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Evaluating the impact of amino acid spray on melon (*Cucumis melo* L.) growth under hydroponic conditions at Polije SGH

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ABSTRACT

Introduction: Melon (*Cucumis melo* L.) is one of the horticultural plants of the fruit type which is included in the gourd tribe or Cucurbitaceae family. The problem with melon cultivation in the field is that it requires intensive maintenance, is susceptible to pests and diseases, uses less efficient nutrients, is sensitive to weeds, and has less controlled growth. The above problems can be overcome by hydroponic techniques. In hydroponic techniques, environmental resources are easier to control and the results obtained are more satisfying compared to conventional cultivation, especially in open fields. Amino acids are proteins that have been broken down through the metabolic process into small molecules. In addition to humans, plants also need amino acids to increase overall yields and quality. **Methods:** This study aims to determine the effect of providing the best Amino Plant concentration for the growth and production of melon plants. This study was conducted in June - October 2022 at the Smart Green House (SGH) of Jember State Polytechnic. The experimental design used was a Completely Randomized Design (CRD) consisting of one factor, namely the concentration of Amino Acid with 3 levels, namely P1 (4 mg/L), P2 (8 mg/L), and P3 (12 mg/L). **Results:** The results of the study showed that the administration of Amino Acids at a dose of 2 g/L gave results that were not significantly different (ns) in all parameters and showed that there was no effective concentration for melon growth and production in all parameters. **Conclusion:** Based on the results of this research, it is recommended to carry out further research by applying Amino Plants according to the guidelines on the packaging. It is necessary to calibrate the drip irrigation or fertigation system so that the nutrient flow is uniform.

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INTRODUCTION

The agricultural sector in Indonesia plays a very important role in Indonesia's economic growth. Horticultural plants are one of the agricultural subsectors, horticulture itself consists of ornamental plants, medicinal plants, vegetables, and fruits. Fruits are one of the commodities that have the largest contribution to horticultural GDP over the past 5 years with an average contribution of 54.7% (Bulan *et al.*, 2022; Nuha *et al.*, 2023; Pradipta & Firdaus, 2015). Indonesia itself has many superior fruits that are expected to increase export potential and improve Indonesia's position as a fruit exporter in the world, seasonal fruits that have high export volumes and are ranked in the top 3 during the period 2015 to 2018 include strawberries, melons and watermelons (Badan Pusat Statistik Provinsi Jawa Barat, 2022). Melon is one of the agricultural commodity products that has a fairly high economic value and a fairly large market both domestically and abroad, high demand for melon exports comes from England, Germany, France, the Netherlands, and Sweden. Potential market targets for melons themselves include Japan and Singapore (Pradipta & Firdaus, 2015).

Indonesia itself is an agricultural country that has a fairly important role in the development of the national economy, and also the majority of the Indonesian population has a livelihood as farmers or is involved in agriculture. The agricultural sector plays a role as the largest contributor to the Gross Domestic Product (GDP), contributing to the absorption of labor and also contributing to exports (Prabowo, 1995). Melon is one of the horticultural plants of the fruit type which is included in the gourd tribe or Cucurbitaceae family. This plant is cultivated in the lowlands and highlands with an altitude of 200 to 2000 above sea level. The temperature needed to grow ranges from 12 ° C to 35 ° C with 10 to 12 hours of sunlight per day and requires rainfall of 166.6 mm to 200 mm per month. Melon varieties developed in Indonesia have a variety of types, there are net types (netted skin), no net (skin without a net), and rock melon (netted skin with colored fruit flesh). These three types of varieties can adapt well to agroclimatic conditions in Indonesia (Daryono B S, 2018).

The problem with melon cultivation in the field is that it requires intensive maintenance, is susceptible to pests and diseases, uses less efficient nutrients, is sensitive to weeds, has less controlled growth, and is less than optimal basil. The above problems can be overcome by hydroponic techniques. In hydroponic techniques, environmental resources are easier to control and the results obtained are more satisfying compared to conventional cultivation, especially in open fields (Lee *et al.*, 2021; Sumarni *et al.*, 2023). Smart Green House (SGH) of Jember State Polytechnic is one of the units of the Teaching Factory (TEFA) which is engaged in the cultivation of fresh fruit plants, especially melon commodities. The melon cultivation system applied at SGH of Jember State Polytechnic is diverse, including hydroponic, semi-hydroponic, and conventional systems. The types of melons cultivated are Red Aroma, Dainty, Kiranti, Orange Melody, Orange Queen, and Honey Dew, Honey Globe. The products produced are mostly distributed to the local market as well as some to markets outside the region.

