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The Effect of Number of Branches and Level of Nitrogen Fertilizer on Growth and Yield of Melon (*Cucumis melo* L.)

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Abstract— *This study was conducted with the aim of examining the effect of the number of branches and the level of nitrogen fertilization on the growth and yield of melon (Cucumis melo L.). The study was conducted using a factorial completely randomized design (CRD) with two factors, namely, the number of branches (J1: 1 branch and J2: 2 branches) and the level of nitrogen fertilization (N150, N175, N200, N225 and N250). Observation parameters included plant length, number of leaves, leaf area, flowering time, number of flowers, chlorophyll content, and fruit yield (quality). The results showed that the number of branches and the level of nitrogen fertilizer gave significant results on growth parameters. The application of a higher nitrogen fertilizer level of 250 kg N ha^{-1} generally increased plant growth in the 1 branch treatment (J1) and increased fruit weight in the 2 branch treatment (J2). This study indicates that the right number of branches and nitrogen fertilization levels can increase melon production.*

Keywords— ***Number of branches, N fertilizer, Melon***

I. INTRODUCTION

Melon or muskmelon is a horticultural plant that has a production level of 27.3 t ha^{-1} in the world. According to Rosa *et al*. (2017), planting or cultivating melons requires a minimum soil temperature of 15˚ C for germination and 20-30˚ C for growth, because melons are plants that require a warm environment.

In Indonesia, melon fruit consumption reaches ± 332,698 t year^{-1} (Widaryanto *et al*., 2017).The high demand for melon commodities has resulted in an increase in farmers income (Makful *et al*., 2017). However, melon production in East Java Province has decreased from 68,520 t ha^{-1} in 2021 to 62,286 t ha^{-1} in 2022. This is thought to be due to climate factors and less than optimal cultivation practices.

The nutrient N plays an important role in higher yields. Strengthened by the opinion of Leghari *et al*. (2016) that the N rate can increase the photosynthesis process, leaf area, and net assimilation rate, where the maximum leaf area and total leaf biomass of the plant are determinants of higher harvest yields.

In melon plants, optimizing branch management can increase light interception and increase photosynthesis efficiency, which is important for melon development and quality (Leite *et al*., 2023)

Branch pruning and fertilizer application are important factors that can affect melon growth and yield, so this study was conducted to determine the effect of the number of branches on melon yield, evaluate the effect of nitrogen fertilization levels on growth and production, and identify interactions between the number of branches and nitrogen fertilizer levels on melon plant growth and yield.

This research is expected to provide useful information for melon farmers in increasing melon production through optimal branch number management and nitrogen fertilization.

II. MATERIALS AND METHODS

2.1 Time and place

This research will be conducted from April to July 2024 in the greenhouse of UPT. Puspa Lebo on Jl. Raya Lebo No.48, Kec. Sidoarjo, Kab. Sidoarjo, East Java 61223, with an altitude of 6 meters above sea level.

2.2 Tools and materials

The tools used are scissors, thread/rope, scales, mulch, SPAD, Refractometer and Leaf Area Meter (LAM). While the materials used are melon seeds var. Red Pearl Melon, Urea fertilizer and ZA fertilizer.

2.3 Research methods

This study used a factorial completely randomized design (CRD) with two factors. Factor 1 is (Number of branches), namely J1 : Number of 1 branch (Cultivate 1 branch) and J2 : Number of 2 branches (Cultivate 2 branches). Factor 2 is (N fertilizer level), namely N150 (150 Kg N ha^{-1}), N175 (175 Kg N ha^{-1}), N200 (200 Kg N ha^{-1}), N225 (225 Kg N ha^{-1}) and N250 (250 Kg N ha^{-1})

In the combination of treatments, 10 treatment combinations were obtained which were repeated 3 times with 6 plant samples. The plant requirements for this study were 180 plants.

Branch pruning is done when the plant is 15 DAP. In the number of 1 branch, pruning is done on all lateral branches and leaving the main branch. While in the number of 2 branches, lateral branches that have the same size are selected.

Fertilization is done 3 times, namely at the age of 15, 22 and 29 DAP. Nitrogen fertilizer is applied in granular form and placed in the fertilizer hole with a distance of 5 cm from the planting hole.

Growth observations including plant length and number of leaves were conducted once a week after fertilization. Leaf area was observed twice at the age of 22 and 36 DAP using LAM with ALA method (*Average Leaf Area*). Chlorophyll was observed twice at 30 and 44 DAP using SPAD. Fruit weight, brix˚ and vitamin C were observed after harvest.

