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Effects of super absorbent polymer and different fertilizer rates on growth and fruit quality of melon (*Cucumis melo L.*) Cultivated in Ultisol Soil

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Abstract

Melon (*Cucumis melo L.*) is a high-value horticultural commodity, yet its productivity on drylands like Ultisols is strictly limited by low water-holding capacity and severe nutrient leaching, particularly during the rainy season. This study evaluated the effects of Super Absorbent Polymer (SAP) application and different macro-nutrient fertilizer rates on soil properties, growth, yield, and fruit quality of melon cultivated on Ultisol soil. The experiment was conducted from September 2025 to April 2026 in Gelumbang, South Sumatra, Indonesia. A Randomized Complete Block Design (RCBD) with two factors was employed: SAPs dosage (A0: SAP 0 g plant^{-1}; A1: SAP 3 g plant^{-1}) and macro essential fertilization rates (B0: 0%, B1: 25%, B2: 50%, B3: 75%, and B4: 100% of recommended dose). The results demonstrated that SAPs application significantly enhanced vegetative growth parameters plant length and stem diameter from 4 to 6 weeks after planting (WAP). A significant interaction was observed regarding fruit weight, the combination of 3 g SAPs and 75% fertilizer dose (A1B3) produced the highest fruit weight and optimal fruit quality of Brix, outperforming the 100% fertilizer application without SAPs. These findings suggest that SAP improves nutrient retention and fertilizer use efficiency by reducing nutrient losses through leaching.

Keywords: Melon Cultivation; Nutrient Management; Super Absorbent Polymer; Sustainable Agriculture; Ultisols

1. Introduction

Melon (*Cucumis melo L.*) is an exotic fruit plant that originates from the tropical and subtropical regions of Asia. Currently, melon cultivation has rapidly developed and spread to the continents of Europe and America [1]. Melon is chosen as a priority horticultural fruit commodity because it has a high market value and increasing demand in line with public awareness of fresh fruit consumption [2]. Melon as Cucurbitaceae family plant requires good soil aeration conditions but is very sensitive to water deficit stress [3]. The low productivity of melons at the farmer level is often caused by the inability of the soil to consistently provide water and essential nutrients during the critical phases, namely the vegetative and fruit formation phases [4][5]. In dry land such as Ultisol, the imbalance in water supply causes physiological disturbances that directly impact the reduction in tonnage and total dissolved solids (brix).

One of the strategies implemented to address the issues of nutrient deficiency and drought stress in several countries around the world in the agricultural sector is the application of Super Absorbent Polymer (SAP). Potassium Polyacrylate-based polymers have a high-water absorption capacity, capable of absorbing and retaining water up to 300–500 times their dry weight [6]. This polymer is a soil amendment that can enhance the soil's capacity to retain water and improve the efficiency of nutrient use from fertilizers for plants [7].

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Based on previous research [8], Super Absorbent Polymers (SAP) in Agriculture functions as a soil conditioner capable of enhancing drought resistance through groundwater storage and improving soil fertility quality through the slow-release fertilizer mechanism. In addition, the application of various fertilizer formulations is also essential in melon cultivation to provide nutrients during the vegetative and generative phases of the melon. The combination of SAP and various fertilizer formulations has been proven to significantly enhance horticultural plant cultivation. The treatment combination of essential macro fertilizers and SAP was able to produce the highest corn yield of 3,274.4 kg/ha and an increase in water use efficiency of 24.53 kg/ha/mm [9].

In Ultisol soil with low water retention capacity, the application of high doses of fertilizer often triggers a high rate of nutrient leaching before being absorbed by plants, especially under conditions of high rainfall. Until now, scientific information regarding the specific interaction between SAP doses and the efficiency of various fertilizer dose combinations on soil characteristics and rainy season conditions is still very limited. Therefore, this research was conducted to determine the most appropriate SAP dose and fertilizer formulation so that the quality of soil physical properties can be improved and melon productivity increased

2. Material and methods

2.1. Place and Time of Research

The research was conducted in Kampung III, Gelumbang District, Muara Enim Regency, South Sumatra. Geographically, the research location is situated at coordinates 3°14'47.4" S and 104°26'29.7" E. This area is part of a dry land expanse dominated by the Ultisol soil order. In general, the research location is situated in a lowland area with a slope gradient between 0-14% and an elevation of 40-60 meters above sea level.

2.2. Research Material

The tools used in this research include: 1. Hoe; 2. Hand sprayer; 3. Measuring tape; 4. Caliper; 5. Hand refractometer; 6. Analytical balance; 7. GPS; 8. Camera; 9. Soil sample ring; 10. Seedling tray; and 11. Soil laboratory analysis equipment. Meanwhile, the materials used in this research include: 1. Melon seeds; 2. Soil samples; 3. NPK fertilizer (16:16:16); 4. KCl fertilizer; 5. MKP fertilizer; 6. Calcium nitrate boron (Nitrabor); 7. Manure; 8. Agricultural lime; 9. Plastic mulch; 10. Inorganic pesticides; and 11. Super Absorbent Polymer (SAP).