Amino acids are proteins that have been broken down through the metabolic process into small molecules. In addition to humans, plants also need amino acids to increase yields and overall quality. As reported by Priya Chemicals, plants synthesize amino acids from primary elements such as carbon and oxygen which are absorbed through air, water and soil. These primary elements form carbohydrates through the process of photosynthesis and combine them with nitrogen elements to form amino acids (De Mello *et al.*, 2001; L. Niam *et al.*, 2015).

According to Fatma, (2017) amino acids are any organic compounds that have carboxyl (-COOH) and amine (usually -NH2) functional groups. In biochemistry, the definition is often narrowed: both are bound to the same carbon atom (C) (called the "alpha" or α C atom). The carboxyl group provides acidic properties and the amine group provides basic properties. In solution form, amino acids are amphoteric: they tend to be acidic in basic solutions and basic in acidic solutions. This behavior occurs because amino acids can become zwitterions. Amino acids are among the most widely studied compounds because one of their functions is very important in organisms, namely as a protein component. Therefore, it is very suitable as a Melon plant fertilizer to produce high-quality Melon fruit, because Melon fruit has a very high economic value. Why are Amino Acids chosen as one of the most important elements of fertilizer to fertilize plants? Amino Acids have the following functions: Increase immunity due to stress (after pest attacks, extreme temperatures, moving/shipping seedlings), Help increase the amount of chlorophyll and photosynthesis process, Help the growth of young leaves and help open stomata (leaf mouths), The main source for binding microelements, Accelerate hormone growth, Help pollination and fruit set, improve fruit quality (content, aroma, and durability), Help soil microbes to convert raw elements into elements absorbed by plants, Increase plant and soil productivity. The purpose of the study was to determine the growth of melons against the administration of various doses and to determine the most effective concentration of amino acids to affect the growth and production of melons.

METHODS

Study site

This research was conducted from June 10, 2022, to October 4, 2022, at the Smart Green House (SGH) of Politeknik Negeri Jember, Sumbersari District, Jember Regency, East Java Province (Figure 1.).

Figure 1. Research site

Tools and materials

The tools needed in the study were hoes, scissors, cardboard (artificial germination), lamps, 20 cm x 40 cm polybags, cloth meters, trellises, TDS and EC meters, Brix refractometers, digital scales, trays, pot trays, buckets, reservoirs, drip irrigation devices, hand sprayers, and stationery.

The materials used in this study were Honey Globe melon seeds, Confidor and Demolish insecticides, Zephyr +

fungicides, Amino Plant, parchment paper, clear plastic, water, AB mix, and cocopeat.

Data analysis

This study was conducted using the Completely Randomized Design (CRD) method using a hydroponic system at the Smart Green House of Jember State Polytechnic. In this study, hydroponic melon cultivation was supplemented with the provision of amino plants with a spray system with the following concentrations:

P0: Without Amino Plant
P1: Amino Plant 4 mg/L
P2: Amino Plant 8 mg/L
P3: Amino Plant 12 mg/L

This study consisted of 4 treatments; each treatment was repeated 5 times with 3 plants per treatment unit so that the total number of plants was 60 plants. The data in this study will be analyzed using the F Test analysis.

Observation parameters

Vegetative phase

1. Plant Height (cm). Plant height is measured by measuring using a cloth meter. Measurements are taken from the base of the stem to the growing point. Observations of plant height are taken when the plants are 14-42 DAP (Days After Planting) old, which are taken once a week on each plant.
2. Number of leaves (strands). The number of leaves is counted manually. Observations of the number of leaves are taken when the plants are 14-42 DAP (Days After Planting) old, which are taken once a week on each plant.