ALA formula: (Widaryanto *et al*., 2020)

$$A_y = n_y \times \bar{A}_s$$

Description :

A_y : Total leaf area (cm^2)

n_y : Number of leaves

$\bar{A}_s$: Average leaf area (cm^2)

2.4 Data analysis

From the observation results that have been obtained, then analyzed using ANOVA in the form of a 5% level F test. If there are real results, then continued with the Smallest Real Difference (LSD) test.

III. RESULTS

3.1 The Effect of Number of Branches and Level of N Fertilizer on Melon Plant Growth

This study shows research results based on observations of various growth parameters such as plant length, leaf area, flowering time of male flowers and chlorophyll.

At increasing levels of N fertilizer showed increasing growth in various treatments of the number of branches. (Table 1) shows that the number of branches and the level of N fertilizer have an effect on the growth of melon plant length. The level of N250 fertilizer gave significantly higher results in various treatments of the number of branches.

Table 1. Effect of Interaction between Number of Branches and N Fertilizer Level on Melon Plant Length

Treatment	Plant length (cm) at 29 DAP									
	N150		N175		N200		N225		N250	
J1	126,6 B	a	154,3 B	b	160,6 B	Bc	168,7 A	cd	176,4 A	d
J2	101,6 A	a	125,3 A	b	133,2 A	b	160,3 A	c	171,0 A	d
LSD 5%	11,57									
CV (%)	4,59									

Description: Numbers followed by the same lower case letter in the same row or the same upper case letter in the same column indicate no difference based on the 5% LSD test. DAP = days after planting, CV = coefficient of variation, J = number of branches, N = level of nitrogen fertilizer

The leaf area of melon plants presented in (Table 2) shows the interaction between the number of branches and the level of N fertilizer. At the N250 fertilizer level, the leaf area was wider in various treatments of the number of branches.

(Table 3) shows the chlorophyll content in various treatments of the number of branches and the level of N fertilizer. In the treatment of 1 branch (J1) at the N225 and N250 fertilizer levels, the chlorophyll content was higher. While in the treatment of 2 branches (J2), at the N250 fertilizer level, the chlorophyll content was higher, but not different from N200 and N225.

Table 2. Effect of Interaction between Number of Branches and N Fertilizer Level on Melon Leaf Area

Treatment	Leaf area (cm^2 $plant^{-1}$) at 36 DAP				
	N150	N175	N200	N225	N250
J1	561,9 a A	625,6 ab A	723,6 b A	749,7 b B	757,9 b A
J2	499,8 a A	600,2 ab A	617,4 ab A	610,8 ab A	677,8 b A
LSD 5%	133,66				
CV (%)	12,19				

Description: Numbers followed by the same lower case letter in the same row or the same upper case letter in the same column indicate no difference based on the 5% LSD test. DAP = days after planting, CV = coefficient of variation, J = number of branches, N = level of nitrogen fertilizer

Table 3. Effect of Interaction between Number of Branches and N Fertilizer Level on Chlorophyll

Treatment	Chlorophyll (mg g^{-1}) at 44 DAP				
	N150	N175	N200	N225	N250
J1	65,06 a A	65,53 a A	77,98 b A	93,56 c B	91,00 c B
J2	69,81 a A	66,51 a A	81,68 b A	81,89 b A	82,26 b A
LSD 5%	7,85				
CV (%)	5,90				

Description: Numbers followed by the same lower case letter in the same row or the same upper case letter in the same column indicate no difference based on the 5% LSD test. DAP = days after planting, CV = coefficient of variation, J = number of branches, N = level of nitrogen fertilizer

3.2 The Effect of Number of Branches and Level of N Fertilizer on Melon Plant Yield

The results of the study showed that there was an interaction between the number of branches and the level of fertilizer. As shown in (Table 4), the number of branches and the level of N fertilizer treatment had an effect on the time of male flowers appearing. At the number of 1 branch (J1) at the N150 fertilizer level, the male flower flowering time was the fastest compared to other fertilizer levels, the higher the N fertilizer level, the faster the flowering time. While at the number of 2 branches (J2) at the N250 fertilizer level, the flowering time was longer, the higher the N fertilizer level, the longer the flowering time.

