

Growth and Yield of Melon at Various Concentrations and Applications KNO₃ with Drip Hydroponic System

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Abstract

Increasing melon production can pursued hydroponic cultivation with drip irrigation system and potassium nitrate (KNO₃) fertilizer to improve the growth and quality melon. This research aimed to investigate the effects of varying concentrations and applications of KNO₃ on the growth and yield of melons within a hydroponic system. The study was conducted in a screen house in Pasir Kulon Village, Karanglewas District, Banyumas Regency, and at the Laboratory of Agronomy and Horticulture at Jenderal Soedirman University. A Randomized Complete Block Design (RCBD) was utilized, incorporating two factors: the concentration of KNO₃ and the application of KNO₃. The research data were analyzed using an F-test, followed by Duncan's Multiple Range Test (DMRT) at a 5% significance level. Results indicated that a KNO₃ concentration of 6 g/L provided the best growth and yield in the variables of fresh weight per plant ($y = 13.895x + 492.03$), dry weight per plant ($y = 1.93x + 47.843$), fruit weight per plant ($y = 0.035x + 0.9783$), and fruit sweetness ($y = 0.5167x + 13.57$). The application of KNO₃ provided the best growth and yield in the variables of fresh weight per plant ($y = 126.92x + 343.33$), dry weight per plant ($y = 11.85x + 35.86$), and fruit sweetness ($y = 0.23x + 14.77$). The combination of KNO₃ fertilizer at a concentration of 6 g/L, used with the pouring method, was the most effective for increasing both fruit sweetness ($y = 1,875x + 11,483$).

Keywords: application; concentration; KNO₃; melon.

Introduction

Increasing melon production can be pursued by hydroponic cultivation. Hydroponic cultivation is one of the methods of cultivating plants that can be used on narrow land, without using soil planting media. The drip irrigation system can be used to grow melons hydroponically inside the screen house. According to Mappanganro & Baharuddin (2021), drip irrigation provides nutrients to plants through an AB mix solution that is dripped into the planting medium. In connection with proper hydroponic cultivation, the fulfillment of nutrients in the growth and development phases of melons is very important. One of the efforts that can be made to improve the growth and quality of melons is fertilization.

Potassium is a nutrient that has a role in the growth and production of melons, regulates photosynthesis, opens and closes stomata, and maintains chlorophyll (Ferdiansyah, 2022). According to Ritawati (2020), potassium can also increase the size and quality of fruits, and the addition of nitrogen can also increase the growth of a plant.

One way that can be used to improve the growth and quality of melons is to use KNO₃ fertilizer. This fertilizer contains 45-46% potassium and 13% nitrogen

(Kusparwanti et al., 2023). KNO_3 fertilizer can be well absorbed by melon plants if given in the right concentration, the right way of application, and with the right frequency so that it can have an influence on the growth and quality of melons. This study was conducted to determine the effect of differences in concentration and application of KNO_3 fertilizer as well as the best combination interaction on the growth and yield of melons of drip hydroponic system.

Research Method

This research was carried out from April to July 2024 at a screen house in Pasir Kulon Village, Karanglewang District, Banyumas Regency, Central Java, Indonesia with an altitude of 110 meters above sea level and Horticulture Laboratory, Faculty of Agriculture, Jenderal Soedirman University. The ingredients used include melon of the Golden Aroma variety, cocopeat, AB mix nutrition, KNO_3 fertilizer, and polybag. The tools used include drip irrigation installations, Total Dissolved Solids (TDS) meters, sprayers, measuring cup, trimming scissors, digital scales, refractometers, meters, digital calipers, ovens, thermohygrometers, lux meters, and stationery.

The observed research variables include leaf area per plant (cm^2), stem diameter (cm), fresh weight per plant (g), dry weight per plant (g), fruit weight plant (kg), and fruit sweetness ($^{\circ}\text{Bx}$). The experimental design used was a factorial Randomized Complete Block Design (RCBD) was utilized, incorporating two factors: the concentration of KNO_3 and the application. The first factor of KNO_3 concentration consists of 3 levels: 0 g/L, 3 g/L, and 6 g/L. The second factor is the application of KNO_3 fertilizer consists of 2 levels: spray and pour. There are 6 combinations of treatments. The treatment was repeated 4 times so that 24 experimental units were obtained. One experimental unit of 3 plants so that 72 plants were obtained. Data were analyzed using the $F \alpha 5\%$ test. If there is a real difference, it is followed by Duncan's Multiple Range Test (DMRT) $\alpha 5\%$.

