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Growth and development of ‘sweet net 9’ melon (*Cucumis melo* L.) in NFT hydroponics as affected by pruning leaves below fruits and foliar application of potassium sulphate (K_2SO_4)

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Abstract

Leaf pruning reduces resource competition, directing assimilates to fruit development, while aging plants require supplemental K to support nutrient uptake. This study aimed to evaluate the effects of pruning leave below fruits and foliar application of K_2SO_4 on fruit weight and quality. The experiment was conducted over three months (October–December 2024) in a screenhouse at Pondok Pesantren Aqwamu Qila, Bantul, Yogyakarta. Sampling and analysis were carried out at the Crop Production Management Laboratory, Faculty of Agriculture, Universitas Gadjah Mada. A split-plot design was used with two factors, namely K_2SO_4 concentrations (0, 1, 2, 3 g/L) as the main plot and pruning (with/without) as the subplot, resulting in 8 treatment combinations replicated in 3 blocks. Data were analyzed using split-plot ANOVA in R-Studio, followed by DMRT at a 95% confidence level when significant differences were found. The study showed that pruning significantly increased leaf length (16.49%) and width (20.89%). The application of 0 g/L K_2SO_4 produced the highest harvest index (0.49), though not significantly different compared to that of 2 g/L and 3 g/L. Combining leaf pruning with 2 g/L K_2SO_4 resulted in a high leaf area and LAI (5.68), comparable to non-pruned plants with 3 g/L K_2SO_4 (5.83). This combination also yielded the highest fruit potassium content (1.90%) but lowered fruit sweetness (8.65 ˚Brix). The elevated potassium content may provide health benefits, particularly in reducing blood pressure.

INTRODUCTION

Melon (*Cucumis melo* L.) is a horticultural crop with high economic value. One of melon varieties favored by Indonesian consumers is ‘Sweet Net 9’. This variety is characterized by its oval shape, netted and cream-colored skin, and orange flesh with a crunchy texture. According to Kumalasari et al. (2024), melon variety of ‘Sweet Net’ has fresh fruit weight of 0.8-0.9 kg, with a fruit sweetness ranging from 14-16˚Brix. The fruit is rich in vitamins and antioxidant compounds, which contribute to various health benefits for humans. Its sweet and refreshing taste has made melon a highly favored fruit, resulting in consistently increasing market demand. Afriyani et al. (2024) reported that the annual consumption of melon fruit in Indonesia reached 332,698 tons. However, domestic melon production was only able to meet approximately 38.8% of national demand (Nurpanjawi et al., 2020). According to Badan Pusat Statistik (2023), melon production in Indonesia has experienced fluctuations from 2013 to 2023. From 2014 to 2017, production declined significantly by 38.52%, followed by an increase of 16.40% during the period of 2018 to 2020. Nevertheless, production declined again, reaching 914 tons by 2023, representing

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a decrease from 2018. Laudji et al. (2021) attributed this decline in production to crop failure, likely caused by suboptimal cultivation techniques and the incidence of pests and diseases. The emergence of pests and diseases is often attributed to suboptimal environmental conditions. Melon plants are particularly susceptible to powdery mildew under excessively humid environments. This condition can inhibit the photosynthetic process, ultimately leading to a decline in both the quality and quantity of melon fruit.

Garba et al. (2020) reported that leaf pruning combined with appropriate plant spacing in cucumber cultivation can reduce the incidence of pests and diseases by improving air circulation and sunlight penetration, thereby lowering humidity levels around the plant canopy. The implementation of proper cultivation practices is therefore essential to mitigate disease incidence and enhance both quantity and quality of melon yield. One such agronomic practice involves leaf pruning and fertilization. Leaf pruning is generally conducted to optimize the translocation of nutrients to generative organs and to improve light interception throughout the plant canopy, thus enhancing photosynthetic efficiency. Heuvelink et al. (2005) demonstrated that the removal of older leaves, while maintaining an optimal leaf area index (LAI) of approximately 3-4, significantly improved fruit yield in tomato cultivation.

Another challenge in melon production is the inability of the fruit to reach its genetic potential in terms of weight. The fruit weight can be diminished from its genetic potential by pest and disease attacks and improper cultivation techniques. According to Badriyah & Amzeri (2022), fruit weight is a vital indicator in the melon cultivation market. Potassium (K) is a key nutrient known to play an essential role in biomass accumulation and fruit quality enhancement. De Souza et al. (2023) found that potassium sulphate (K_2SO_4) fertilization in zucchini (*Cucurbita pepo*) resulted in an 18.21% higher yield compared to potassium chloride (KCl) application. Furthermore, Darwiyah et al. (2021) found that the application of potassium sulphate (K_2SO_4) 10% with an additional potassium dose of 0.005 g/L of water to the nutrient solution in a hydroponic system increased fruit weight, diameter, and flesh thickness by 24.49%, 3.04%, and 32.85% compared to control. Foliar application of fertilizer was selected to optimize fertilization efficiency. According to Noaema et al. (2020), this method is conducted to accelerate the absorption of nutrients by plants. This application is expected to improve plant immunity against pathogens and enhance fruit development. The integration of leaf pruning and foliar fertilization of K_2SO_4 is thus anticipated to improve melon fruit quality. This study supports Sustainable Development Goals (SDG) 2, aiming to end hunger by improving nutrition and promoting sustainable agriculture and SDG 13, which aims to enhance crop resilience against pathogen attacks, thereby contributing to food security and sustainable agriculture practices in the face of climate change. The objective of this study is to evaluate the effects of pruning leaves below fruits and foliar application of K_2SO_4 on the fresh weight and quality of melon fruit.