In (Table 5), the weight of fruit per plant and (Table 6), the weight per fruit are shown. The weight of fruit in the treatment of 1 branch number (J1) with a fertilizer level of N200 produces a heavier weight. While in the treatment of 2 branches (J2) with a fertilizer level of N250, the weight of fruit is heavier.

In (Table 7), the fruit diameter with the treatment of 1 branch (J1) and fertilizer levels N225 and N250 showed a significantly larger fruit diameter. While the number of 2

branches (J2) at the fertilizer level N250 gave a significantly larger fruit diameter, but no different from N200 and N225.

Table 4. Effect of Interaction between Number of Branches and N Fertilizer Level on Male Flowering Time

Treatment	Flowering time of male flowers (flowers plant^{-1})				
	N150	N175	N200	N225	N250
J1	19,39 c A	18,72 b A	18,17 A A	18,61 ab A	18,11 a A
J2	19,11 a A	19,34 ab B	19,44 abc B	19,81 bc B	19,89 c B
LSD 5%	0,54				
CV (%)	1,67				

Description: Numbers followed by the same lower case letter in the same row or the same upper case letter in the same column indicate no difference based on the 5% LSD test. DAP = days after planting, CV = coefficient of variation, J = number of branches, N = level of nitrogen fertilizer

Table 5. Effect of Interaction between Number of Branches and N Fertilizer Level on Fruit Weight Per Plant

Treatment	Fruit weight (g plant^{-1})				
	N150	N175	N200	N225	N250
J1	1392 a A	1490 ab A	1843 b A	1637 ab A	1576 ab A
J2	1897 a B	2228 ab B	2600 b B	2658 bc B	3085 c B
LSD 5%	432,7				
CV (%)	12,43				

Description: Numbers followed by the same lower case letter in the same row or the same upper case letter in the same column indicate no difference based on the 5% LSD test. DAP = days after planting, CV = coefficient of variation, J = number of branches, N = level of nitrogen fertilizer

Table 6. Effect of Interaction between Number of Branches and N Fertilizer Level on Fruit Weight Per Fruit

Treatment	Fruit weight (g fruit^{-1})				
	N150	N175	N200	N225	N250
J1	1392 a A	1490 a A	1843 b B	1637 ab A	1576 ab A
J2	1259 a A	1265 a A	1491 a A	1749 b A	2944 b B
LSD 5%	299,0				
CV (%)	11,17				

Description: Numbers followed by the same lower case letter in the same row or the same upper case letter in the same column indicate no difference based on the 5% LSD test. DAP = days after planting, CV = coefficient of variation, J = number of branches, N = level of nitrogen fertilizer

Table 7. Effect of Interaction between Number of Branches and N Fertilizer Level on Fruit Diameter

Treatment	Fruit diameter (cm fruit^{-1})									
	N150		N175		N200		N225		N250	
J1	19,11	a	21,67	ab	22,61	ab	20,39	b	20,39	b
	A		B		A		A		A	
J2	18,33	a	18,94	a	23,78	b	24,44	b	26,00	b
	A		A		A		B		B	
LSD 5%	2,54									
CV (%)	6,89									

Description: Numbers followed by the same lower case letter in the same row or the same upper case letter in the same column indicate no difference based on the 5% LSD test. DAP = days after planting, CV = coefficient of variation, J = number of branches, N = level of nitrogen fertilizer

Table 8. Effect of Interaction between Number of Branches and N Fertilizer Level on Brix˚ Content

Treatment	Brix˚ fruit^{-1}									
	N150		N175		N200		N225		N250	
J1	9,50	a	8,51	a	8,43	a	8,31	a	7,92	b
	B		A		A		A		A	
J2	7,37	a	7,83	a	9,28	b	9,36	b	9,97	b
	A		A		B		B		B	
LSD 5%	0,83									
CV (%)	5,66									

Description: Numbers followed by the same lower case letter in the same row or the same upper case letter in the same column indicate no difference based on the 5% LSD test. DAP = days after planting, CV = coefficient of variation, J = number of branches, N = level of nitrogen fertilizer

Furthermore, in (Table 8) on the brix˚ content parameters of the number of branches and N fertilizer levels, there is an interaction. In the treatment of 1 branch (J1) and N250 fertilizer levels, the highest real brix˚ content results were obtained. While in the treatment of 2 branches (J2) and N250 fertilizer levels, the results were significantly higher, but not different from N200 and N225.