Results and Discussion

The location of the screen house is at an altitude of 110 meters above sea level. The type of screen house used is piggy back and a light steel building frame with a screen house roof made of UV plastic with a thickness of 200 microns. The air temperature and humidity of the morning air in the screen house during the research activities ranged from 28.6-33.8°C and 30-79%, respectively. The intensity of morning light in the screen house during the research activities ranged from 8,081-37,630 lx. The results of the fingerprint analysis showed that the concentration treatment had an effect on the fresh weight per plant, dry weight per plant, and fruit sweetness. The treatment of the application has a very noticeable effect on the fresh weight per plant, dry weight per plant, and fruit sweetness. The interaction of treatment combinations has a very real effect on the fruit sweetness. Full results are presented in Table 1.

Table 1. Fingerprint results of various concentrations and applications of KNO_3 fertilizer on melon growth and yield variables

No	Research Variables	Treatments			KK (%)
		Concentration (K)	Application (A)	Interaction (K x A)	
1.	Leaf area per plant (cm ²)				
	14 HST	tn	tn	tn	14,25
	28 HST	tn	tn	tn	11,77
	42 HST	tn	tn	tn	7,48
	56 HST	tn	tn	tn	6,78
2.	Stem diameter (mm)				
	14 HST	tn	tn	tn	11,97
	28 HST	tn	tn	tn	8,31
	42 HST	tn	tn	tn	3,68
	56 HST	tn	tn	tn	4
3.	Fresh weight per plant (g)	n	sn	tn	9,67
4.	Dry weight per plant (g)	sn	sn	tn	9,05
5.	Fruit weight per plant (kg)	sn	tn	tn	10,38
6.	Fruit sweetness (°Bx)	sn	sn	sn	0,58

Remarks: sn = very real, n = real, and tn = unreal according to the Duncan Multiple Range Test (DMRT) at a 5% error level. KK = diversity coefficient, HST = days after planting.

Leaf area per plant (cm²)

The concentration of KNO_3 fertilizer does not have a real effect on the leaf area per plant, allegedly because the treatment of the difference in the concentration of KNO_3 fertilizer is not high so that it does not have a real effect on the growth of the leaf area. According to research by Palupi et al. (2017), the addition of potassium can increase the leaf area and stem circumference in melon plants. According to Sulistyowati (2011), by providing enough nitrogen elements to plants, they will grow large and the leaves can develop well for the photosynthesis process. In addition, the KNO_3 application is less efficient because it is only applied 4 times, if you look at the long life of the melon harvest, there is a possibility of further application. This causes the treatment applied to show no real effect on the leaf area per plant.

Stem diameter (cm)

The concentration of KNO_3 fertilizer has no real effect on the stem diameter, it is suspected that because the treatment of the difference in the concentration of KNO_3 fertilizer is not high so that it does not have a real effect on the development of the stem. According to Kamaratih & Ritawati (2020), nitrogen supports the vegetative growth of plants because it plays a role in the formation of cells and tissues within plant stems. the addition of nitrogen to plants plays a role in stimulating the growth of branches, stems, and leaves of melon plants (Kamaratih & Ritawati, 2020). KNO_3 fertilizer contains nitrogen and potassium elements to stimulate plant growth. However, the applying

KNO₃ through spraying to leaves or pouring into the planting medium is not optimal so that the nutrients absorbed by plants are also not optimal. This causes the treatment applied to show no real effect on the stem diameter.

Fresh weight per plant and dry weight per plant (g)

The results of further tests showed that the treatment of the concentration of KNO₃ fertilizer 6 g/L produced the highest average, namely increasing the fresh weight per plant by 16.77% compared to the 0 g/L treatment and could increase the dry weight per plant by 24.35% compared to the 0 g/L treatment. The application of KNO₃ pour fertilizer treatment produced the highest average, namely increasing the fresh weight of plant crowns by 26.99% compared to spray treatment and can increase the dry weight of plant crowns by 24.84% compared to spray treatment. Full results are presented in Table 2.

Table 2. Effect of different concentrations and application of KNO₃ fertilizer on the fresh weight per plant and dry weight per plant

Treatment	FWP (g)	DWP (g)
KNO₃ Concentrations		
0 g/L (K0)	497,13 b	47,55 b
3 g/L (K1)	523,50 b	54,22 a
6 g/L (K2)	580,50 b	59,13 a
F count	5,46*	11,47**
F table	3,68	3,68
KNO₃ applications		
Spray (A1)	470,25 b	47,71 b
Pour (A2)	597,17 a	59,56 a
F count	36,32**	35,83**
F table	4,54	4,54

Remarks: Numbers followed by different letters on the same variable show a difference in the DMRT test α 5%. FWP = fresh weight weight per plant, DWP = dry weight weight per plant, * = has a real effect, and ** = has a very real effect.