Generative phase

1. Number of female flowers per branch (fruit). Observation of the number of female flowers on melon plants is done by counting all female flowers from branches 9-20 found on melon plants. Female flowers are characterized by the presence of fruit ovaries under the flower petals.
2. Number of Female Flowers that Become Fruit per Sample Plant (fruit). Observation of the number of female flowers that become fruit is done when the female flowers have gone through the pollination process. Female flowers that have been pollinated are marked by the wilting of the flower crown on the female flower.
3. Fruit Weight per Sample Plant (kg). Observation of melon fruit weight is done during harvesting. Observation of fruit weight is done by weighing using a digital scale on each sample plant.
4. Fruit Diameter per Sample Plant (cm). Observation of fruit diameter is done during harvesting. Observation of the size of the fruit diameter is done using a cloth meter on each sample plant.
5. Sweetness Level (brix) per Sample Plant (%). Observation of the sweetness level of melon fruit is done during harvest. This observation is done using a tool called a Brix Refractometer. Checking the sweetness level is done by taking a little melon flesh and then inserting it into the tool on each sample plant.
6. The thickness of Fruit Flesh per Sample Plant (cm). Observation of the thickness of the fruit flesh is done during harvest. Observation of the thickness of the fruit flesh is done by splitting the melon and then measuring it using a cloth meter.
7. Thickness of Fruit Skin per Sample Plant (cm). Observation of the fruit skin is done during harvest. Observation of the thickness of the melon skin is done by splitting the melon and then separating the fruit flesh from the fruit skin. After that, measure it using a cloth meter.

RESULTS AND DISCUSSIONS

Table 1 presents the recapitulation results of the F test on various observation parameters carried out on plants in various weeks after planting (WAP). This F test aims to determine whether there is a significant effect of the treatment given on plant growth and yield, which is indicated by parameters such as plant height, number of leaves, number of female flowers, and fruit yield components such as weight, diameter, sweetness level, flesh thickness, and fruit skin thickness. The calculated F value is compared with the F table value at the 5% and 1% significance levels to determine the level of significance of the treatment effect.

Based on the results presented in Table 1, all observation parameters exhibited calculated F values that were lower than the critical F values from the F table at both the 5% and 1% significance levels. This is indicated by the notation "ns" (not significant), suggesting that statistically, the treatments applied did not result in a significant difference in plant growth and yield across all measured variables. In other words, within the confidence intervals set for this experiment, the variations observed among treatment groups could be attributed to random variation rather than the treatment effect itself. However, it is important to emphasize that despite the lack of statistical significance, several parameters—when examined more closely, including through graphical representations of the data—showed observable numerical differences in mean values between the amino acid treatment group and the control group.

These numerical trends, although not statistically significant, suggest a potential biological response to the amino acid application. Such patterns may warrant further investigation, perhaps with a larger sample size, longer observation period, or more refined treatment dosages, to determine whether these preliminary indications could translate into statistically verifiable outcomes in future studies.

Table 1. Recapitulation Results of F Test

Observation Parameter	F count	F table (5%)	F table (1%)
Plant height at 2 WAP	2.48ns	3.24	5.29
Plant height at 3 WAP	2.65ns	3.24	5.29
Plant height at 4 WAP	0.70ns	3.24	5.29
Plant height at 5 WAP	0.98ns	3.24	5.29
Plant height at 6 WAP	1.44ns	3.24	5.29
Number of leaves at 2 WAP	0.90ns	3.24	5.29
Number of leaves at 3 WAP	2.16ns	3.24	5.29
Number of leaves at 4 WAP	1.10ns	3.24	5.29
Number of leaves at 5 WAP	1.29ns	3.24	5.29
Number of leaves at 6 WAP	0.39ns	3.24	5.29
Number of female flowers at 4 WAP	0.44ns	3.24	5.29
Number of female flowers at 5 WAP	1.15ns	3.24	5.29
Number of female flowers becoming fruit at 5 WAP	1.01ns	3.24	5.29
Fruit weight per sample plant	1.40ns	3.24	5.29
Fruit diameter per sample plant	1.01ns	3.24	5.29
Sweetness level (Brix) per sample plant	1.19ns	3.24	5.29
Flesh thickness per sample plant	0.70ns	3.24	5.29
Rind thickness per sample plant	2.40ns	3.24	5.29

Notes: (*): Significantly different, (**): Highly significantly different, (ns): Not significantly different

Plant height (cm)

Plant height observations were carried out when the plants were 14 DAP old and were observed once a week until the plants were 42 DAP old. Plant height observations were carried out starting from the base of the stem to the growing point using a meter. Based on Figure 2, the P2 treatment showed the highest average value at 2 MST, namely 23.80 cm, at 3 MST P2 obtained the highest data, 67.53 cm, at 4 MST P2 obtained the highest data, namely 139.40 cm, at 5 MST P2 obtained the highest data, 222.67 cm and at 6 MST P2 obtained the highest data, namely 292.00 cm.