MATERIALS AND METHODS

Time and location

The experiment was conducted over a period of three months, from October to December 2024. The experimental site was located in the screenhouse of Pondok Pesantren Aqwamu Qila, Jatiarang RT 01, Sokowaten, Tamanan, Banguntapan District, Bantul Regency, Special Region of Yogyakarta, Indonesia. Destructive sampling and laboratory analyses were carried out at the Crop Production Management Laboratory, Sub-Laboratory of Plant and Horticultural Sciences, Faculty of Agriculture, Universitas Gadjah Mada.

Tools and materials

The equipment used in this study included net pots, flannel cloth, hydroponic installations (gutters, nutrient tanks, and tubing), rulers, measuring tapes, strings, scissors, brushes, ovens, digital scales, digital calipers, leaf area meter Delta T Divice series 50007, water pump sprayer, yellow and blue sticky traps, Genesys UV-Vis 10S Spectrophotometer, Atomic Absorption Spectrophotometer (AAS) AA-6200 Shimadzu®, measuring cylinders, test tubes, pipettes, pH meter auto calibrate Mediatech, TDS and EC meter AB02301, thermo-hygrometer HM6010 Only, lux meter KUBER® AS803 Mini, penetrometer digital GY-4, refractometer digital pocket PAL-1 (Atago®) , writing tools, and a smartphone. The materials used included melon seeds of the ‘Sweet Net 9’ variety, fungicide Dithane M-45, rockwool, and potassium sulphate (K_2SO_4) fertilizer (MerokeSOP®) containing 52% potassium oxide (K_2O) and 18% sulphur (S). The nutrient solution used was a mixture of MKP, Calnit, Kalinitra, MagS, SOP, and Meroke® compound micronutrients. The nutrient concentrations ranged between 647–2140 ppm with an EC of 1.01–3.34 mS/cm and a pH of 7.06–7.92.

Research stages

Seed germination was carried out on 2 × 2 cm rockwool media, with watering applied as needed when the media dried. Sterilized net pots lined with flannel cloth were then prepared. Seedlings aged 7–10 days were transferred into the net pots. The hydroponic system was activated, and nutrient flow to all channels was verified. Lateral shoot pruning was performed at 2 weeks after planting (WAP). Manual pollination was carried out at 2–4 WAP. Fruit thinning was conducted at 4–5 WAP, leaving only one well-developed fruit per plant. Apical shoot pruning was carried out at 5 WAP, leaving 25 leaves per plant. Leaf pruning was conducted at 6 WAP on the leaves below fruits. Foliar application of K_2SO_4 was performed at 5–7 WAP, specifically on 35, 45, and 55 days after planting, during the morning hours between 07.00 and 09.00 AM. Harvesting was carried out at 9 weeks after planting.

Experimental Design

The experiment was arranged in a Split Plot 2x4 design with two factors. The main plot was K_2SO_4 foliar concentration (0, 1, 2, 3 g/L), and the sub plot was leaf pruning (with or without). Each plant was treated with 100 ml K_2SO_4 solution. Foliar fertilization was applied three times (35, 45, 55 days after planting), while leaf pruning was carried out at 6 weeks after planting. The leaf pruning treatment involved retaining 12–14 leaves above fruits, whereas the non-pruning treatment retained 25 leaves. In both treatments, the fruits were positioned between nodes 11-13. The treatment details are presented in the Table 1.

Table 1. Experimental design

Name	Treatment
P0K0	= no leaf pruning + 0 g/L K_2SO_4
P0K1	= no leaf pruning + 1 g/L K_2SO_4
P0K2	= no leaf pruning + 2 g/L K_2SO_4
P0K3	= no leaf pruning + 3 g/L K_2SO_4
P1K0	= leaf pruning + 0 g/L K_2SO_4
P1K1	= leaf pruning + 1 g/L K_2SO_4
P1K2	= leaf pruning + 2 g/L K_2SO_4
P1K3	= leaf pruning + 3 g/L K_2SO_4

Climate

Climate data observed include temperature (˚C), humidity (%), and light intensity (lux), during 1-9 weeks after planting. Temperature (˚C) and humidity (%) were observed using thermo-hygrometer HM6010, while light intensity (lux) observed using lux meter KUBER AS803 Mini. Data were observed between the hydroponic gutters.

Length and width of leaf (cm)

Leaf length and width (cm) were measured once at 9 weeks after planting on every leaf of sample plants using a ruler. Length was measured from the base to the apex of the leaf blade (Ding et al., 2020) excluding the petiole. Width was measured at the widest part of the leaf blade. The leaves were numbered sequentially from the base to the apex of the stem. The leaf length and width data used were the average values of each leaf.

Leaf area (cm²) and leaf area index

Leaf area (cm²) was measured once at 9 weeks after planting on all the leaves of the plant using leaf area meter. For the pruning treatment, leaf area and leaf area index were calculated for 13 leaves, compared to 25 leaves in the non-pruning treatment. Leaf area index (LAI) was calculated following Eq. 1 (Guimarães et al., 2013), with plant spacing area of 40x28 cm = 1120 cm².

$$LAI = \frac{TLA}{PSA} \quad \text{..................................(1)}$$

where TLA = total leaf area (cm²) and PSA = plant spacing area (cm).