The application of KNO₃ fertilizer concentrations each has a real and very real effect on the fresh weight per plant and dry weight plant crown is suspected to be due to the provision of potassium nutrients to the plant in accordance with the needs of melon plants so as to produce maximum fresh and dry crown weight. According to Imran (2017), the effect of providing good additional nutrients for plant growth can absorb sunlight well so that the photosynthesis process takes place well and will increase the fresh weight per plant and dry weight of plant. This is according to the treatment applied to the concentration of KNO₃ fertilizer showing a real effect on the fresh weight per plant and a very real effect on the dry weight per plant.

The way KNO₃ fertilizer application has a real effect on the fresh weight per plant and dry weight per plant suspected to be because the way KNO₃ is applied by spraying more maximizes the plant in absorbing nutrients, while the way KNO₃ is applied by spraying is less than optimally absorbed by plants due to evaporation. According to Sabri (2017), plants will easily regulate the absorption of fertilizer concentrations given to the soil in liquid form. This is according to the treatment applied to the way KNO₃

fertilizer is applied shows a very real effect on the fresh weight per plant and dry weight per plant.

Fruit weight per plant (kg)

The results of further tests showed that the treatment of the concentration of KNO_3 fertilizer 6 g/L produced the highest average, namely increasing the weight fruit plant by 22.1% compared to the treatment of 0 g/L. The application of KNO_3 pour fertilizer produced the highest average, namely increasing the fruit weight per plant by 6.67% compared to the spray treatment. Full results are presented in Table 3.

Table 3. The effect of differences in concentration and application of KNO_3 fertilizer on fruit weight per plant and fruit sweetness

Treatment	FWP (kg)	FS ($^{\circ}\text{Bx}$)
KNO_3 Concentrations		
0 g/L (K0)	0,95 b	13,53 c
3 g/L (K1)	1,14 a	15,20 b
6 g/L (K2)	1,16a	16,63 a
F count	8,31**	2549,34**
F table	3,68	3,68
KNO_3 applications		
Spray (A1)	1,05	15,00 b
Pour (A2)	1,12	15,23 a
F count	2,33	43,24**
F table	4,54	4,54

Remarks: Numbers followed by different letters on the same variable show a difference in the DMRT test α 5%. FW = fruit weight per plant, FS = fruit sweetness, and ** = have a very real effect.

The application of KNO_3 fertilizer concentration has a very noticeable effect on the fruit weight, allegedly because the available nutrients, especially element K, are quite balanced and in accordance with the needs of melon plants in the fruit formation process so as to maximize the weight of fruit. According to Bolly & Jeksen (2021), the size of the fruit and the quality of the fruit are influenced by the availability of element K. The increase in fruit weight is influenced by the adequacy of nutrients K because the element K plays a role in carbohydrate translocation and starch formation (Bilalang & Maharia, 2021).

In addition to the available nutrients, environmental or external factors such as sunlight, temperature, and air humidity affect the weight of melons. According to Lestari et al. (2019), the nutrient minerals used in plant metabolic processes are supported by internal and external conditions experienced by plants. This is according to the treatment applied to the concentration of KNO_3 fertilizer showing a very real effect on the fruit weight per plant.

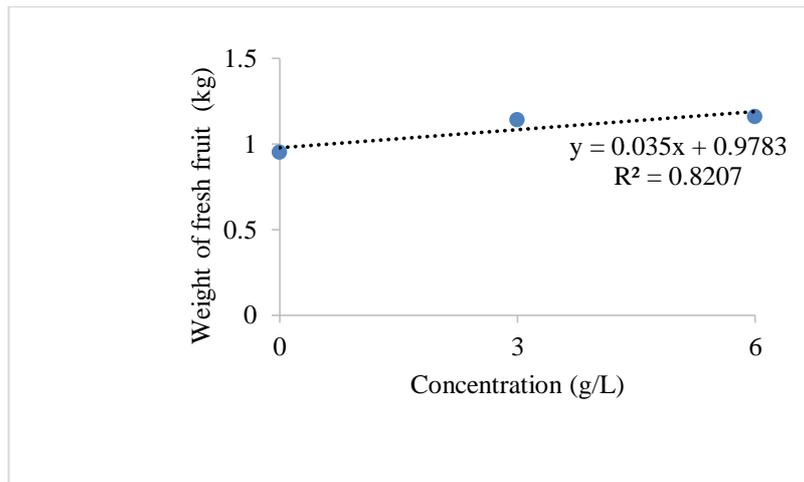


Figure 1. Graph on the fruit weight per plant at different concentrations of KNO_3 fertilizer