2.3. Experimental Design

The experimental design used in this study is a Factorial Randomized Block Design (FRBD) with: Factor I being the dose of Super Absorbent Polymer (SAP):

- A0 : Super Absorbent Polymer (SAP) dose 0 gram/plant (Control)
- A1 : Super Absorbent Polymer (SAP) Dose 3 gram/plant.

Factor II being the dose of essential macro nutrient fertilizers:

- B0 : NPK 16-16-16 + NPK 15-09-20 + Nitrabor + MKP + KCl Fertilizer Dose 0% (Control)
- B1 : NPK 16-16-16 + NPK 15-09-20 + Nitrabor + MKP + KCl Fertilizer Dose 25 %
- B2 : NPK 16-16-16 + NPK 15-09-20 + Nitrabor + MKP + KCl Fertilizer Dose 50 %
- B3 : NPK 16-16-16 + NPK 15-09-20 + Nitrabor + MKP + KCl Fertilizer Dose 75 %
- B4 : NPK 16-16-16 + NPK 15-09-20 + Nitrabor + MKP + KCl Fertilizer Dose 100 %

The experiment was arranged in a factorial randomized complete block design with three replications, resulting in 30 experimental units. The experiment was conducted in plots measuring 2 m × 2 m. Three representative plants were selected as sample plants from each plot, resulting in a total of 90 sample plants across all experimental units.

2.4. Field Research Procedures

2.4.1. Soil Analysis Before Planting

Undisturbed soil samples were collected using a soil core ring sampler to preserve the natural soil structure. These samples were used for the analysis of soil physical properties, including field capacity moisture content, bulk density, and total porosity. Disturbed soil samples were subsequently collected using a Belgian auger at a depth of 0–20 cm. During the preliminary stage of the study, composite soil samples were obtained following a zig-zag sampling pattern by combining five subsamples from each replication. The composite soil samples were used to determine the initial soil fertility status prior to the experiment.

2.4.2. Seed Preparation and Sowing

The germination stage begins with soaking the seeds in warm water for 1x24 hours. The seeds selected for sowing are the ones that sink during the soaking process. The seeds are then sown in a special pot tray as the growing medium, which is placed in the nursery location and covered [10]. Seedling care is carried out by watering with clean water twice a day, in the morning and evening. The seedlings are ready to be transplanted to the field at 5–7 days after sowing.

2.4.3. Application Super Absorbent Polymer (SAPs)

The application of Super Absorbent Polymer (SAP) at a dose of 3 grams per planting hole or a total of 360 grams per planting season. SAP in the form of granules sized 20 – 80 mesh (0.2 – 0.8 mm) is dissolved in 500 ml of water and evenly mixed with the soil in the top layer around the root zone at a depth of 5 to 20 cm around the planting hole [11]. This application aims to stimulate root hair growth and maximize nutrient absorption during the vegetative phase. Subsequently, the experimental plot will be covered with black-silver mulch plastic.

2.4.4. Planting

The melon seedlings that have been sown will then be planted in the prepared planting holes. According to Gois et al., (2020) The seedlings that are ready for planting are those that are 8 to 10 days old after sowing and have 3 to 4 true leaves. The planting of seedlings is done in the afternoon from 3:00 PM to 6:00 PM WIB to reduce plant stress.

2.4.5. Fertilization

Fertilizer is applied using a manual fertigation drip system at the planting holes. The volume of fertilizer solution application is 200 ml per plant for each fertilization schedule, totaling 11 times. The concentration of fertilizer given is adjusted according to the Treatment Factor of fertilizer dosage at levels ranging from 0% to 100%.

2.4.6. Maintenance

Plant maintenance includes weed control and Plant Disturbing Organisms (PDO). Weed control is carried out mechanically through regular weeding around the plants. Meanwhile, for pest and disease control, an integrated method is applied by combining the application of chemical pesticides with active ingredients such as Abamectin (whiteflies, thrips, and other insect pests), Azoxystrobin, and Difenoconazole (leaf spots/dew), interspersed with physical control, adjusted according to the intensity of the attack in the field [12].

2.4.7. Harvest

Melon harvesting is done after the plants are approximately 58-64 days old. Melons that are ready for harvest are those that have released a distinctive aroma and have a yellowish skin color. At the harvesting stage, the melon fruit stems are cut with a knife or scissors, leaving at least 2 cm of the stem to extend the fruit's shelf life [13].