Fresh and dry weight of plant (g)

Fresh and dry weight measurements were conducted once at 9 weeks after planting or at harvest. Fresh weight was determined using a digital balance with a precision of 0.05 g. For dry weight analysis, plant samples were oven-dried at 80°C for 48 hours, then weighed using the same digital balance (precision: 0.05 g). The total fresh and dry weights of the plant were calculated as the sum of the weights of the roots, stems, and leaves.

Harvest index

Harvest index (HI) was measured at 9 weeks after planting following Eq. 2. Total plant dry weight was the sum of the vegetative dry weight and the fruit dry weight. A harvest index value approaching 1 indicates that nearly all photo assimilates from photosynthesis are translocated to the fruit for its development.

$$HI = \frac{\text{Fruit dry weight (g)}}{\text{Total plant dry weight (g) + fruit dry weight (g)}} \quad \text{...(2)}$$

Fruit fresh weight (kg)

Fruit fresh weight was measured at 9 weeks after planting using a digital hanging scale. The fruit was suspended from the scale via a support string.

Fruit dry weight (g)

Fruit dry weight (FDW) was determined by weighing 200 g of fresh fruit samples and oven-drying them at 65°C for 48 hours or until a constant weight was achieved. The dried samples were then weighed using a digital balance. The dry weight of the sample was converted to the total fruit dry weight using the following equation 3:

$$FDW = \frac{\text{Half fruit dry weight (g)}}{\text{Half fruit fresh weight (g)}} \times \text{Total fruit fresh weight (g)} \quad \text{........(3)}$$

Water content of fruit (%)

Water content of fruit was calculated by subtracting the fruit dry weight from the fruit fresh weight. This observation was conducted to determine the percentage of water content present in the fruit.

Fruit Firmness (N)

Each fruit was positioned beneath a digital penetrometer probe. The probe was then activated to apply pressure to the fruit until a pre-set mark on the device was reached. The unit of measurement was newtons (N).

Fruit sweetness (˚Brix)

Fruit sweetness (total soluble solids content) was measured using a digital refractometer. Small segments of melon flesh were cut, and the extracted juice was dropped onto the instrument's sensor.

Leaf and fruit potassium content (%)

Leaf and fruit potassium content was measured at 9 weeks after planting using Kjeldahl method (Office of the Federal Register, 1995). The dried leaf and fruit ground into a fine powder using a blender. One gram aliquot of the dried powder was weighed and transferred into a Kjeldahl flask. Subsequently, 5 mL of concentrated HNO_3 (nitric acid) and 0.5 mL of $HClO_4$ (perchloric acid) were added. The mixture was swirled until homogenized and allowed to stand overnight. The digestion process was initiated by heating the flask in a digestion block at 100°C. After the yellow fumes (nitrogen oxides) had dissipated, the temperature was increased to 200°C. The digestion was considered complete when white fumes (perchloric acid) appeared, and the remaining volume in the flask was approximately 0.5 mL. The digestion result was left to cool then diluted with deionized water (H_2O) in a volumetric flask, with the final volume made up to 50 mL. This solution was shaken until homogeneous and allowed to settle overnight. The solution was filtered using filter paper. One milliliter aliquot of the filtrate was pipetted into a 25 mL volumetric flask. The flask was filled to the mark with deionized water and shaken thoroughly to ensure homogeneity. The potassium concentration was determined using Atomic Absorption Spectrophtometer (AAS). The instrument was calibrated using a standard series for comparison.

Leaf potassium uptake (g)

Leaf potassium uptake (LPU) was calculated following equation 4:

LPU = Leaf potassium content (%) x Dry weight of leaf (g) ....(4)

All the statistical analyses were performed using R studio version 4.3.2. Data analysis was conducted using Analysis of Variance (ANOVA) and further tested using the DMRT test with a 95% confidence level if P- value was significant.

RESULTS AND DISCUSSION

There are two main factors that influence plant growth and development, namely genetic and environmental factors. Environmental factors, which include climate, water availability, nutrients, soil pH, and biotic components such as the presence of pathogens, significantly affect plant growth. The microclimate surrounding plants (temperature, light intensity, and air humidity) plays a crucial role in supporting essential elements of the photosynthetic

Table 2. Average of the experiment environment

WAP	1	2	3	4	5	6	7	8	9
T (˚C)	37.70	39.13	40.10	36.27	32.20	33.77	38.07	32.70	31.50
H (%)	37.33	40.67	40.00	65.00	71.67	73.67	57.67	91.33	70.33
LI (lux)	50790.00	55500.00	49330.00	11377.33	19772.33	20426.33	23107.00	19371.33	52280.33

process. Therefore, an optimal climate facilitates efficient photosynthesis, enabling plants to produce fruits of higher quality and yield.