IV. DISCUSSION

4.1 The effect of number of branches and N fertilizer levels on melon growth

To obtain good plant growth, good management is also needed, such as plant care, appropriate fertilizer doses and also environmental conditions that are suitable for the cultivated plants. In this study, the treatment of the number of branches and the level of N fertilizer was used, where the number of branches is included in the biotic factor and the level of N fertilizer is included in the edaphic factor.

In the treatment of the number of branches and the level of N fertilizer showed an increase in the growth of melon plants. In the parameters of plant length, leaf area, flowering time of male flowers and chlorophyll content of plants, it was shown that the increasing level of nitrogen fertilizer applied to the treatment of the number of branches could increase plant growth. In the treatment of the number of 1 branch (J1) at the application of N225 and N250 fertilizer levels gave optimal plant growth results compared to the treatment of the number of 2 branches (J2). This is thought to occur due to intraception competition, because the planting distance in the treatment of the number of 2 branches (J2) was too close and resulted in less than optimal growth. According to Mardhiana *et al*. (2017) the more branches and too close, the less light the plant will get so that growth tends to decrease.

In addition, small leaf area also affects plant growth. Leaves are the part of the plant that plays a role in producing nutrients for plants. Leaves absorb light, CO_2 and also water so that glucose and O_2 can be produced through the process of photosynthesis. Glucose is related to the activity of photosystem II and photochemical reactions that increase total chlorophyll, photosynthesis rate, stomatal conductance and rubisco activity in photosystem I (Limbongan *et al*, 2023)

With the addition of optimal N fertilizer, it can produce better plant growth. Increasing the dose of N fertilizer significantly increases plant vegetative growth (Mardhiana *et al*., 2017).Nitrogen application affects chlorophyll content and plant yield (Li *et al*., 2011; Zhang *et al*., 2020)

4.2 Effect of number of branches and N fertilizer level on melon yield

Generative growth in this study includes the flowering time of male flowers, fruit weight, fruit diameter and also the brix˚ content of the plant. Significantly, the treatment of 1 branch (J1) and the N150 fertilizer level gave the fastest male flower emergence time. In the treatment of 1 branch (J1) the plant nutrients were sufficient and not divided, as in the study of Erniati *et al*. (2023), stating that melon plants with fewer branches will have faster initial growth, but do not always produce better fruit. Increasing the dose or level of N can affect the distribution pathway that regulates the transition from the vegetative to the generative phase (Vidal *et al*., 2014). In line with the opinion of (Andre *et al*., 2017), that increasing nitrogen levels tend to increase the number of male and female flowers in melons.

In the treatment of 2 branches (J2) and fertilizer levels of N225 and N250 showed better results in fruit weight, fruit diameter and also brix˚ content than the treatment of 1 branch (J1). It is suspected that this occurs because the distribution of photosynthate in the treatment of 2 branches (J2) is greater, thus supporting the growth of melon fruit *(Mendonça et al*., 2021). In addition, the treatment of 2 branches (J2) has more growing points so that it can increase the potential for harvest yields. The hormones ethylene and abscisic acid also play a role in fruit growth. According to (Zhou *et al*., 2023), ethylene is the main regulator in fruit ripening which interacts with abscisic acid for fruit growth and development. With the addition of optimal nitrogen, it can contribute to increasing fruit diameter and weight (Parmar *et al*., 2023). In the treatment of 1 branch (J1) with an N fertilizer level of more than 50% tends to reduce fruit weight and fruit diameter. This shows that there is an optimal limit for nitrogen use to obtain maximum fruit growth (Olesińska *et al*., 2021).

Meanwhile, according to (Park and Seo, 2012), the application of N fertilizer affects the quality of melons, such as fruit size, texture and also the level of fruit sweetness (Brix˚). Nitrogen plays a role in the formation of chlorophyll which can increase sugar accumulation in the fruit (Assunção *et al*., 2020)

In (Fig 1) it is shown that the number of 1 branch (J1) of fruit weight/plant , the polynomial equation obtained is $y = -0.1003x^2 + 42.183x - 2711.6$ with $R^2 = 0.3669$ shows that the optimal N dose used is 210.28 kg N ha^{-1} with a fruit weight of 1,72 tons ha^{-1}. While in the treatment of the number of 2 branches (J2) fruit weight $fruit^{-1}$, the polynomial equation $y = 0.0417x^2 - 9.0924x + 1648.5$ was obtained with an $R^2 = 0.76677$. The optimal N dose obtained is 109,02 with fruit weight 1,15 tons ha^{-1}.

