



ANALYSIS OF NUTRIENT STRESS IN THE GROWTH PHASE OF CHERRY TOMATOES (*SOLANUM LYCOPERSICUM* VAR. *CERASIFORME*) HYDROPONICALLY.

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Abstract

One solution to urban farming is hydroponic cultivation. Currently, the development of the world of agriculture, especially in the field of hydroponics, is increasingly rapid. When compared to conventional farming, hydroponics has advantages that conventional farming does not have. One plant that is often cultivated hydroponically is the cherry tomato plant. The growth and production of tomatoes with a good hydroponic system requires the right concentration and volume of nutrients. This research used a non-factorial randomized block design (CRD) with Nutrient concentration (N) treatment, consisting of 5 levels, namely: N1 = 800 ppm, N2 = 900 ppm, N3 = 1000 ppm, N4 = 1100 ppm and N5 = 1200 ppm. The results showed that nutrient concentration had an effect on the generative growth phase, but had no significant effect on the vegetative growth phase of cherry tomato plants. Nutrient concentration influences the morphology and physiology of cherry tomato plants. Nutrient concentration had a significant effect on the production of cherry tomato plants hydroponically with the heaviest fruit weight per plant found in the AB Mix nutrient concentration of 1000 ppm (N3) of 97.89 g.

Keywords: *Plant Length, Header Wet Weight, Root Wet Weight, Root Dry Weight*

1. INTRODUCTION

One solution to urban farming is hydroponic cultivation. Currently, the development of the world of agriculture, especially in the field of hydroponics, is increasingly rapid. When compared to conventional farming, hydroponics has advantages that conventional farming does not have. The most important advantage of growing hydroponically is that the production is healthy because it is free from pesticides. Hydroponic vegetables or fruit have better quality than results from conventional cultivation. Therefore, middle to upper economic class people generally prefer hydroponic vegetables and fruit (Sutanto, T. 2015). The growth and production of tomatoes with a good hydroponic system requires the right concentration and volume of nutrients. Tomatoes can grow well in a nutrient solution that has a concentration of 517 ppm - 1238 ppm. Environmental factors such as solar radiation, temperature and water quality also influence tomato growth, production and quality (Resh, HM 2012). The quality of hydroponic tomatoes is influenced by the environment in which the plants are grown, including light levels and nutrient content in the feed. A high proportion of potassium in the nutrient solution can increase lycopene production and total soluble solids. (Fanasca, 2016) Higher sulfur content can increase lycopene production while low N produces positive effects on vitamin C and some phenolics (Zelena, 2019). However, research on hydroponic cherry tomatoes using an irrigation system has not been widely reported. Therefore, based on this background, this research will identify the response of cherry tomatoes to nutrient concentration treatment in the vegetative and generative growth phases hydroponically using a wick system.

2. RESEARCH METHODS

This research was carried out in the Kasa House in the hydroponic garden on Jalan Nusa Indah I, Medan Tuntungan. With a height of $\pm$ 30 meters above sea level. This research was conducted from April 2022 to July 2022. This research used a non-factorial Randomized Block Design (CRD) with Nutrient concentration (N) treatment, consisting of 5 levels: N1 = 800 ppm, N2 = 900 ppm, N3 = 1000 ppm, N4 =



1100 ppm and N5 = 1200 ppm. The research was carried out with 3 replications. The parameters observed were plant length, fruit weight per plant, shoot wet weight, root wet weight, shoot dry weight, root dry weight and vitamin C content.

Data analysis was carried out using analysis of variance (ANOVA), with a mean difference test, namely the BNJ test with a level of 5%.

3. RESULTS AND DISCUSSION

Plant Length

The results of the analysis of variance showed that the nutrient concentration treatment had no significant effect on the length of Cherry tomato plants at all ages of observation. The average length of Cherry tomato plants due to different nutrient concentration treatments at 2, 3 and 4 WAP can be seen in Table 1.