Based on Table 2, the climate in the study area exhibited fluctuations. Between the 4th and 9th week, temperature decreased due to frequent afternoon rainfall, which increased humidity. This condition is associated with the transitional period from the dry to the rainy season, resulting in higher temperatures during the early planting stage and lower temperatures with higher humidity in November. Optimal temperature supports photosynthesis, whereas temperatures exceeding 39°–45°C damage the Rubisco enzyme, thereby reducing photosynthetic activity (Kurtar, 2010). Amarasinghe et al. (2021) reported that high temperatures reduced relative growth rate by 0.38–7.46% during the vegetative stage, 8.70–15.68% during fruit development, and 15–24.48% during flowering. Humidity in the study area ranged from 33% to 91%, which falls below the minimum tolerance of 50% and the maximum of 95% for melon (Jeenprasom et al., 2019). The optimal range for melon growth is 85%–95% (Diao et al., 2022). Excessive humidity may induce powdery mildew, which thrives at 70%–92% humidity under high temperatures of around 35°C (Milod et al., 2021) and is caused by P*odosphaera xanthii*. This disease disrupts photosynthesis through gene dysregulation (Polonio et al., 2019). In this study, powdery mildew was controlled chemically using the fungicide Dithane M-45. Light intensity in the study site also fluctuated, particularly from the 4th week onward due to afternoon rainfall. Melon can grow well under light intensities of 22–1630 μmol/m²/s (equivalent to 1188–88020 lux) (Chen et al., 2003). An intensity of 400–500 μmol/m²/s has been shown to enhance carbohydrate accumulation by increasing the photosynthetic rate (Tang et al., 2022).

Leaf pruning is presumed to influence leaf growth by promoting leaf expansion. According to du Toit et al. (2020), leaf pruning, whether light, moderate, or severe, induces leaf expansion compared to the control plants. This phenomenon likely occurs as the plant adjusts its energy balance to ensure the successful completion of its life cycle. However, this cellular expansion in the leaves must be supported by a sufficient supply of energy in the form of carbohydrates, providing the necessary resources for the process. Meanwhile, potassium plays a critical role in regulating cellular osmotic pressure, enzyme activation, and assimilate transport (Volkov et al., 2009). The combination of pruning and the application of K_2SO_4 at an optimal dose is hypothesized to enhance cell elongation, particularly in leaves, which serve as the primary site of photosynthesis.

According to Table 3, pruning treatment had a significant effect on the leaf length and width. However, there was no interaction between the two treatments, as indicated by the symbol (-), which suggests that both treatments influenced the plant independently. Leaf pruning increased leaf length and width by 16.49% and 20.89%, respectively, compared to the non-pruned treatment. Meanwhile, the application of K_2SO_4 at different concentrations showed that the longest leaf lengths were observed in plants treated with 2 g/L and 3 g/L, measuring 16.26 cm and 16.55 cm, respectively. The shortest leaf length

Table 3. Length and width of leaf (cm) at 9 weeks after planting

Treatment	Length of leaf (cm)	Width of leaf (cm)
Pruning		
No leaf pruning	14.43 b	18.70 b
Leaf pruning	17.28 a	23.64 a
K_2SO_4 concentration		
0 g/L	15.60 pq	19.98 p
1 g/L	15.02 q	20.08 p
2 g/L	16.26 p	22.42 p
3 g/L	16.55 p	22.21 p
Interaction between treatments	-	-
CV (%)	5.63	11.51

Remarks: means followed by the same lowercase letters in the same column are not significantly different based on DMRT test at 5%; (-) indicates no interaction between treatments.

Table 4. Total leaf area (cm^2) at 9 weeks after planting

Pruning	K_2SO_4 concentration				Average
	0 g/L	1 g/L	2 g/L	3 g/L	
No leaf pruning	5495.28 ab	5009.23 ab	5825.79 ab	6536.78 a	5716.77
Leaf pruning	4299.22 b	4321.09 b	6372.14 a	4037.58 b	4757.51
Average	4897.25	4665.16	6098.97	5287.18	(+)
CV (%)					18.24

Remarks: means followed by the same lowercase letters in the same column are not significantly different based on DMRT test at 5%; (+) indicates there is interaction between treatments.

was recorded in the 1 g/L concentration treatment, with an average of 15.02 cm. These results indicate that the application of K_2SO_4 at 2 g/L and 3 g/L can enhance leaf length compared to the control (0 g/L). Kumalasari et al. (2024) reported that ‘Sweet Net’ melon normally had leaf length of 12.1-14.7 cm and leaf width of 16.6-20.5 cm. This study proved that pruning leaves below fruits increased length and width of leaf. This phenomenon is likely due to the morphological response of leaves to pruning. Leaf elongation may occur as a compensatory mechanism for the loss of photosynthetic area. In blueberry plants, pruning increased canopy leaf area by 60% due to the emergence of new leaves (Jorquera-Fontena et al., 2014). However, in the present study, all lateral branches and leaf buds were removed to focus assimilate translocation toward fruit development. Therefore, the observed leaf elongation is presumed to result from continued assimilate distribution to the remaining leaves, promoting cell elongation. Potassium supplement also contributed to increased leaf length but did not significantly affect leaf width. This may be attributed to potassium’s role in regulating cellular osmotic pressure, which facilitates water uptake into cells, leading to increased turgor pressure. Elevated turgor pressure promotes cell wall loosening, which in turn triggers cell expansion or division. This cellular activity ultimately results in leaf elongation (Volkov et al., 2009). The study by Liu et al. (2025) demonstrated that the application of potassium at 90 kg/ha equally divided as base fertilizer and panicle fertilizer under full sunlight conditions significantly increased the length of the third leaf by 5.27%. However, no significant difference was observed in leaf width compared to the control. Furthermore, a significant increase in leaf area of 8.58% was recorded compared to the control. The leaf area index also showed a significant increase of 15.61% compared to the control.