2.5. Observation Parameters

The observation parameters in this study include Plant Height (cm), Stem Diameter (cm), Weight Per Fruit (g), Fruit Circumference (cm), Fruit Diameter (cm), Total Dissolved Solids (%), Number of Fruits Per Plot, and Yield per Plot (g).

2.6. Data Analysis

The observational data were analyzed using ANOVA (Analysis of Variance) to test the independent treatment effects and whether there is an interaction between SAP doses and various fertilizer formulations on the observed variables. If the analysis of variance results shows a significant effect (F calculated > F table 5%), the analysis will continue with the Least Significant Difference (LSD) test at the 5% level to compare treatment means. Statistical analysis will use Excel and R Studio software.

3. Results and discussion

3.1. Soil Physical and Chemical Properties Before Experiment

Soil texture analysis in the soil laboratory at a depth of 0-30 cm has a sand fraction content of 86.4%, clay 9.6%, and silt 4.0%, so it is included in the loamy sand texture class. Meanwhile, at a depth of 31-60 cm, the content of sand 74.4%, clay 13.6%, and silt 12.0% is classified as a sandy loam texture class. The soil water content is 25.39%, bulk density 1.72 g cm^{-3}, and total pore space 35.22%.

Analysis of soil chemical properties showed that the research soil reacted very acidic with a pH of 4.45 H_2O and a pH of 4.42 KCl. The organic carbon content was low (1.79%), while the cation exchange capacity (CEC) was in the moderate category, namely 17.21 me (100 g) $^{-1}$. The total nitrogen content of 0.45% was classified as moderate, the available phosphorus content of 4.99 ppm was classified as very high, while the extra potassium content of 3.01 me $(100\ g)^{-1}$ was classified as very low. The base cation content of Ca and Mg was in the moderate category, while Na was classified as low. The base saturation value (BCC) of 17.84% indicated low soil fertility status. In general, the research soil conditions were characterized by high acidity levels, low organic matter content, and suboptimal availability of several nutrients, so efforts were needed to improve soil fertility to support the growth and productivity of melon plants.

3.2. Plant Height (cm)

Based on the observation results and analysis of variance (ANOVA) in Table 1, it shows that Super Absorbent Polymer (SAP) and various fertilizer doses in the 2nd week did not have a significant effect on plant height. However, the application of Super Absorbent Polymer and essential macro-nutrient fertilizers affected plant height from the 3rd to the 6th week.

Table 1 Average plant height of melon plants aged 2-6 weeks after planting with Super Absorbent Polymer (SAP) treatment and essential macro nutrients

Treatment	Plant height (cm)				
	Weeks-				
	2 (WAP)	3 (WAP)	4 (WAP)	5 (MST)	6 (MST)
A0 (SAP 0 g $plant^{-1}$)	6.84	14.91	53.20 b	94.10 b	106.52 b
A1 (SAP 3 g $plant^{-1}$)	7.3	15.20	59.18 a	102.05 a	115.78 a
LSD 0.05	-	-	4.74	4.84	4.93
B0 (Fertilizer dose 0%)	6.92	81.00 c	51.14 c	86.84 b	99.31 b
B1 (Fertilizer dose 25%)	7.43	87.70 bc	51.84 c	91.97 b	104.39 b
B2 (Fertilizer dose 50%)	6.57	92.83 ab	60.59 ab	106.96 a	121.06 a
B3 (Fertilizer dose 75%)	7.21	99.60 a	62.90 a	110.72 a	124.96 a
B4 (Fertilizer dose 100%)	7.22	90.57 b	54.47 bc	93.89 b	106.05 b
LSD 0.05	-	1.20	7.49	7.66	7.80

Note: Numbers followed by the same letter indicate that the results are not significantly different in the least significant difference test (LSD 5%); WAP (Weeks After Planting); - No further tests conducted

The plant height in the second week showed that neither the SAP treatment nor the various fertilizer doses had a significant effect on the plant height component. In the third week, the SAP treatment had not yet shown a significant effect, but the fertilizer dose had a very significant effect on B3 fertilizer (75% fertilizer dose), followed by B4 (100% fertilizer dose), B2 (50% fertilizer dose), B1 (25% fertilizer dose), and B0 (control). In the fourth week, the SAP treatment at A1 (3 grams per planting hole) had a significant effect, and various fertilizer formulations also had a significant effect, with the most significant effect from B3 (75% fertilizer dose), followed by B2 (50% fertilizer dose), B4 (100% fertilizer dose), B1 (25% fertilizer dose), and B0 (control). From the fifth to the sixth week, the SAP at A1 (3 grams per planting hole) still had a very significant effect, and various fertilizer formulations also had a significant effect, with the most significant effect from B3 (75% fertilizer dose), followed by B2 (50% fertilizer dose), B4 (100% fertilizer dose), B1 (25% fertilizer dose), and B0 (control).

