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The Influence of Growing Media Composition and Volume of Nutrient Solution Application on The Growth and Yield of Cherry Tomato (Lycopersicon esculentum Miller.) With Drip Irrigation Hydroponic System

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ABSTRACT

The increasing growth and production of cherry tomatoes, especially in the lowlands, is influenced by water, humidity, and crop cultivation technology. This research aimed to identify the appropriate composition of planting media and the volume of nutrient solutions for the growth and production of cherry tomatoes with drip irrigation hydroponic systems. This research was conducted at Perumahan Royal Sumatra's Screenhouse, Medan Tuntungan (± 32 m above sea level), from March to August 2017. The research used Completely Randomized Factorial Designs with two treatment factors, consisted of M1 planting media (husk charcoal), M2 (cocopeat), M3 (husk charcoal and cocopeat) and watering volume V1 (150 ml nutrient AB mix), V2 (250 ml nutrient AB mix) V3 (350 ml nutrition AB mix). The results showed that the composition of the growing medium had a significant effect on the diameter of the stem at 3-12 weeks after planting and the amount of fruit weight, while the volume of nutrient solution significantly affected the stem diameter at 3-12 weeks after planting, plant length, number of fruit and fruit weight.

Keywords: cherry tomatoes, planting media composition and volume of nutrient solution

INTRODUCTION

Cherry tomatoes (Lycopersicum esculentum Miller.) are plants belonging to the Solanaceae family. Cherry fruit is currently one of the horticultural commodities with high economic value because public awareness of the health value makes cherry tomatoes a source of vitamin C / antioxidants that the body needs. However, tomato cultivation still requires serious handling, especially in increasing the yield and quality of the fruit. According to the Central Bureau of Statistics (2015) data, tomato production in West Java reaches 296,217 tons/year. Whereas in 2014, tomato production in West Java reached 304,687 tons/year.

The low tomato production in Indonesia is due to the problems of cultivation in the lowlands, namely the lack of soil fertility and lack of water sources due to low rainfall and humidity, pest attacks that are quite dominant from the soil, less effective technical culture or less optimal fertilizer application also improper cropping patterns. Efforts to overcome these obstacles are the improvement of cultivation techniques. One common cultivation technique to improve cherry tomatoes' yield and quality is hydroponic drip irrigation (Wijayani and Wahyu, 2005).

Cultivation of cherry tomatoes with hydroponic drip irrigation is done without using soil as a medium for growing plants but using other porous media that function to bind water and support the plant's body. The technique of cultivating cherry tomatoes with hydroponic drip irrigation can be regulated in environmental conditions such as temperature, relative humidity, and light intensity, even rainfall factors can be eliminated altogether, and pest attack factors can be minimized (Lestari, 2003).

In the hydroponic cultivation of drip irrigation, plants require growing media to support plant growth and obtain nutrients from nutrient solutions prepared specifically. In this technique, nutrients are provided in a nutrient solution and flowed to the media near the root area, containing all essential nutrients where macro and micronutrients are fulfilled to be needed by the plant to achieve average growth. According to the research results, it showed that drip irrigation has significantly increased the agricultural yields and saved water usage between 50-70%, and the quality of tomato yields has also increased (Merit and Narka 2007).

The drip irrigation method is the application of nutrients along with irrigation in a hydroponic system and is the application of water to plants directly or an open system because the nutrient solution that is channelled to the plant is not recirculated. The nutrient is an AB mix solution containing macro and micronutrients. The application of nutrient and irrigation solutions is very suitable for the planting media of substrates that have high water absorption because the water is absorbed by the roots of plants and does not experience excessive evaporation or dissolution (Hardjadi, 1989).

The growing medium serves as a place to hold planted plants' roots and absorb nutrient solutions when poured or dripped. The roots then absorb the nutrient solution. To get the growth and production of tomato plants with hydroponics drops are expected to be better, it is necessary to regulate the growing media composition and volume to provide the right nutrient solution. According to the results of Afandi's research (2016), showed that the composition of the substrate growing medium with a mixture of husk and sand charcoal gave the best results in plant height and dry weight of plants. The right concentration also supports the application of the right volume of nutrient solution. According to Susila (2006), the watering volume is 250 ml, with a frequency of 4 or 5 times a day according to the application schedule of the best results for paprika plants.

Based on the description above, the authors are interested in researching The Influence of Media Composition and Volume of Nutrient on The Growth and Yield of Cherry Tomato (Lycopersicon esculentum Miller.) With Drip Irrigation Hydroponic System.