Table 4 indicates a significant interaction between leaf pruning and foliar application of K_2SO_4. This finding suggests that the effect of K_2SO_4 concentration on the plant varies depending on whether pruning is performed. Pruning leaves below fruits resulted in an average reduction in total leaf area of 16.77%, decreasing from 5716.77cm^2 to 4757.51cm^2. The highest total leaf area was recorded in unpruned plants treated with 3 g/L of K_2SO_4 (6536.78 cm^2) and in pruned plants treated with 2 g/L (6372.14 cm^2). The remaining number of leaves per plant in the pruning treatment was 13 leaves and in the non-pruned treatment was 25 leaves.

The leaf area index (LAI) of plants at 9 weeks after planting corresponded with the total leaf area values (Table 5). LAI serves as an indicator of the plant’s ability to intercept light (Obok et al., 2024). According to Adinegara et al. (2017), the ideal LAI for melon plants ranges between 3 and 5. Pruning reduces total leaf area, which may subsequently lower LAI values. However, leaf cell expansion, which acts as a compensatory response by the plant, may contribute to increased LAI values. In this study, the observed LAI values indicate that all

Table 5. Leaf area index at 9 weeks after planting

Pruning	K_2SO_4 concentration				Average
	0 g/L	1 g/L	2 g/L	3 g/L	
No leaf pruning	4.91 ab	4.47 ab	5.20 ab	5.83 a	5.10 a
Leaf pruning	3.84 b	3.85 b	5.68 a	3.60 b	4.24 b
Average	4.37	4.16	5.44	4.71	(+)
CV (%)					18.26

Remarks: means followed by the same lowercase letters in the same column are not significantly different based on DMRT test at 5%; (+) indicates there is interaction between treatments.

Table 6. Leaf potassium uptake (g) and leaf potassium content (%) at 9 weeks after planting

Treatment	Leaf potassium uptake (g)	Leaf potassium content (%)
Pruning		
No leaf pruning	0.23 a	0.78 a
Leaf pruning	0.21 a	0.85 a
K_2SO_4 concentration		
0 g/L	0.19 a	0.78 p
1 g/L	0.23 a	0.90 p
2 g/L	0.24 a	0.82 p
3 g/L	0.21 a	0.76 p
Interaction between treatments	(-)	(-)
CV (%)	13.50*	12.36*

Remarks: means followed by the same lowercase letters in the same column are not significantly different based on DMRT test at 5%; (-) indicates no interaction between treatments; (*) data were transformed using log or sqrt formulas.

plants fall within the ideal range for optimal growth. Nevertheless, non-pruned plants treated with 3 g/L K_2SO_4 and pruned plants treated with 2 g/L exhibited slightly higher LAI values than the recommended range, with values of 5.83 and 5.68, respectively.

These findings suggest that the application of K_2SO_4 at an optimal concentration of 2 g/L results in higher leaf area and Leaf Area Index (LAI) compared to other treatments. Interestingly, despite having 25 leaves, plants without pruning did not necessarily exhibit greater total leaf area than pruned plants, which retained only 13 leaves. This may be attributed to the role of K_2SO_4 in altering leaf structure by promoting cell expansion. Foliar potassium application, which is directly absorbed by the leaves, can lower the leaf water potential, thereby increasing cellular osmotic pressure. As a result, more water enters the leaf cells, causing them to become more turgid. In this turgid state, cells have sufficient energy and nutrients to undergo expansion. Apelt et al. (2017) explain that leaf cell expansion requires carbohydrates formed from photosynthesis also necessitates sufficient cell turgor pressure to irreversibly stretch the primary cell wall.

Furthermore, Lu et al. (2022b) demonstrated that potassium supply synergistically enhances leaf expansion during both day and night by increasing diurnal carbon availability and water supply during the daytime. Furthermore, leaf pruning has also been reported to enhance leaf cell expansion. Research conducted by Lu et al. (2022a) demonstrated that pruning in tea plants increased gibberellin levels, which in turn promoted cell elongation and division, thereby potentially increasing leaf size. It is also presumed that the plant performs this cellular response as a defend mechanism to compensate for the significant loss of photosynthetic area due to pruning.

According Table 6, shows leaf potassium uptake and content exhibited no significant differences and no interaction between treatments. The potassium content of each plant is influenced by plant condition, age, and environment. Lamari et al. (2009) stated that potassium content in melon could reach up to 2% of the dry weight, whereas the observed potassium content in this study was approximately 0.70%. A similar pattern was observed for leaf potassium uptake, which is dependent on leaf dry weight and leaf potassium content. Menzel et al. (1987) reported that the potassium content in plants decreased as the plant aged. Potassium is a mobile element within plant tissues. This element will translocate to younger tissues, namely fruits, to form more complex compounds.

There were no significant differences and no interaction effects between treatments on total fresh and dry plant biomass (Table 7). This suggests that the plants maintain a balance in biomass allocation in response to the treatments applied. This phenomenon may be attributed to the plant's compensatory mechanisms, whereby assimilate allocation is redirected to other organs, such as fruits. According to Iqbal et

Table 7. Plant fresh, dry weight (gram), and harvest index (g/g) at 9 weeks after planting

Treatment	Plant fresh weight (g)	Plant dry weight (g)	Harvest index (g/g)
Pruning			
No leaf pruning	433.28 a	49.90 a	0.48 a
Leaf pruning	406.68 a	44.34 a	0.45 a
K_2SO_4 concentration			
0 g/L	415.27 p	44.66 p	0.49 p
1 g/L	378.29 p	45.19 p	0.43 q
2 g/L	454.73 p	51.44 p	0.48 pq
3 g/L	431.62 p	47.19 p	0.46 pq
Interaction between treatments	-	-	-
CV (%)	17.34	18.90	7.46