Table 1. Cherry Tomato Plant Height Due to Different Nutrient Concentrations at Age 2, 3 and 4 WAP

Treatment	Plant Height(cm)		
	2 WAP	3 WAP	4 WAP
N1	21.63	47.75	76.83
N2	21.42	47.17	75.75
N3	21.67	46.17	72.83
N4	22.42	48.58	76.67
N5	21.71	46.33	74.50

Table 2 shows that differences in nutrient concentrations do not result in different tomato plant heights at each age of observation. Using a nutrient solution with a concentration of 800 ppm is optimal enough to support the height growth of cherry tomato plants at each growth phase.

Fruit Weight per Plant

The results of variance analysis showed that the nutrient concentration treatment had a significant effect on fruit weight per plant. The average weight of plant fruit due to different nutrient concentration treatments can be seen in Table 2.

Table 2. Fruit Weight per Plant Due to Different Nutrient Concentrations

Treatment	Fruit Weight per Plant (g)
N1	78.56abc
N2	90.06bc
N3	97.89c
N4	59.73ab
N5	55.70a
BNJ0.05	31.81

Note: Numbers followed by the same letter in the same column mean that they are not significantly different in the BNJ test at the 5% level

Table 2 shows that the heaviest cherry tomato fruit weight per plant was found at a nutrient concentration of 1000 ppm (N3) of 97.89 g which was significantly heavier than at concentrations of 1100 ppm (N4) and 1200 ppm (N5), but was not significantly different from a concentration of 800 ppm (N1) and 900 ppm (N2). The effect of nutrient concentration on fruit weight per plant can be seen in Figure 1.

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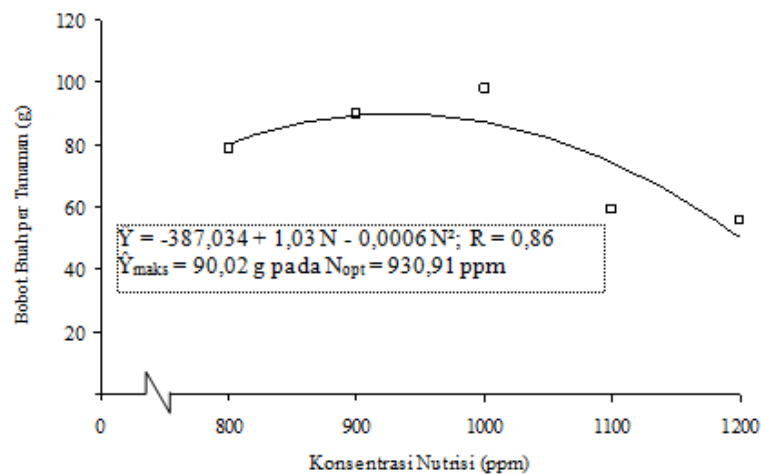


Figure 1. Effect of Nutrient Concentration on Fruit Weight per Plant

Figure 1 shows that providing nutrients with a concentration of 930.91 ppm produces a maximum fruit weight per plant of 90.02 g. This shows that the provision of nutrients has reached the optimum concentration at 930.91 ppm. Providing nutrition above a concentration of 930.91 ppm can reduce fruit weight per plant. The higher the concentration of nutrients (concentrated), the more nutrients contained in the nutrients, where the AB Mix nutrient solution contains various nutrients needed for hydroponic plant growth, in the form of macro nutrients N, P, K, Mg, Ca and S and micro nutrients Fe, Mn, Zn, B, Cu and Mo, while the elements H, C and O are obtained by plants from air and water. (Subandi, M. 2015).

Header Wet Weight

The results of the analysis of variance analysis of the nutrient concentration treatment had no significant effect on the wet weight of the canopy in the vegetative phase, but has a real effect on generative. The average wet weight of the crown in the vegetative and generative phases of Cherry tomato plants due to different nutrient concentration treatments can be seen in Table 3.