MATERIALS AND METHODS

This research was conducted at Perumahan Royal Sumatera's Screenhouse, Medan Tuntungan with an altitude of ± 32 m above sea level, started from March to August 2017. The material used was cherry tomato seeds, First Love F1 variety, husk charcoal, cocopeat, AB mix nutrients, fungicides, and water.The tools used were the seedling tray, TDS and EC meter, pH meter, measuring cup, bucket, stick, ruler/meter, callipers, hand sprayer, scales, timers, water

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tanks, drip irrigation pipes, water tanks, water hoses, and polybag.

This research used Completely Randomized Factorial Design with two treatment factors, as follows: Factor 1: Growing Media Composition (M) based on media volume with three types, namely: M1: 100% rice husk charcoal, M2: 100% Cocopeat, M3: Rice husk charcoal : Cocopeat (50% : 50%). Factor 2: The volume of nutrient solution application (V) with three levels of treatment, namely: V1: 150 ml, V2: 250 ml, V3: 350 ml.

The research began with growing media preparation, the ingredients needed such as husk charcoal and cocopeat were used as growing media, seedbed, cherry tomato seeds were sown on the seedling tray filled with growing media in the form of husk charcoal, preparation of Nutrient Solution, hydroponic nutrition or nutrition AB mix Haileys's Farm used is solid (powder), planting the seedlings, Mounting, Nutrient application was carried out by flowing nutrients from the tank which was set by its watering schedule using the drip irrigation timer. Control of Plant Disturbing Organisms, and Harvest. The observation variables were length, stem diameter, the age of flowering, number of branches, number of sections, number of fruit and weight of fruit per plant.

RESULTS AND DISCUSSIONS

Plant Length

Analysis of variance showed that the treatment composition of the growing medium did not significantly affect the length of cherry tomato plants while the volume treatment of nutrient solution significantly affected the length of cherry tomato plants aged 12 weeks after transplanting. Different test results for the average length of cherry tomato plants in the treatment of the growing medium composition and the volume of nutrient solutions application can be seen in Table 1.

Based on observation and variance data, it can be seen that the composition has no significant effect while the volume of the nutrient solution has a significant effect on increasing the plant length parameters. The highest average result was the V3 treatment which was 190.22 cm, and the lowest V1 was 161, 67 cm.

Plant growth can grow vegetatively influenced by macro and micronutrients contained in nutrient solutions with a volume of 350 ml which was a high element of N, P and K so that the availability of nutrients was increasingly absorbed by the roots of plants and can support the long growth of plants, especially Nitrogen needed for the growth of stems and roots. N elements that can be absorbed by plant roots in the form of NO3- (nitrate) and NH4 + (ammonium) and converted into proteins and protoplasm in leaves and stems. This was in accordance with Susila's (2006) research which stated that watering volumes as much as 250 ml 4 or 5 times a day according to the schedule gives the best results on plants

Table 1. The average length of cherry tomato plants aged 12 weeks after transplanting in the treatment of growing media composition and volume of nutrient solutions application

Media (M)	Volume of Nutrition Solution Application (V)	Average

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	V1(150)	V2(250)	V3(350)	
	------------------------		cm ----------------------	
Husk Charcoal (M1)	165,44	156,22	191,78	171,15
Cocopeat (M2)	149,78	172,78	182,67	168,41
Mix (M3)	169,78	191,22	196,22	185,74
Average	161,67c	173,41b	190,22a	

Description: The numbers followed by different letters on the same line showed significant differences in Duncan's Multiple Distance Test at the 5% level.

Plant growth can grow vegetatively influenced by macro and micronutrients contained in nutrient solutions with a volume of 350 ml which was a high element of N, P and K so that the availability of nutrients was increasingly absorbed by the roots of plants and can support the extended growth of plants, especially Nitrogen needed for the growth of stems and roots. N elements can be absorbed by plant roots in the form of NO3- (nitrate) and NH4 + (ammonium) and converted into proteins and protoplasm in leaves and stems. According to the schedule, Susila's (2006) research stated that watering volumes as much as 250 ml 4 or 5 times a day according to the schedule gives the best results on plants.

Stem Diameter

Observation data and analysis of variance on the treatment of growing media composition and volume of nutrient solution applied on the parameters of stem diameter of cherry tomato plants aged 2-12 weeks after transplanting can be seen in Annex 8-30. At the age of 2 weeks after transplanting, both treatments had no significant effect, while at the age of 3-12 weeks after transplanting, the stem diameter significantly affected by the composition of growing media and the volume of nutrient solution application can be seen in Table 2.