Figure 1 Visual condition of the plants in Weeks 1-6 after transplanting

Super Absorbent Polymer is highly capable of increasing plant productivity by maintaining the availability of water and nutrients in the root zone, reducing fertilizer leaching, and improving soil porosity [14]. In the condition of the plants in Week 4 to Week 6, where the roots have developed optimally, the plants can maintain the process of photosynthesis and growth even during the rainy season [15]. The role of NPK 16-16-16 fertilizer and Nitrabor boron nitrate in the 3rd week has a significant impact during the vegetative phase, as nitrogen is needed by plants for cell division and stem elongation. Dose B3 (75% fertilizer dose) was the best treatment until Week 6 and was superior to the highest dose B4 (100% fertilizer dose), indicating that the use of SAP helps improve nutrient absorption efficiency, so a 25% reduction in dose is actually sufficient to meet the plant's needs compared to the 100% fertilizer dose. The application of nutrient doses at medium levels has been proven to result in more optimal growth compared to maximum doses because nutrients are absorbed efficiently without reaching toxic levels for the root environment [16].

3.3. Stem Diameter

Based on the ANOVA analysis results, the application of Super Absorbent Polymer in the 2nd week has not yet had a significant effect on the plant stem diameter. The treatment with NPK 16-16-16 and Nitrabor fertilizers also did not show any significant effect in the early weeks (Table 2).

The effect became apparent in the 4th and 6th weeks after planting. The treatment of SAP at a dose of 3 grams (A1) in the 4th week resulted in an average stem diameter of 8.42 mm, which was higher than the control treatment (A0). The application of fertilizer at a 75% dose level (B3) also resulted in the highest stem diameter with an average of 8.76 mm, significantly higher than the highest dose and the control dose. Furthermore, in the 6th week, SAP also had a significant effect, resulting in the highest average diameter of 14.25 mm, which was higher than without SAP (A0), which only produced an average of 13.39 mm. The NPK 16-16-16 fertilizer treatment in the 6th week also showed a significant effect, where the 75% dose (B3) consistently produced the largest stem diameter compared to other treatments. Although statistically B1 to B4 are in the same group, meaning they are not significantly different, the average of the B3 (75%) fertilizer dose still shows the highest figure at 15.46 mm. This indicates a better nutrient use efficiency. The presence of SAP means that the nutrients from the fertilizer can be released slowly or based on the principle of slow-release fertilizer, thereby meeting the plant's needs without causing salinity stress, which often occurs with high-dose fertilizer application. The application of Super Absorbent Polymer in agriculture functions to enhance plant growth and yield by providing water and nutrients sustainably [17].

Table 2 Average stem diameter of melon plants aged 2-6 weeks after planting with Super Absorbent Polymer (SAP) treatment and essential macro nutrients

Treatment	**Stem Diameter (mm)**		
	Weeks-		
	2 (WAP)	**4 (WAP)**	**6 (WAP)**
A0 (SAP 0 g plant^{-1})	4.22	8.02 b	13.39 b
A1 (SAP 3 g plant^{-1})	4.40	8.42 a	14.25 a
LSD 0.05	-	0.31	0.80
B0 (Fertilizer dose 0%)	4.06	7.71 c	11.34 c
B1 (Fertilizer dose 25%)	4.23	8.12 bc	13.70 b
B2 (Fertilizer dose 50%)	4.28	8.34 ab	14.52 ab
B3 (Fertilizer dose 75%)	4.45	8.76 a	15.46 a
B4 (Fertilizer dose 100%)	4.57	8.19 bc	14.11 b
LSD 0.05	-	0.50	1.27

Note: Numbers followed by the same letter indicate that the results are not significantly different in the least significant difference test (LSD 5%); WAP (Weeks After Planting); - No further tests conducted

3.4. Fruit Weight

Based on the results of the ANOVA analysis in Figure 2, the application of SAP treatment (A1) has been proven to significantly increase the average fruit weight compared to the control treatment (A0). In addition, the difference in fertilizer formulations also had a significant impact, with treatment B3 consistently yielding the most optimal fruit weight. Figure 2 shows a mutually supportive interaction between SAP application and the formulation of various types of fertilizers given. The combination of treatment A1B3 has the highest average fruit weight, which is 2,210.33 grams. Meanwhile, plants without SAP application with fertilizer doses of 75% (A0B3) and 100% (A0B4) are not statistically different from plants without SAP with low fertilizer doses, namely treatments A0B1 (1,324.78 grams) and A0B2 (1,467.67 grams).