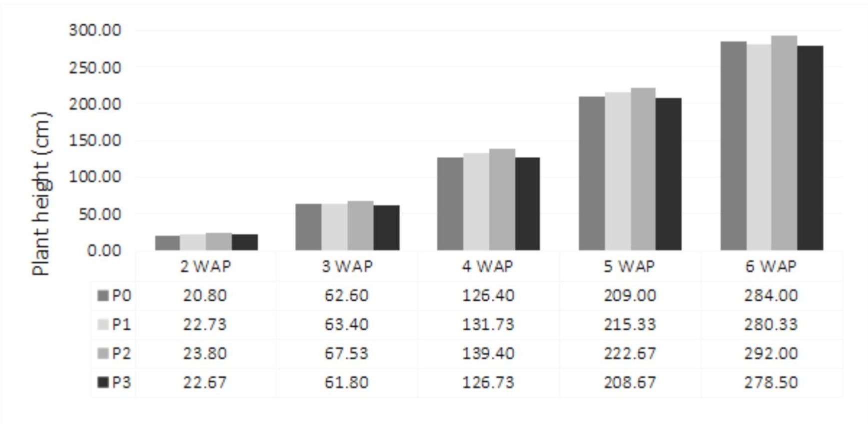

Figure 2. Average height of melon plants (cm)

Number of leaves (pieces)

Observations on the number of leaves were carried out when the plants were 14 days after planting (DAP) and continued weekly until the plants reached 42 DAP. The data collection was conducted manually by counting the leaves on each plant. At 2 weeks after planting (WAP), all treatments showed a similar average number of leaves, which was 6. However, starting from 3 WAP, differences began to emerge between treatments. At 3 WAP, treatment P2 recorded the highest average number of leaves at 14. This trend continued at 4 WAP, where P2 again showed the highest leaf count of 29. By 5 WAP, P2 maintained its dominance with 51 leaves. Interestingly, at 6 WAP, the highest number of leaves was observed in treatment P3, which reached an average of 59 leaves. These results indicate dynamic growth responses among treatments over time, with P2 showing early vigor and P3 demonstrating superior leaf development in the later stages of observation.

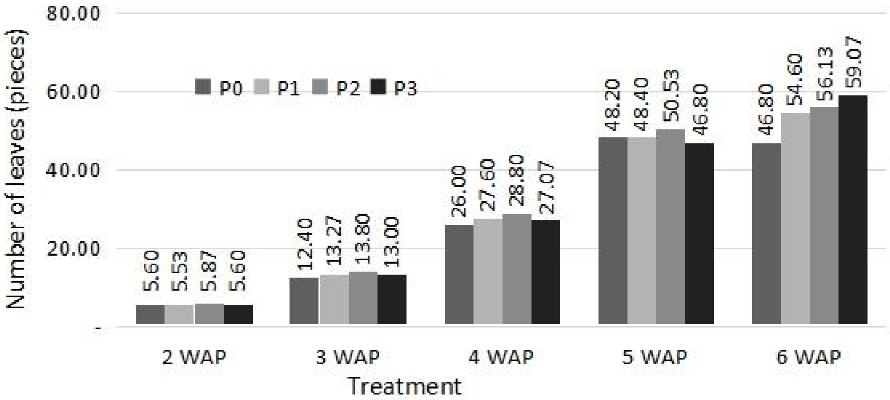

Figure 3. Average number of leaves (pieces)

Number of female flowers per sample plant (flower)

Observation of the number of female flowers was carried out when the plants were 28 DAP and observed once a week until the plants were 35 DAP. Observation of the number of female flowers was carried out by counting all the female flowers from branches 9 - 20. Based on Figure 4 above, it can be seen that the results of observing the number of female flowers in P2 obtained the highest data from 4 WAP with 3 flower, while at 5 WAP there were 8 flower in P1, compared to other treatments.