The results of the regression analysis (Figure 1) show that there is an influence relationship between the fruit weight per plant (kg) and the concentration of KNO_3 fertilizer. The correlation value reached 0.820 which means that there was a positive relationship between the fruit weight per plant (kg) and the concentration of KNO_3 fertilizer. The resulting regression equation is $y = 0.035x + 0.9783$, from this equation it shows that each increase in concentration per 1 g/L of KNO_3 fertilizer can increase the fruit weight per plant by 0.035 kg.

According to Kamaratih & Ritawati (2020), the development of plant roots can support the ability of the roots to absorb nutrients so as to affect plant growth and yield. In addition, in growing media and leaf tissue with sufficient water conditions and high nutrient content, it can increase the rate of photosynthesis which is used to increase the fruit weight of melons (Christy, 2020). The application of KNO_3 does not affect the fruit weight, but the availability of nutrients K that is in accordance with the needs of the melon plant in the fruit formation process affects the fruit weight per plant. This causes the treatment applied to the KNO_3 fertilizer application to show no real effect on the fruit weight per plant.

Fruit sweetness ($^{\circ}\text{Bx}$)

The results of the follow-up test showed that the treatment of the concentration of KNO_3 fertilizer 6 g/L produced the highest average, namely increasing the fruit sweetness by 22.91% compared to the treatment of 0 g/L. The application of KNO_3 pour fertilizer produced the highest average, namely increasing the fruit sweetness by 1.53% compared to the spray treatment. Full results are presented in Table 3.

The application of KNO_3 fertilizer concentration has a very noticeable effect on the sweetness level of fruits, allegedly because the nutrient content of K is enough to increase the fruit sweetness of melons. The nutrient that plays the most role in the fruit sweetness of melons is the element K. According to Bariyyah & Hadi (2023), the availability of sufficient element K in plants can improve the quality of fruits such as sugar content and fruit size. The degree of ripeness of melons also affects the fruit sweetness. According to Setiawati & Bafdal (2020), unripe melons contain starch-shaped carbohydrates so the fruit tastes unsweet.

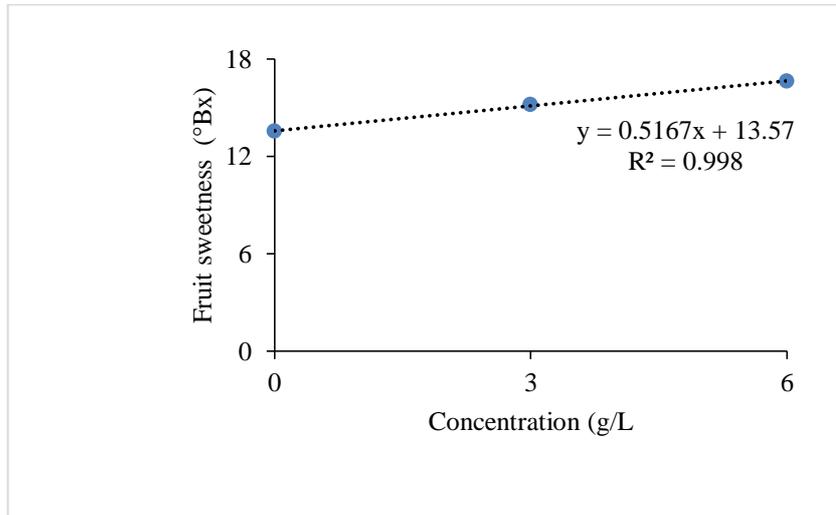


Figure 2. Graph of the fruit sweetness of melons at various concentrations of KNO_3 fertilizer

The results of the regression analysis (Figure 2) showed that there was an influence relationship between the fruit sweetness ($^{\circ}\text{Bx}$) and the concentration of KNO_3 fertilizer. The correlation value reached 0.998 which means that there was a positive relationship between the fruit sweetness ($^{\circ}\text{Bx}$) and the concentration of KNO_3 fertilizer. The resulting regression equation is $y = 0.5167x + 13.57$, from this equation it shows that each increase in concentration per 1 g/L of KNO_3 fertilizer can increase the yield per land area by 0.516 $^{\circ}\text{Bx}$.