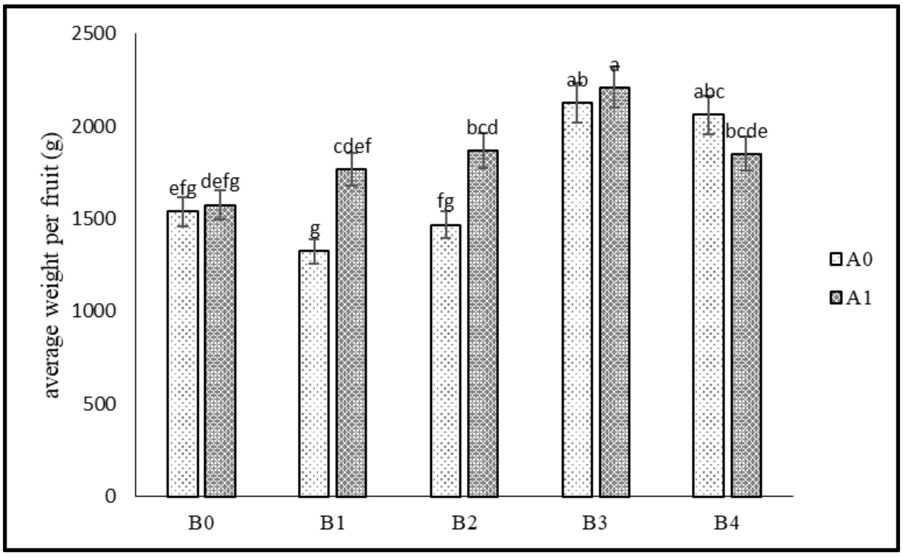

Figure 2 Interaction of average fruit weight per treatment of Super Absorbent Polymer (SAPs) and various fertilizer formulations (LSD 0.05 = 227.75)

The application of 3 grams of SAP (A1) has a significant effect on the weight per fruit because SAP plays a role in improving fruit quality compared to the control treatment (A1). The improvement in the quality of melon production is very evident with the application of Super Absorbent Polymer Hydrogel [11]. The average weight of melons treated with a soil and aquasource-based SAP hydrogel mixture in a 3:0.15 ratio is between 3.3 Kg and 3.7 Kg. The significant fruit weight indicates that the application of SAP aids in the fruit enlargement process, and this is also because melons are plants that require a large amount of water, especially during the fruit enlargement phase [12].

The application of fertilizer during the fruit enlargement phase, specifically the NPK 15-09-20, MKP, and KCl formulations at a dosage level of 75% each, has a very significant effect on the weight per fruit. NPK 15-09-20 has a significant impact on fruit weight and fruit quality. Additionally, the Nitrabor fertilizer applied during this phase also aids in the fruit enlargement process and prevents melons from cracking [18]. The MKP fertilizer given in this phase also has a significant impact the P content obtained by the plants through MKP fertilizer greatly affects fruit weight, while the K content plays a role in the formation of sugars and starches and regulates the allocation of photosynthates to the fruit organs [19]. The positive combination of various types of fertilizers given during the fruit enlargement phase indicates that SAP plays a crucial role in minimizing nutrient leaching due to rainwater, thereby allowing the translocation of photosynthates to the fruit organs to occur optimally and resulting in maximum fruit biomass accumulation [20].

3.5. Fruit Circumference, Fruit Diameter, Total Soluble Solids (Brix)

The results of the analysis of variance show no interaction between Super Absorbent Polymer and macro nutrient fertilizers on Fruit Circumference, Fruit Diameter, and Total Soluble Solids (Brix). However, each treatment independently had a significant effect on the improvement of the internal quality of the fruit, although SAP had no effect on the total dissolved solids/brix (Table 3).

Table 3 Average Fruit Circumference, Fruit Diameter, and Total Soluble Solids (Brix) with Super Absorbent Polymer (SAP) treatment and essential macro nutrients

Treatment	**Fruit Circumference (cm)**	**Fruit Diameter (cm)**	**Total Soluble Solids (Brix)**
A0 (SAP 0 g plant^{-1})	48.50 b	15.05 b	14.46
A1 (SAP 3 g plant^{-1})	50.26 a	15.65 a	14.61
LSD 0.05	1.30	0.38	-
B0 (Fertilizer dose 0%)	47.17 b	14.91 b	9.04 b
B1 (Fertilizer dose 25%)	47.42 b	14.77 b	9.12 b
B2 (Fertilizer dose 50%)	48.02 b	14.97 b	9.88 ab
B3 (Fertilizer dose 75%)	53.00 a	16.34 a	10.60 a
B4 (Fertilizer dose 100%)	51.31 a	15.75 a	9.81 ab
LSD 0.05	2.06	0.60	0.70

Note: Numbers followed by the same letter indicate that the results are not significantly different in the Least Significant Difference Test (LSD 5%); - No further tests conducted.