Remarks: means followed by the same lowercase letters in the same column are not significantly different based on DMRT test at 5%; (-) indicates no interaction between treatments.

al. (2012), plants can compensate for defoliation by initiating the growth of new organs, such as leaves. In such cases, energy reserves particularly carbohydrates from photosynthesis are redirected towards the development of new tissues, thereby ensuring plant survival. The harvest index values showed significant differences among K_2SO_4 concentration treatments. The highest harvest index was observed at 0 g/L K_2SO_4 (0.49), although it was not significantly different from the values at 2 g/L and 3 g/L. The lowest harvest index was recorded at 1 g/L (0.43). The reduction in harvest index at the 1 g/L concentration, compared to the control, may be due to potassium-induced leaf cell expansion. In this case, assimilates that would otherwise be allocated to fruit development may have been redirected towards leaf growth.

There were no significant differences and no interaction effects between treatments on fruit fresh weight, dry weight, moisture content, and firmness (Table 8). The morphological appearance of the fruit is shown in Figure 1, which indicates no differences in either shape or weight. This indicates that leaf pruning and K_2SO_4 application did not have a substantial impact on overall fruit characteristics. One possible explanation is that the treatments may have induced cell expansion in the leaves, thereby limiting the resources available for fruit development. Another likely contributing factor is the stronger influence of genetic factors on fruit shape and weight.

A fruit sweetness level of <9 °Brix indicates below-standard quality fruit, whereas the standard sweetness for melons ranges between 9-12 °Brix. A sweetness level of >12 °Brix signifies that the fruit exceeds quality standards (Galvan Cardona et al., 2024). In the present study, the fruit sweetness levels were generally within the standard range; however, a substandard value of 8°Brix was recorded in the treatment with a 2 g/L K_2SO_4 concentration. This is presumably due to an excess of potassium in the fruit tissues, leading to a nutrient imbalance within the fruit. The fruit experienced osmotic stress, consequently reducing its quality. This finding is consistent with research conducted by Galvan Cardona et al. (2024), which demonstrated that excessive potassium application reduced fruit sweetness and firmness, as a result of osmotic imbalance.

The application of K_2SO_4 has been reported to enhance the metabolite content of fruits, including increased potassium accumulation. The combination of leaf pruning treatments may further augment potassium content due to reduced source-sink competition. However, excessive potassium can lead to nutrient imbalances. Specifically, potassium may inhibit the uptake of calcium ions (Ca^{2+}), which play a crucial role in maintaining the elasticity of fruit cell walls. This condition may result in fruit cracking due to Ca^{2+} deficiency in the fruit tissues (Kuzin & Solovchenko,

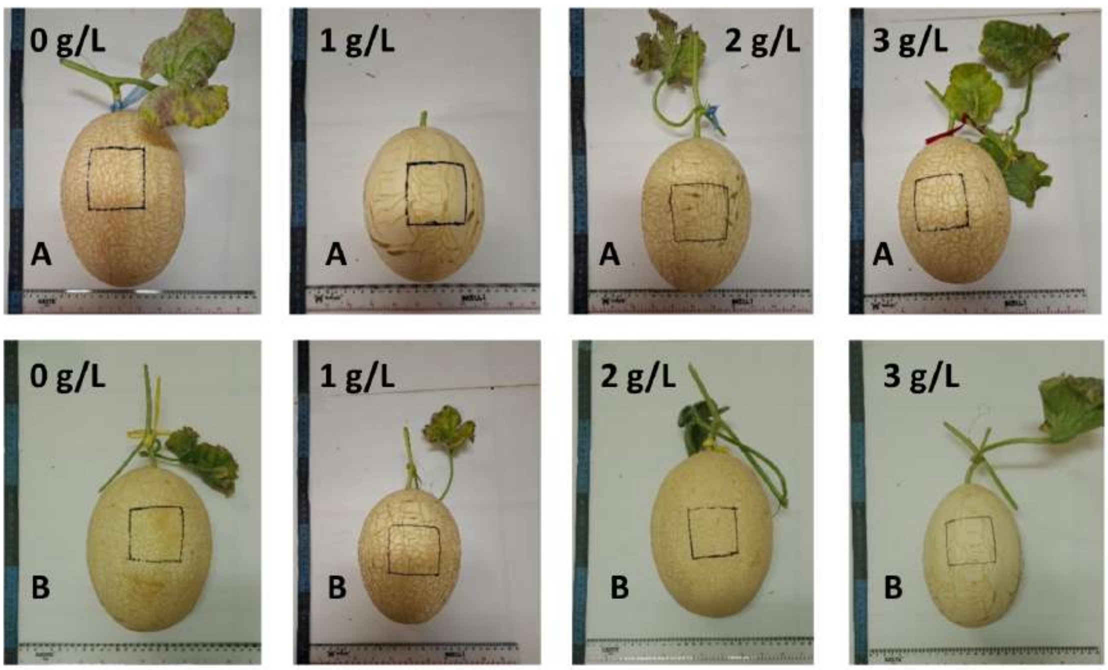

Figure 1. Melon fruit morphology (A. no leaf pruning; B. leaf pruning)

Table 8. Fresh weight of fruit (kg), dry weight of fruit (g), water content of fruit (%), firmness (N), sweetness (˚brix) at 9 weeks after planting