Table 3. Header Wet Weight of Cherry Tomato Plants in the Vegetative and Generative Phases

Due to Different Nutrient Concentrations		
Treatment	Wet Weight Header(g)	
	Vegetative Phase	Generative
N1	30.63	335.67b
N2	28.83	369.00b
N3	22.77	182.67a
N4	26.57	379.67b
N5	25.57	167.33a
BNJ0.05		123.56

Note: Numbers followed by the same letter in the same column meaning that they are not significantly different in the BNJ test at the 5% level

The heaviest wet weight of the canopy in the generative phase was found in the N4 treatment (1100 ppm) at 379.67 g is significantly different from treatments N3 (1000 ppm) and N5 (1200 ppm), but not different from treatments N1 (800 ppm) and N2 (900 ppm). The influence of nutrient concentration on the wet weight of cherry tomato plant crowns in the generative phase can be seen in Figure 2, where the effect of nutrient concentration on the wet weight of cherry tomato plant crowns in the generative phase follows a linear regression curve. The use of higher concentrations of AB Mix nutrients reduces the wet weight of cherry tomato plant crowns in the generative phase.

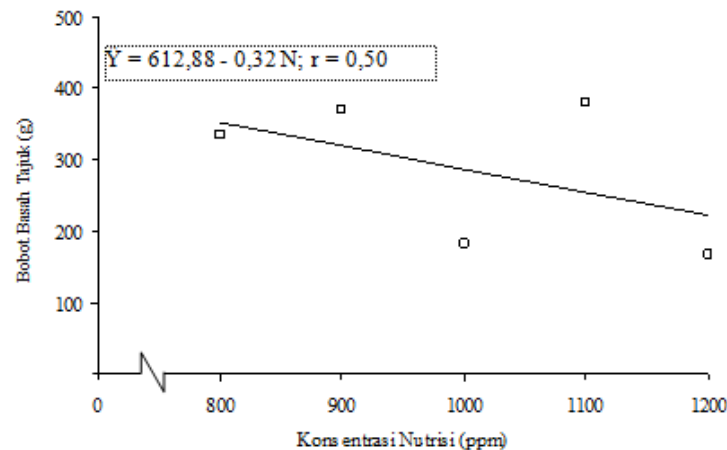


Figure 2. The Effect of Nutrient Concentration on Wet Weight of Cherry Tomato Plants in the Generative Phase

Increasing the nutrient solution concentration above 800 ppm can reduce the wet weight of plant roots. This shows that using a nutrient solution concentration of 800 ppm has maximally increased the wet weight of plant roots. Plant root growth occurs due to cell division activity which causes an increase in the number and size of cells. This growth process cannot be separated from the occurrence of physiological activities in the plant body. Plant root growth is related to the number of plant leaves, where the more leaves there are, the more photosynthesis in the plant will increase. Increasing photosynthesis will increase photosynthate which is translocated in the growth of plant roots and leaves. The greater number of leaves allows for more even distribution of light between the leaves. A more even distribution of light will reduce the occurrence of mutual shading of plant leaves. Leaf area will increase the wet weight of the greater canopy. (Syahputra, 2014)

Root Wet Weight

The results of the analysis of variance analysis of the nutrient concentration treatment had no significant effect on the wet weight of the roots in the vegetative phase, but has a real effect on generative. The average wet root weight in the vegetative and generative phases of Cherry tomato plants due to different nutrient concentration treatments can be seen in Table 4.

Table 4. Root Wet Weight of Cherry Tomato Plant Roots in the Vegetative and Generative Phases Due to Different Nutrient Concentrations

Treatment	Root Wet Weight (g)	
	Vegetative Phase	Generative
N1	6.23	81.67bc
N2	6.90	93.67c
N3	3.83	57.00ab
N4	5.23	80.33bc
N5	5.67	43.00a
BNJ0.05	-	34.08

Note: Numbers followed by the same letter in the same column meaning that they are not significantly different in the BNJ test at the 5% level

The heaviest wet root weight in the generative phase was found in treatment N1 (800 ppm) at 81.67 g is significantly different from treatments N3 (1000 ppm) and N5 (1200 ppm), but not different from treatments N2 (900 ppm) and N4 (1100 ppm). The effect of nutrient concentration on the wet weight of cherry tomato plant roots in the generative phase can be seen in Figure 3.