The results of the analysis of variance and the 5% BNT test (Table 3) indicate that the Super Absorbent Polymer (SAP) treatment significantly affects fruit circumference and fruit diameter, but does not significantly affect total soluble solids (Brix). Treatment A1 produced a fruit circumference of 50.26 cm and a fruit diameter of 15.65 cm, higher than treatment A0, which only produced a fruit circumference of 48.50 cm and a fruit diameter of 15.05 cm. These results show that the application of SAP can support the development of fruit size by increasing water availability in the root zone, thereby optimizing the fruit enlargement process.

The application of SAP did not have a significant effect on the Brix value. The total dissolved solids in treatments A0 and A1 were relatively the same, at 14.46% and 14.61%, respectively. This indicates that the increase in water availability due to the application of SAP plays a more significant role in the formation of fruit size compared to the increase in fruit sugar content. The use of Super Absorbent Polymer can enhance plant growth and yield, but does not always lead to an improvement in the internal quality of the fruit [21].

In addition, the relatively high rainfall conditions during the fruit growth to ripening phase are suspected to also affect the obtained Brix value (Figure 3). High rainfall can increase the water content in the fruit tissue, resulting in a lower sugar concentration. High soil moisture and lower temperatures due to rain can hinder the formation and accumulation of sugar in melons, resulting in lower sweetness levels at harvest [22].

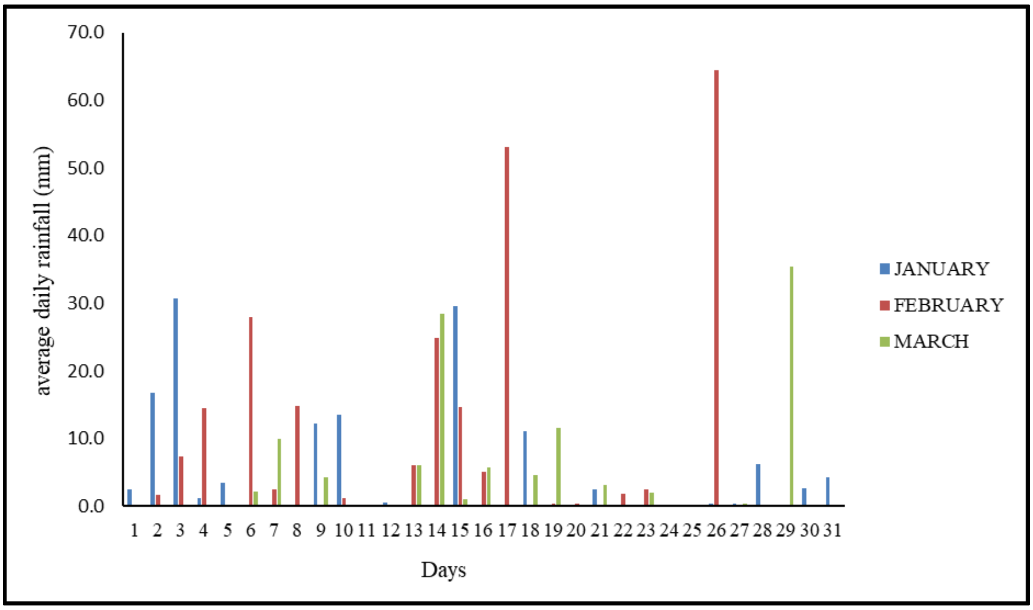

Figure 3 Average daily rainfall during cultivation

The treatment of macro nutrients has a significant effect on the fruit circumference, fruit diameter, and total soluble solids (Brix) of melons (Table 3). Treatment B3 produced the highest fruit circumference, measuring 53.00 cm, which was significantly different from treatments B0, B1, and B2, but not significantly different from treatment B4, which resulted in a fruit circumference of 51.31 cm. The same results were observed in fruit diameter, where treatment B3 yielded the largest fruit diameter of 16.34 cm. This value was higher compared to treatments B0, B1, and B2, while treatment B4 produced a fruit diameter of 15.75 cm, which was not significantly different from B3.

The high fruit circumference and diameter in treatment B3 indicate that the plant's nutrient needs were met, leading to better fruit formation and enlargement processes. Nitrogen plays a role in plant growth and the formation of photosynthates, while phosphorus and potassium are involved in fruit development and the translocation of photosynthesis products to the fruit organs [23]. However, increasing the fertilizer dose to 100% no longer significantly increases fruit size compared to the 75% dose, which means that this indicates that the 75% dose alone is already sufficient to meet the plant's nutrient needs during growth and fruit formation compared to the optimal dose.