Treatment Pruning	Fresh weight of fruit (kg)	Dry weight of fruit (g)	Water content of fruit (%)	Firmness (N)	Sweetness (˚brix)
No leaf pruning	1.38 a	41.93 a	96.86 a	51.09 a	10.67 a
Leaf pruning	1.32 a	42.13 a	96.89 a	51.68 a	9.49 a
K_2SO_4 concentration					
0 g/L	1.38 p	42.80 p	96.88 p	49.10 p	10.60 pq
1 g/L	1.29 p	36.07 p	97.23 p	48.16 p	10.91 p
2 g/L	1.44 p	48.74 p	96.62 p	53.61 p	8.65 q
3 g/L	1.28 p	40.50 p	96.78 p	54.66 p	10.16 pq
Interaction between treatments	-	-	-	-	-
CV (%)	11.02*	7.15*	0.56	10.15	14.48

Remarks: means followed by the same lowercase letters in the same column are not significantly different based on DMRT test at 5%; (-) indicates no interaction between treatments; (*) data were transformed using log or sqrt formulas.

2021). Table 9 indicates significant differences between treatments, with evidence of interaction effects. Plants subjected to leaf pruning exhibited an 8.82% higher fruit potassium content compared to those without pruning. This suggests that plants respond differently to K_2SO_4 concentrations depending on whether pruning was applied. Generally, pruning increases the average potassium content in the fruit, presumably due to reduced competition between vegetative and generative organs, allowing more efficient and direct potassium translocation to the fruit.

The highest potassium content (1.90%) was found in plants receiving pruning combined with foliar K_2SO_4 at 2 g/L, whereas the lowest (1.44%) was observed in non-pruned plants treated with 1 g/L. When converted to a fresh weight basis, the potassium content in this study ranges between 1440-1900 mg/100 g. According to Hussain et al. (2024), potassium content in the dry weight of melon fruit can reach 1605 mg/100 g, indicating that the values observed in this study are within the normal range. The potassium content within a fruit can vary depending on its sink capacity. Larger fruits possess larger vacuole cells. These vacuole cells serve as the primary storage site for potassium, which plays a crucial role in maintaining cellular ion homeostasis. The accumulation of potassium in the fruit is also influenced by the size of these vacuoles. Consequently, the potassium content of fruits may vary according to their size. Therefore, foliar K_2SO_4 at 2 g/L is recommended based on its ability to enhance potassium accumulation in the fruit.

According to Selvanathan et al. (2020) in Pearson correlation, a value of $0 < |r| < 0.19$ indicates a very weak correlation, $0.2 < |r| < 0.39$ indicates a weak correlation, $0.4 < |r| < 0.59$ indicates a moderate correlation, $0.6 < |r| < 0.79$ indicates a strong correlation, and $0.8 < |r| < 1.0$ indicates a very strong correlation. Furthermore, a negative sign (-) denotes an antagonistic (or inverse) relationship between the two variables, whereas a positive value signifies that an increase in one variable corresponds to an increase in the other. A strong positive correlation was observed between leaf length and leaf width, indicating that these two dimensions increase in tandem (Figure 2). This relationship is supported by a highly significant and very strong Pearson's correlation coefficient (r = 0.92), meaning that an increase in leaf length is associated with a corresponding increase in leaf width. However, both leaf length and width exhibited a very weak and non-significant correlation with

Table 9. Potassium content of fruit (%) at 9 weeks after planting

Pruning	K2SO4 concentration				Average
	0 g/L	1 g/L	2 g/L	3 g/L	
No leaf pruning	1.48 b	1.44 b	1.53 b	1.75 ab	1.55
Leaf pruning	1.62 ab	1.68 ab	1.90 a	1.62 ab	1.70
Average	1.55	1.56	1.71	1.68	(+)
CV (%)					9.71

Remarks: means followed by the same lowercase letters in the same column are not significantly different based on DMRT test at 5%; (+) indicates there is interaction between treatments.

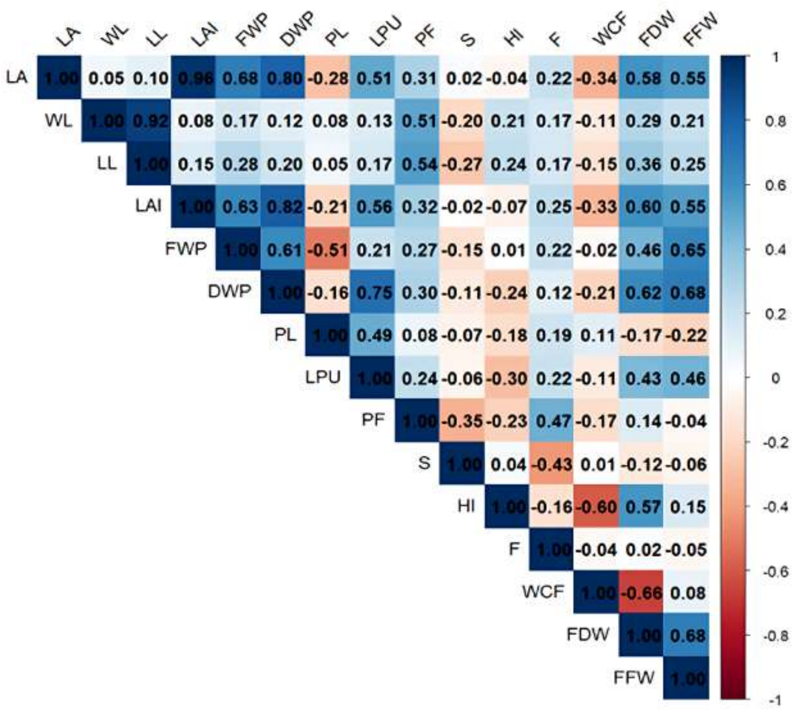

Figure 2. Coefficient correlation of data

Remarks: LA = leaf area; WL = width of leaf; LL = length of leaf; LAI = leaf area index; FWP = fresh weight of plant; DWP = dry weight of plant; PL = potassium content of leaf; LPU = leaf potassium uptake; PF = potassium content of fruit; S = sweetness; HI = harvest index; F = firmness; WCF = water content of fruit; FDW = fruit dry weight; FFW = fruit fresh weight.