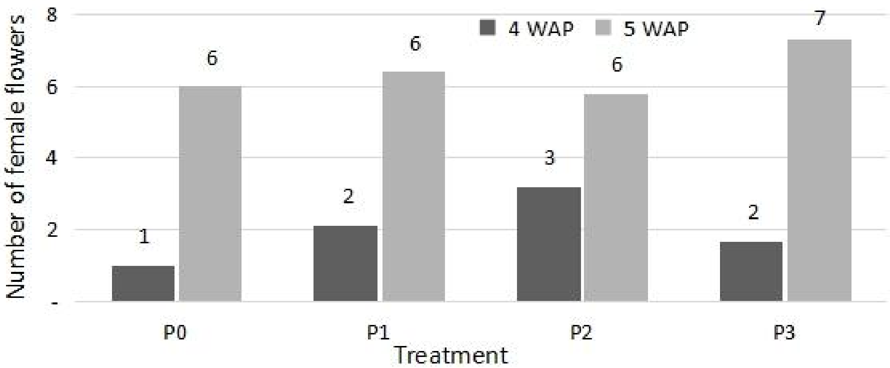

Figure 4. Average number of female flowers (fruit)

Number of finished female flowers per sample plant (fruit)

Observation of the number of female flowers was carried out when the plants were 35 DAP and observed once a week. Observation of the number of female flowers is carried out when the pollination process has been carried out and then marked by the wilting of the female flowers. Based on Figure 5, the observation results show that the P2 treatment produced the highest average number of mature fruits (3.53 fruits per sample plant) compared to other treatments.

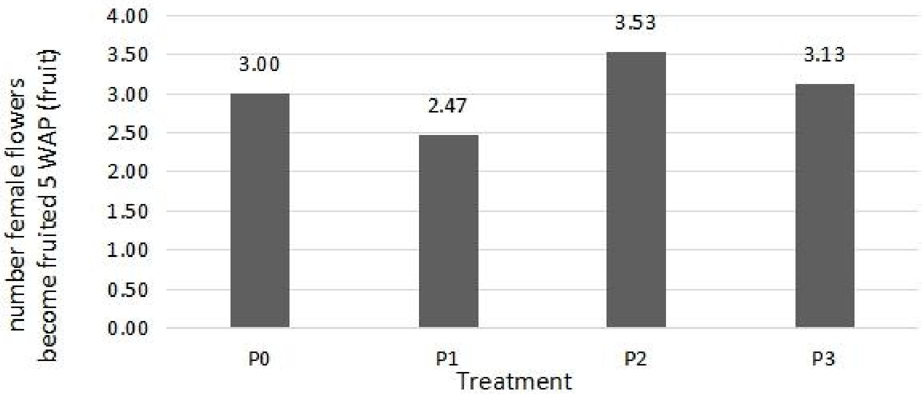

Figure 5. The average number of female flowers that become fruited (fruit)

Fruit weight per sample plant (kg)

Observation of fruit weight was carried out when the melons were harvested. Observations were made by weighing the fruit of each plant using a digital scale. From observations of fruit weight, P2 obtained the highest data of 1.38 kg and P0 obtained the lowest data of 1.18 kg.

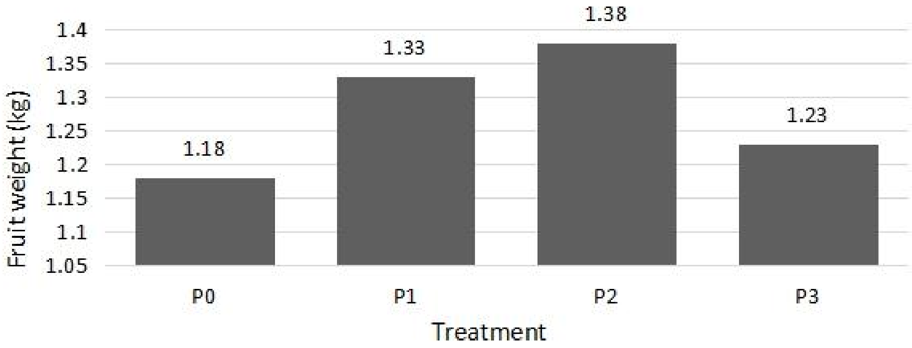

Figure 6. Results average fruit weight (kg)

Fruit diameter per sample plant (cm)

Observation of fruit diameter is carried out when the melons have been harvested. Observations were made by splitting the fruit and then measuring it with a cloth meter. From observations of fruit diameter, P1 obtained the highest data of 14.10 cm and P0 obtained the lowest data of 11.69 cm.