The way KNO_3 is applied is to maximize the absorption of nutrients than spraying. The level of sweetness of fruit is influenced by the nutrient K. According to Rivandy et al. (2024), high assimilation yield translocated by plant organs to the fruit part causes a decrease an increase sweetness. This according to the treatment applied shows the results have a very real effect on the fruit sweetness.

Table 4. Interaction between treatments on fruit sweetness

Application	Concentration (g/L)		
	0 (K0)	3 (K1)	6 (K2)
Spray (A1)	13,7 d	15,15 c	16,15 b
Pour (A2)	13,35 e	15,25 c	17,1 a

Remarks: Numbers followed by different letters on the same variable show a difference in the DMRT test α 5%.

Based on table 4, the use of a concentration of 6 g/L of KNO_3 fertilizer and the method of drying showed the best results, namely the fruit sweetness 17.1 $^{\circ}\text{Bx}$. This is in accordance with the opinion of Darwiyah et al. (2021), the potassium content in KNO_3 fertilizer helps the growth, flowering, and formation of fruits and increases the sugar content of the fruit, which makes the fruit sweeter. Many dissolved solids affect the fruit sweetness expressed in the value of brix degrees ($^{\circ}\text{brix}$). The amount of sugar (brix) produced from the fruit indicates the fruit sweetness, at a high brix value indicates that the fruit is sweeter. A legend graph of the fruit sweetness of melons in different treatment combinations can be seen in Figure 3.

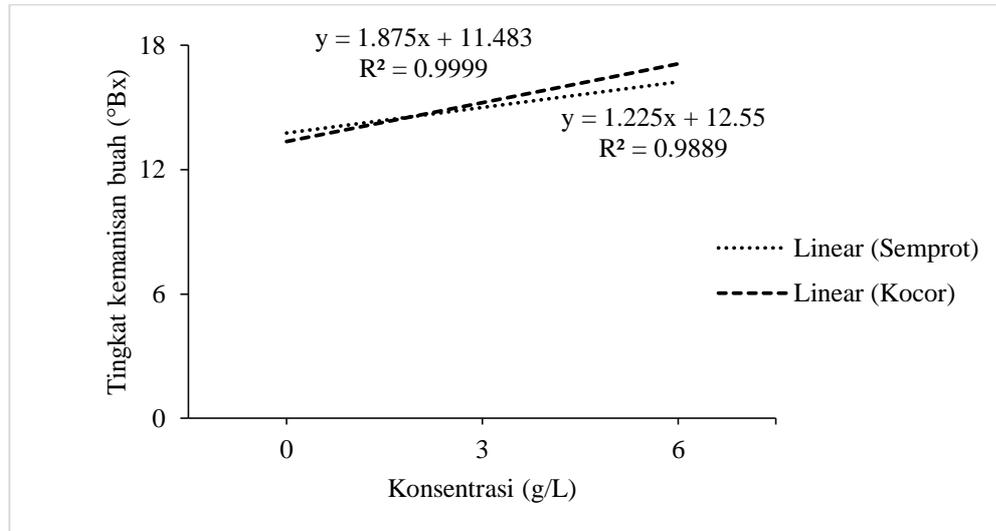


Figure 3. Legend chart the fruit sweetness of melon at various concentrations of KNO_3 fertilizer

Conclusion

The conclusion of this study is: 1). KNO_3 concentration of 6 g/L provided the best growth in the variables of fresh weight per plant ($y = 13.895x + 492.03$), dry weight per plant ($y = 1.93x + 47.843$), fruit weight per plant ($y = 0.035x + 0.9783$), and fruit sweetness ($y = 0.5167x + 13.57$); 2). The application of KNO_3 provided the best growth in the variables of fresh weight per plant ($y = 126.92x + 343.33$), dry weight per plant ($y = 11.85x + 35.86$), and fruit sweetness ($y = 0.23x + 14.77$); 3). The combination of KNO_3 fertilizer at a concentration of 6 g/L, used with the pouring method, was the most effective for increasing both fruit sweetness ($y = 1,875x + 11,483$).

The suggestion of this research is that in the cultivation of hydroponic melon plants of the Golden Aroma variety, the application of KNO_3 fertilizer is carried out 5 times until the harvest age of melons to maximize melon growth and yield.

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