both leaf area (r = 0.10; r = 0.05) and leaf area index (LAI) (r = 0.15; r = 0.08). This indicates that changes in individual leaf dimensions do not significantly influence the total leaf area or LAI. This phenomenon is likely attributable to the pruning treatment, which reduced the total leaf area by 16.77% compared to non-pruned plants. This suggests that the reduction in leaf quantity has a more substantial impact on decreasing total leaf area and LAI than any potential changes in the size (length or width) of the remaining leaves. In contrast, leaf area itself showed a very strong correlation with plant dry weight (r = 0.80) and LAI (r = 0.96) and a strong positive correlation with plant fresh weight (r = 0.68). This demonstrates that an increase in leaf area promotes higher LAI as well as greater plant fresh and dry biomass. Furthermore, leaf area was moderately positively correlated with leaf potassium uptake, suggesting that increased leaf area can enhance potassium absorption within certain limits. Leaf potassium uptake, in turn, showed a strong positive relationship with plant dry weight (r = 0.75), implying that greater potassium assimilation contributes to increased plant biomass accumulation.

Fruit fresh weight was strongly positively correlated with plant fresh weight (r = 0.65), plant dry weight (r = 0.68), and fruit dry weight (r = 0.68). Additionally, both fruit fresh and dry weight were positively correlated with LAI (r = 0.55 and r = 0.60, respectively). These correlations indicate that enhanced photosynthetic output and an optimal LAI (~5.68) support fruit development by promoting a better microclimate, characterized by moderated temperatures and maintained humidity. Conversely, a high leaf area did not support a positive relationship with the harvest index, as shown by a very weak negative correlation (r = -0.04). This suggests that increasing the leaf area beyond an optimal point may reduce the harvest index, likely due to shading stress within the canopy.

The harvest index also demonstrated a strong negative correlation with fruit water content (r = -0.60). This indicates that a higher fruit moisture content can negatively impact the harvest index. The harvest index represents the proportion of photo assimilates produced through photosynthesis that are translocated to the fruit. High water content in fruit may not be proportional to the amount of translocated assimilates, leading to a dilution of dry biomass and consequently a lower harvest index. Regarding fruit quality parameters, a moderate negative correlation (r = -0.43) was found between fruit sweetness (ºBrix) and firmness. This means that an increase in fruit firmness is associated with a decrease in sweetness, although other influencing factors, such as cultivar type, are also likely involved.

It can thus be concluded that the best-performing plants, in terms of growth and fruit quality as indicated by the highest fruit potassium content of 1.9%, were those subjected to pruning combined with 2 g/L foliar K_2SO_4. As explained by Tulungnen et al. (2016), the ideal daily potassium intake for humans is approximately 4.7 g, typically sourced from vegetables and fruits. Inadequate potassium intake may lead to elevated blood pressure, whereas higher intake is associated with blood pressure reduction. This supports the assertion that high potassium content in melon fruit is a marker of superior fruit quality with potential health benefits. Research conducted by Stolarz-Skrzypek et al. (2013) demonstrated that oral potassium supplementation, tested on 586 individuals (412 hypertensive patients and 174 healthy subjects), reduced blood pressure by 5.9/3.4 mmHg, with an average potassium supplementation of 86 mmol/day over 39 days. Another study indicated that consuming potassium-rich melon effectively reduced hypertension in pregnant women, decreasing the prevalence from 100% to 62.5% pre-hypertensive and 37.5% normotensive. The study also noted that consuming melon was significantly more effective in lowering blood pressure in pregnant women compared to consuming bananas, likely due to its superior potassium bioavailability and additional beneficial compounds, thereby supporting its role as a dietary intervention for managing hypertension and reducing preeclampsia risk.

CONCLUSIONS

The results of this study demonstrated that the pruning treatment significantly enhanced leaf dimensions, increasing leaf length and width by 16.49% and 20.89%, respectively. Furthermore, the application of K_2SO_4 at a concentration of 3 g/L resulted in the highest leaf length (16.55 cm) among all treatments. Regarding the harvest index, no significant differences were observed due to the pruning treatments. However, the application of 0 g/L K_2SO_4 yielded the highest harvest index value (0.49), though this was not statistically different from the values obtained with the 2 g/L and 3 g/L concentrations. A notably effective treatment combination was identified, namely pruning combined with a K_2SO_4 concentration of 2 g/L. This combination produced high leaf area and leaf area index (LAI) values (5.68), which were not significantly different from those in non-pruned plants treated with 3 g/L K_2SO_4 (5.83). Additionally, this combination resulted in the highest fruit potassium content, reaching 1.90%. A trade-off was observed, as this treatment also produced a lower fruit sweetness value (8.65 °Brix) compared to other treatments. The high potassium content in the fruit is potentially beneficial for human health, particularly for reducing blood pressure.

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