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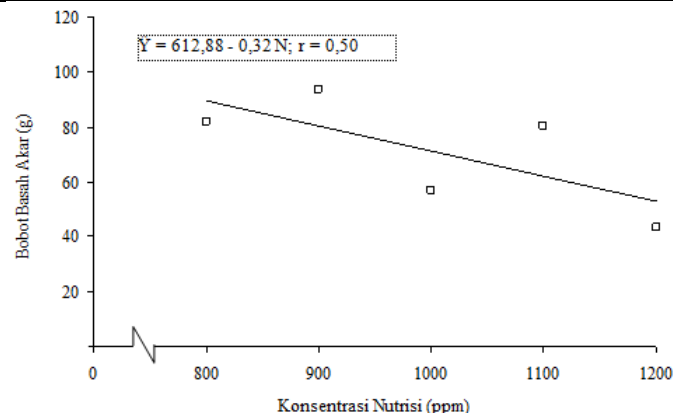


Figure 3. Effect of Nutrient Concentration on Wet Weight of Cherry Tomato Plant Roots in the Generative Phase

Figure 3 shows that the effect of nutrient concentration on the fresh weight of cherry tomato plant roots in the generative phase follows a linear regression curve. The use of higher concentrations of AB Mix nutrients reduces the wet weight of cherry tomato plant roots in the generative phase.

Header Dry Weight

The results of analysis of variance analysis of nutrient concentration treatment had no significant effect on canopy dry weight in the vegetative phase, but has a real effect on generative. The average dry weight of the crown in the vegetative and generative phases of Cherry tomato plants due to different nutrient concentration treatments can be seen in Table 5.

Table 5. Head Dry Weight of Cherry Tomato Plants in the Vegetative and Generative Phases Due to Different Nutrient Concentrations

Treatment	Head Dry Weight (g)	
	Vegetative Phase	Generative
N1	3.98	73.33b
N2	4.54	110.33c
N3	3.76	42.00a
N4	4.40	91.33bc
N5	4.62	25.67a
BNJ0.05	-	30.63

Note: Numbers followed by the same letter in the same column mean that they are not significantly different in the BNJ test at the 5% level

The heaviest dry weight of the canopy in the generative phase was found in the N2 (900 ppm) treatment of 110.33 g is significantly different from treatment N1 (800 ppm), N3 (1000 ppm) and N5 (1200 ppm), but not different from treatment N4 (1000 ppm). The effect of nutrient concentration on the dry weight of cherry tomato plant shoots in the generative phase can be seen in Figure 4.

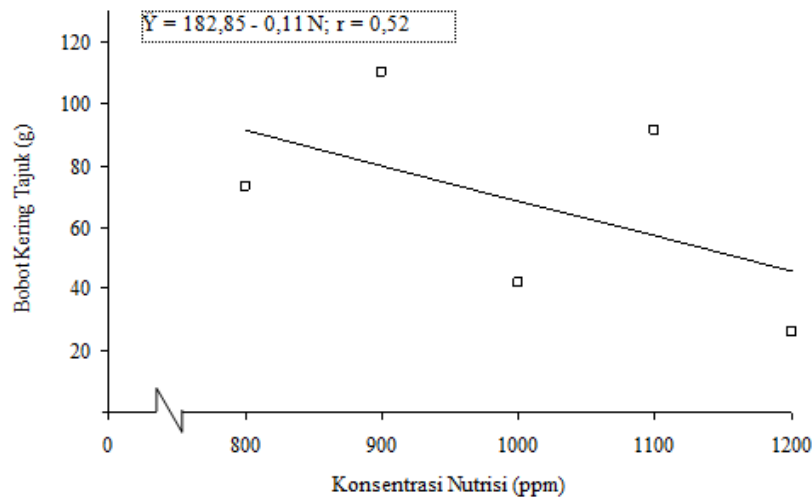


Figure 4. The Effect of Nutrient Concentration on Dry Weight of Cherry Tomato Plants in the Generative Phase

Figure 4 shows that the effect of nutrient concentration on the shoot dry weight of Cherry tomato plants in the generative phase follows a linear regression curve. The use of higher concentrations of AB Mix nutrients reduces the dry weight of cherry tomato plant shoots in the generative phase.