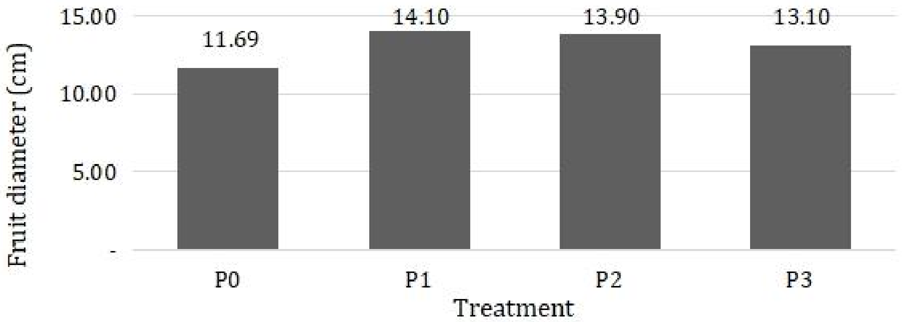

Figure 7. Results of average fruit diameter (cm)

Sweetness level Brix per sample plant (%)

Observation of the sweetness level Brix of the fruit is carried out when the melons have been harvested. Observation of the sweetness level is carried out using a tool called a Refractometer Brix by taking a small amount of melon flesh and then inserting it into the tool for each sample plant. The results of observing the sweetness level of fruit P1 obtained the highest data of 12.90 brix and P0 obtained the lowest data of 10.33 brix.

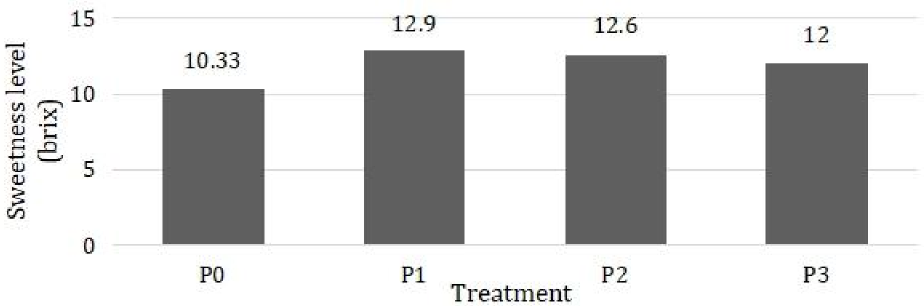

Figure 8. Results of average sweetness level brix

Fruit flesh thickness per sample plant (cm)

Observation of the thickness of the fruit flesh was conducted at harvest time, when the melons had reached physiological maturity. The measurement was performed by splitting the melon fruits and measuring the thickness of the flesh using a cloth meter to ensure accuracy and consistency. Based on the results, treatment P1 produced the highest average fruit flesh thickness of 2.58 cm. Meanwhile, treatments P2 and P3 showed slightly lower but identical results, with an average thickness of 2.56 cm. These findings indicate that all treatments produced melons with relatively similar flesh thickness, with P1 showing a slight advantage in this parameter.

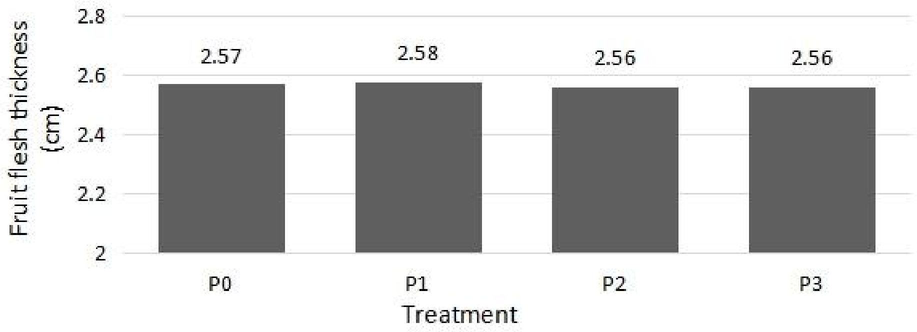

Figure 9. Average results of Fruit flesh thickness (cm)

Fruit skin thickness per sample plant (cm)

Observation of the thickness of the fruit skin was carried out by cutting the melon fruit and then separating the flesh from the skin. After that, measurements were taken using a cloth meter. From the results of observations of the diameter of the fruit skin, P3 obtained the highest data of 0.80 cm and P2 obtained the lowest data of 0.60. According to Obando *et al.* (2008) which was carried out with watermelon as the object, it was stated that fruit ripening affects the physical and mechanical properties of watermelon. Increased mass, size, surface, and roundness values and decreased bulk density, fruit length-width ratio, grain length-width ratio, water content, and elasticity index were found in both types of watermelon during ripening. Several aspects experienced significant changes during the second and third ripening.