Fertilizer treatment also has a significant effect on total dissolved solids (Brix). The highest Brix value was obtained in treatment B3, which was 10.60%, significantly different from treatments B0 (9.04%) and B1 (9.12%). Meanwhile, treatments B2 (9.88%) and B4 (9.81%) did not differ significantly from the other treatments. These results indicate that the proper application of fertilizer not only increases fruit size but also supports the formation and accumulation of sugar in melons. According to (Neno and Raga, 2025), The availability of sufficient nutrients, especially potassium, plays an important role in sugar formation and improving fruit quality. Based on the results of this study, the combination of SAP treatment at 3 g per plant (A1) and a fertilizer dose of 75% (B3) is the best treatment because it produces better fruit size and quality compared to other treatments.

4. Conclusion

The application of Super Absorbent Polymer (SAP) significantly improved the vegetative growth and fruit characteristics of melon cultivated on Ultisol soil. The interaction between SAP and fertilizer rate significantly affected fruit weight. The combination of 3 g SAP per plant and 75% of the recommended fertilizer rate (A1B3) produced the highest fruit weight and superior fruit quality compared with the full fertilizer rate without SAP. These results indicate that SAP can improve fertilizer use efficiency and may reduce fertilizer requirements by up to 25% under Ultisol conditions

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Wang, X., Ando, K., Wu, S., Reddy, U. K., Tamang, P., Bao, K., Hammar, S. A., Grumet, R., McCreight, J. D., and Fei, Z. (2021). Genetic characterization of melon accessions in the U.S. National Plant Germplasm System and construction of a melon core collection. Molecular Horticulture, 1(1), 11-. https://doi.org/10.1186/S43897-021-00014-9

[2] Prasetyo, A., and Madiyatama, R. (2023). Consumer Preference Analysis of Melon (*Cucumis Melo. L*) In Traditional Markets In Karanganyar Regency. JRUCS : Journal of Rural and Urban Community Studies, 1(1), 37–42.

[3] Anggara, H., Suwarno, W. B., Saptomo, S. K., Endang Gunawan, Amalia Nurul Huda, and Budi Indra Setiawan. (2020). Performance of Five Varieties of Melon (*Cucumis melo L.*) with Ring Irrigation Treatment in a Greenhouse. Jurnal Agronomi Indonesia, 48(3), 307–313. https://doi.org/10.24831/jai.v48i3.32206

[4] Abdurrahman, A., Hamdani, H., and Yanti, N. D. (2023). Analysis of Melon Farming (*Cucumis Melo L.*) in Martapura District, Banjar Regency. Frontier Agribisnis, 7(1), 63–72. https://ppjp.ulm.ac.id/journals/index.php/fag/article/view/8280

[5] Hafiz, M., Hassan, M., Zaman Omar, F., Hamid, M. H., and Ghazali, N. F. (2025). Effect of Various Fertilizer Rates of Water-Soluble NPK on Growth, Photosynthetic Pigments, Yield and Fruit Quality of Watermelon. United International Journal for Research and Technology, 06(05), 28–33.

[6] Gosden, D., Studley, M., and Rossiter, J. (2023). Material extrusion of sodium polyacrylate superabsorbent polymer. Additive Manufacturing, 78, 1–10. https://doi.org/10.1016/j.addma.2023.103886

[7] Ostrand, M. S., DeSutter, T. M., Daigh, A. L. M., Limb, R. F., and Steele, D. D. (2020). Superabsorbent polymer characteristics, properties, and applications. Agrosystems, Geosciences and Environment, 3(1), 1–14. https://doi.org/10.1002/agg2.20074

[8] Muhammad, M., Tawfic, M., and Elsabbagh, A. (2024). Review of design and manufacturing of superabsorbent polymers (SAPs) hydrogel for agriculture in arid areas. In Discover Materials (Vol. 4, Issue 1). Springer. https://doi.org/10.1007/s43939-024-00114-5

[9] Sherzad, R. A., Shinwari, H., Noor, N. A., Baber, B. M., Durani, A., Aryan, S., Kakar, K., Hashemi, T., Thobunluepop, P., and Sarobol, E. (2022). Improving Water Efficiency, Nutrients Utilization, and Maize Yield using Super Absorbent Polymers Combined with NPK during Water Deficit Conditions. Nangarhar University International Journal of Biosciences, 2(2), 15–31. https://doi.org/10.70436/nuijb.v2i02.40

[10] Budiarto, R., Sutari, W., Farida, Soleh, M. A., Nuraini, A., Mubarok, S., Kusumiyati, Rasiska, S., Istifadah, N., and Djaya, L. (2025). Melon Cultivation Guidance for Empowering Women in Pajagan Village, Sumedang Regency. Indonesian Journal of Community Services Cel, 4(2), 35–41. https://doi.org/10.70110/IJCSC.V4I2.96