Root Dry Weight

The results of the analysis of variance analysis of nutrient concentration treatment had no significant effect on root dry weight in the vegetative phase, but has a real effect on generative. The average dry weight of roots in the vegetative and generative phases of Cherry tomato plants due to different nutrient concentration treatments can be seen in Table 6.

Table 6. Root Dry Weight of Cherry Tomato Plants in Vegetative and Generative Phases Due to Different Nutrient Concentrations

Treatment	Root Dry WeightDry Weight (g)	
	Vegetative Phase	Generative
N1	1.84	8.59ab
N2	2.00	11.52b
N3	1.75	5.96a
N4	1.91	6.94a
N5	2.04	4.66a
BNJ0.05	-	4.29

Note: Numbers followed by the same letter in the same column mean that they are not significantly different in the BNJ test at the 5% level

The heaviest root dry weight in the generative phase was found in the N2 (900 ppm) treatment of 11.52 g is significantly different from treatment N3 (1000 ppm), N4 (1100 ppm) and N5 (1200 ppm), but not different from treatment N1 (800 ppm). The effect of nutrient concentration on the dry weight of cherry tomato plant roots in the generative phase can be seen in Figure 5.

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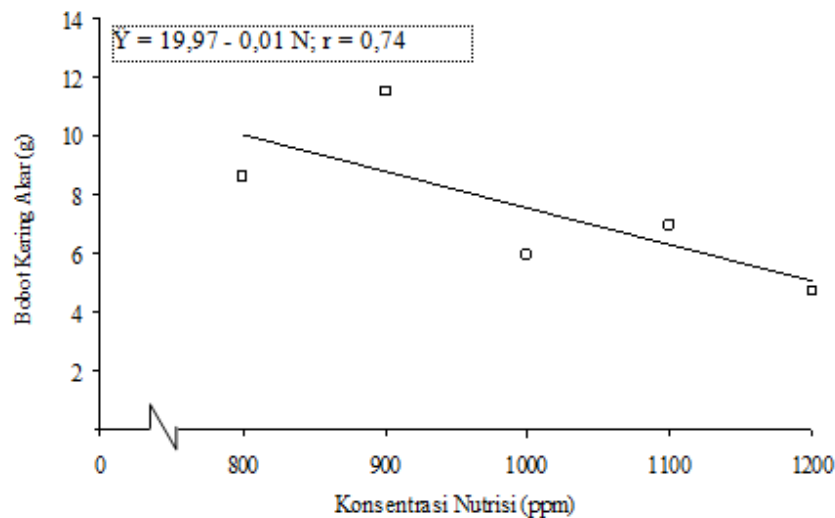


Figure 5. Effect of Nutrient Concentration on Root Dry Weight of Cherry Tomato Plants in the Generative Phase

Figure 7 shows that the effect of nutrient concentration on the dry weight of cherry tomato plant roots in the generative phase follows a linear regression curve. Using a higher concentration of AB Mix nutrients reduces the dry weight of cherry tomato plant roots in the generative phase. Nutrient solutions are one of the most important things for cultivating plants using a hydroponic system. The nutrition used for plants must be in accordance with the composition required by the plant, namely: at the beginning of planting the nutritional requirement is around 800 ppm, after entering the third to fifth week, the nutritional requirement is around 1000 ppm and in the sixth week and so on the nutritional requirement is around 1200 ppm. (Wahyuni, 2017).

4. CONCLUSION

Nutrient concentration has an effect on the generative growth phase, but has no significant effect on the vegetative growth phase of cherry tomato plants. Nutrient concentration influences the morphology and physiology of cherry tomato plants. Nutrient concentration had a significant effect on the production of cherry tomato plants hydroponically with the heaviest fruit weight per plant found in the AB Mix nutrient concentration of 1000 ppm (N3) of 97.89 g.

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