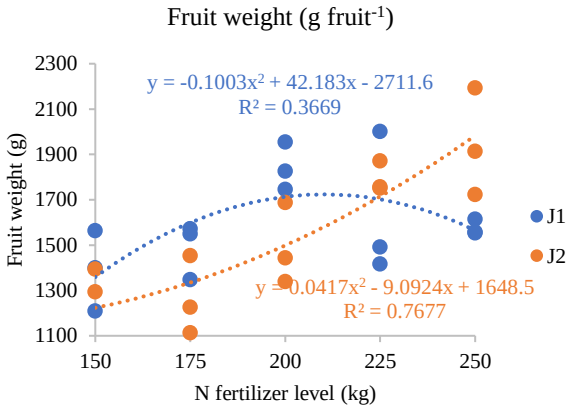

Fig 1. Interaction between number of branches and N fertilizer on melon fruit weight.

The interaction of the number of branches and N fertilizer on fruit diameter is shown in (Fig 2). At the number of 1 branch (J1) fruit diameter, the polynomial equation is obtained $y = -0.0009x^2 + 0.3835x - 16.847$ with an $R^2 = 0.3311$ which shows the optimal N dose is 213,16 kg N ha^{-1} and a fruit diameter of 24,01 cm^2. While at the number of 2 branches (J2) fruit diameter, the polynomial equation is $y = -0.0003x^2 + 0.1877x - 4.4806$ with an $R^2 = 0.8086$ which shows the optimal N dose is 312,84 kg N ha^{-1} and a fruit diameter of 24,88 cm^2.

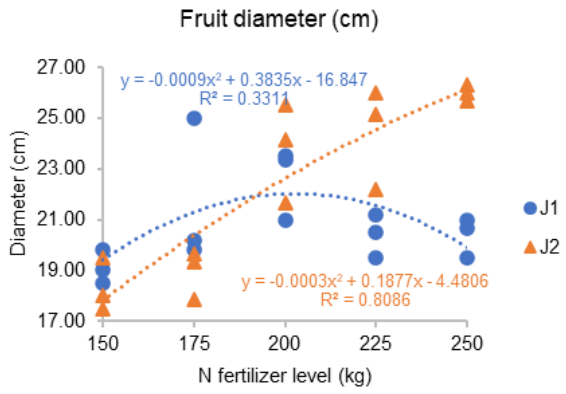

Fig 2. Interaction between the number of branches and N fertilizer on melon fruit diameter.

Furthermore, in the brix˚ content of melon fruit shown in (Fig 3).

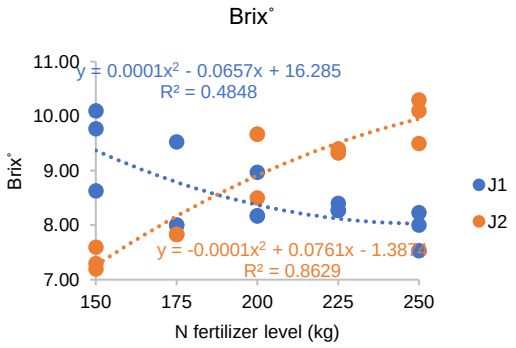

Fig 3. Interaction between the number of branches and N fertilizer on the brix˚ content of melon fruit

The brix˚ content in the number of 1 branch (J1) shows the results of the polynomial equation $y = 0.0001x^2 - 0.0657x + 16.285$ with $R^2 = 0.4848$ which produces a brix˚ content of 5.49. Meanwhile, the brix˚ content is obtained from a polynomial equation, namely $y = -0.0001x^2 + 0.0761x - 1.3874$ with $R^2 = 0.8629$ and the optimal N dose is 380.5 kg N ha^{-1} which produces a brix˚ content of 13.09.

V. CONCLUSION AND SUGGESTIONS

5.1 Conclusion

1. Increasing the dose of nitrogen fertilizer, especially 250 kg ha^{-1}, affects the weight of melon fruit. Higher fertilizer levels increase fruit production.

2. The number of 2 branches (J2) produces heavier fruit weight, while the number of 1 branch (J1) tends to increase the vegetative growth of the plant.

3. The interaction of the treatment of 2 branches (J2) and a nitrogen fertilizer level of 250 kg ha^{-1} provides more optimal fruit yields.

5.2 SUGGESTIONS

Further research can be conducted with more varied fertilizer doses to determine the optimal fertilizer dose for each number of melon branches.

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