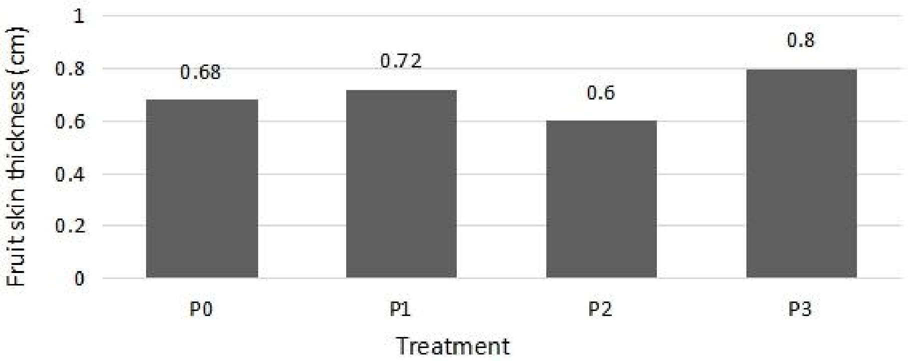

Figure 10. Graph of average skin thickness results (cm)

The ANOVA results (Table 1) show that the amino acid spray application technique had a non-significant (ns) effect on all observed parameters. Melon plants require adequate nutrients during both the vegetative and generative growth phases. The most essential nutrients for melon cultivation are nitrogen (N), phosphorus (P), and potassium (K) (Kering et al., 2013; Yuan et al., 2017). Amino acids in plants consist of 55% amino acids and 45% crude protein (Syukur, 2021). Amino acids also serve as nutrients for soil microbes. The application of amino acids to the soil can enhance the activity and population of beneficial microorganisms. Balanced and active microbial populations improve the mineralization of organic matter in the soil, thereby increasing soil fertility (Kering et al., 2013; Tellez & Merino, 2012; Wibowo & Suhastyo, 2023). Nitrogen is a nutrient that contributes to increasing plant height (Pertami et al., 2024; Wilujeng et al., 2024), and it also influences the growth of stems, branches, and leaves. Christy (2020) and Huda et al. (2018) further stated that nitrogen affects the formation of leaf and shoot organs.

The element Nitrogen (N) is a macronutrient that plays a role in plant growth. Nitrogen nutrients are needed for the growth of vegetative parts of plants, namely leaves, stems, and roots, such as green leaf color, leaf length, leaf width, stem height, and stem size(Liu *et al.*, 2019; Mahmud, 2018). Nitrogen nutrients function to increase plant chlorophyll and increase leaf growth. The nitrogen element has advantages and disadvantages. The advantage of the nitrogen element in plants is that the leaves and stems produced by the plant are large in number, and the stems are weak and prone to collapse. Meanwhile, there is a lack of nitrogen, namely yellowing of plant leaves chlorosis and stunted plant growth (Kusparwanti *et al.*, 2023).

Research by Kering *et al.*, (2011), stated that fruit weight can be influenced by the availability of macro (N, P, K, Ca, Mg, and S) and micro (Cu, Zn, Fe, B, Mo, Mn, Cl nutrients. Which is needed by plants for plant physiological processes, so that it can activate meristematic cells and facilitate photosynthesis in leaves. Fruit diameter is greatly influenced by the shape of the fruit, the larger the size and weight of the fruit, the greater the fruit diameter. According to Budiman (2004), the availability of sufficient nutrients during growth causes plant metabolism to be more active so that the process of cell division, elongation, and differentiation will be better and will encourage an increase in fruit diameter. The plants experienced wilting after treatment when the plants were 50 DAT which was affected by giving AB Mix not to be measured but only by time, possibly due to excessive fertigation of nutrients. Nutrients that are too low will show deficiency symptoms resulting in imperfect plant growth, while excessive nutrient concentrations will cause phytotoxicity (Ouzounidou *et al.*, 2008).

CONCLUSION

So, from the results of data processing, the conclusion shows that administering Amino Plant at doses of 4, 8, and 12 mg/l gave non-significantly different results ns on all parameters. The research results showed that there was no effective concentration on melon growth and production for all parameters. Melon plants need sufficient nutrients for the vegetative and generative phases. The nutrients most needed by melon plants are nitrogen (N), phosphorus (P), and potassium (K). On amino acids, the plant contains 55% amino acids and 45% crude protein

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