[11] Pahlevanyan, A. M., Martirosyan, G. S., Tadevosyan, L. M., Balayan, R. S., Harutyunyan, Z. E., and Vardanian, I. V. (2023). The effect of hydrogel Aquasource on yield capacity and seed efficiency of melon *Cucumis melo L.* IOP Conference Series: Earth and Environmental Science, 1154(1). https://doi.org/10.1088/1755-1315/1154/1/012069

[12] Zhang, Q., Zhou, M., and Wang, J. (2022). Increasing the activities of protective enzymes is an important strategy to improve resistance in cucumber to powdery mildew disease and melon aphid under different infection/infestation patterns. Frontiers in Plant Science, 13, 950538. https://doi.org/10.3389/FPLS.2022.950538/TEXT

[13] Huda, A. N., and Bayuardi Suwarno, W. (2023). Characteristics and variability of melon genotypes under shade conditions in greenhouse. Indonesian Journal of Agronomy, 51(3), 324–333. https://doi.org/10.24831/jai.v51i3.48986

[14] Krasnopeeva, E. L., Panova, G. G., and Yakimansky, A. V. (2022). Agricultural Applications of Superabsorbent Polymer Hydrogels. International Journal of Molecular Sciences, 23(23). https://doi.org/10.3390/ijms232315134

[15] de Vasconcelos, M. C., Gomes, R. F., Sousa, A. A. L., Moreira, F. J. C., Rodrigues, F. H. A., Fajardo, A. R., and Neto, L. G. P. (2019). Superabsorbent Hydrogel Composite Based on Starch/Rice Husk Ash as a Soil Conditioner in Melon (*Cucumis melo L.*) Seedling Culture. Journal of Polymers and the Environment, 28(1), 131–140. https://doi.org/10.1007/S10924-019-01593-X

[16] Aryani, M., Raksun, A., and Mertha, I. G. (2024). The Effect of Using NPK Fertilizer and Liquid Organic Fertilizer Vegetable Waste on the Vegetative Growth of Purple Eggplant (Solanum melongena L.). Jurnal Biologi Tropis, 24(2), 812–824. https://doi.org/10.29303/jbt.v24i2.6973

[17] Mandal, M., Singh Lodhi, R., Chourasia, S., Das, S., and Das, P. (2025). A Review on Sustainable Slow-Release N, P, K Fertilizer Hydrogels for Smart Agriculture. ChemPlusChem, 90(3). https://doi.org/10.1002/cplu.202400643

[18] Rizky, N. R., Suharti, W. S., Minarni, E. W., and Soedirman, J. (2025). Growth and Yield of Melon at Various Concentrations and Applications KNO3 with Drip Hydroponic System. 1(1), 321–330.

[19] Rohcahyani, F. E., Hidayat, R., and Kusumaningrum, N. A. (2025). Sustainable Fertilization Strategy: The Effect of Mono Potassium Phosphate and Amino Acid Liquid Organic Fertilizer on Melon Plants. Agro Bali : Agricultural Journal, 8(2), 525–537. https://doi.org/10.37637/ab.v8i2.2075

[20] Park, J., Guan, W., Lei, C., and Yu, G. (2024). Self-Irrigation and Slow-Release Fertilizer Hydrogels for Sustainable Agriculture. ACS Materials Letters, 6(8), 3471–3477. https://doi.org/10.1021/ACSMATERIALSLETT.4C01120

[21] Malik, S., Chaudhary, K., Malik, A., Punia, H., Sewhag, M., Berkesia, N., Nagora, M., Kalia, S., Malik, K., Kumar, D., Kumar, P., Kamboj, E., Ahlawat, V., Kumar, A., and Boora, K. (2022). Superabsorbent Polymers as a Soil Amendment for Increasing Agriculture Production with Reducing Water Losses under Water Stress Condition. Polymers 2023, Vol. 15, Page 161, 15(1), 161. https://doi.org/10.3390/POLYM15010161

[22] Diao, Q., Cao, Y., Yao, D., Xu, Y., Zhang, W., Fan, H., and Zhang, Y. (2022). Effects of Temperature and Humidity on the Quality and Textural Properties of Melon Fruits During Development and Ripening. Molecular Plant Breeding, 13(22), 1–13. https://doi.org/10.5376/mpb.2022.13.0022

[23] Jiaying, M., Tingting, C., Jie, L., Weimeng, F., Baohua, F., Guangyan, L., Hubo, L., Juncai, L., Zhihai, W., Longxing, T., and Guanfu, F. (2022). Functions of Nitrogen, Phosphorus and Potassium in Energy Status and Their Influences on Rice Growth and Development. Rice Science, 29(2), 166–178. https://doi.org/10.1016/J.RSCI.2022.01.005