The quality of melon fruit is commonly evaluated based on its sweetness, which is expressed as sucrose content or total soluble solids (°Brix). According to International Ag Labs Inc., melon fruit quality can be classified into four categories based on sweetness: poor (8 °Brix), moderate (12 °Brix), good (14 °Brix), and excellent (16 °Brix) (Firmansyah *et al*., 2018). As presented in Table 12, the application of granular organic fertilizer significantly affected fruit sweetness, with the R4: 6 tons/ha; 360 g/plant treatment producing the highest total soluble solids of 11.36 °Brix. The sweetness values of all treatments ranged from 10 to 12 °Brix, indicating a moderate level of fruit quality. Fruit sweetness is closely associated with the degree of fruit maturity, which is influenced by harvest age. In addition, better seed development may enhance the accumulation of photosynthates in the fruit, resulting in higher sugar content.

However, fruit sweetness is also strongly influenced by the availability of phosphorus (P) and potassium (K). According to Ayu *et al*. (2017), adequate phosphorus availability promotes the conversion of carbohydrates into sugars, thereby increasing fruit sweetness. Furthermore, the application of granular organic fertilizer containing higher levels of potassium contributes to sweeter fruits because potassium plays a key role in carbohydrate transport and the translocation of assimilates to the fruit. As fruits approach physiological maturity and harvest, carbohydrate accumulation continues to increase, resulting in higher sugar content.

CONCLUSION

The application rates of granular organic fertilizer significantly affected plant length, number of leaves, days to the appearance of male and female flowers, fruit weight per plant, stem diameter, harvest age, fruit diameter, fruit flesh thickness, number of seeds, and total soluble solids (°Brix). However, the application of granular organic fertilizer had no significant effect on the number of leaves at 14 days after planting (DAP), leaf area, and fruit rind thickness. The application of granular organic fertilizer at treatment R4: 6 tons/ha; 360 g/plant) showed the best overall results in terms of the generative growth and fruit quality of melon under the conditions of this study. However, this dose cannot yet be considered the optimum dose because it was the highest dose tested. Therefore, further research using higher application doses and conducting an economic analysis is needed to determine the optimum dose that provides the best results in terms of both agronomic performance and economic feasibility.Application of the best performing fertilizer dose, R4: 6 tons/ha; 360 g/plant, significantly produced the best results by increasing fruit weight per plant, fruit diameter, fruit flesh thickness, and total soluble solids (°Brix), while also accelerating flowering and harvest compared with the other treatments.

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