Based on observation data and variance data, the composition of growing media and the volume of nutrient solutions application significantly affected the diameter of the plant stem. It was suspected that mixing these two media also improved the physical and chemical properties of the media, as biopori media can improve the circulation of air carrying the oxygen needed by plants. According to Zainal and Yulius (2005) which stated that rice husk and coconut fibre media contain nutrients needed by plants, namely in the form of high potassium (K), in addition to the content of other elements Calcium (Ca), Magnesium (Mg), Sodium (Na) and Phosphorus (P) husk charcoal and coconut fibre are both used as planting media.

Plant growth can grow vegetatively influenced by macro and micronutrients contained in nutrient solutions with a volume of 350 ml which has a high element of N, P and K so that the availability of nutrients is increasingly absorbed by the roots of plants and can support the growth of plants, especially Nitrogen needed for the growth of stems and roots. N elements can be absorbed by plant roots in the form of NO3- (nitrate) and NH4 + (ammonium) and converted into proteins and protoplasm in leaves and stems. According to Susila's (2006) research, watering volumes as much as 250 ml 4 or 5

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times a day according to the schedule gave the best results on plants.

Table 2. The average of stem diameter on cherry tomato plants aged 2-12 after transplanting in the treatment of growing media composition and volume of nutrient solution application

Observation	Media (M)	Volume of Solution Application (V)			Average
		V1(150)	V2(250)	V3(350)	
		------	mm	------	
3 weeks after Transplanting	Husk Charcoal (M1)	1,85	2,38	2,61	2,28c
	Cocopeat (M2)	2,42	2,62	2,59	2,54b
	Mix (M3)	2,72	2,78	3,04	2,85a
	Average	2,33c	2,59b	2,75a	
6 weeks after Transplanting	Husk Charcoal (M1)	4,30	4,59	5,07	4,65c
	Cocopeat (M2)	4,75	4,96	5,38	5,03b
	Mix (M3)	5,29	5,51	5,91	5,57a
	Average	4,78c	5,02b	5,45a	
9 weeks after Transplanting	Husk Charcoal (M1)	7,22	7,67	8,16	7,68c
	Cocopeat (M2)	7,54	8,06	8,17	7,92b
	Mix (M3)	8,35	8,74	8,87	8,65a
	Average	7,70c	8,16b	8,40a	
12 weeks after Transplanting	Husk Charcoal (M1)	10,27	10,66	11,35	10,76c
	Cocopeat (M2)	10,63	11,03	11,60	11,09b
	Mix (M3)	11,21	11,91	12,02	11,71a
	Average	10,70c	11,20b	11,65a	

Description: The numbers followed by different letters in the row and column group are significantly different in Duncan's Multiple Range Test at the 5% level.

Fruit Weight per Plant

Analysis of variance showed that the treatment of growing media composition and volume of nutrient solution application had a significant effect on cherry tomatoes plant weight parameters. The results of difference mean test that of growing media composition treatment and the volume of nutrient solution application to cherry tomatoes can be seen in Table 3.

The research results showed that the highest average of fruit weight per plant was in M3 treatment (husk and cocopeat charcoal) as much as 125.46 and the lowest on M1 as much as 16.80 g. It was presumably because the addition of husk charcoal with cocopeat organic matter was beneficial. After all, it can improve the physical properties of the media compared with control media. According to Afandi's research (2016), the media composition of husk charcoal and organic matter gave the best results in tomato plants' fruit volume and fruit weight.

Based on the results of the observation and variance, it was found that the fruit weight per plant significantly affected the highest average with the highest average in V3 that was 149.02 g and the lowest average in V1 was 32.16 g. It was presumably related to the amount of fruit

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formed in each plant. The more the amount of fruit harvested, the higher the fruit weight tends to be. In the 150 ml volume of nutrient solution, it was suspected that a drastic decrease in fruit weight was caused due to the lack of water and nutrients available, which contained little Ca nutrients in the form of Ca +, which could be absorbed by the plant roots so that the fruit become small. According to Salisbury and Ross (1995), Ca serves to form a new middle lamella on the cell plate, which assists the cell division process, and the cell does not shrink or change shape.

Table 3. The average rate of fruit weight per cherry tomato plant aged 2-12 weeks after transplanting on the treatment of growing media composition and volume of nutrient solution application

Media (M)	Volume of Solution Application (V)			Average
	V1(150)	V2(250)	V3(350)	
	----------------------	g	-----------------------	
Husk Charcoal (M1)	17,75	19,54	15,22	16,80 a
Cocoeat (M2)	35,02	167,22	145,50	115,91b
Mix (M3)	43,20	144,64	188,54	125,46a
Average	32,16c	112,85b	149,02a	

Description: The numbers followed by different letters in the same column and row showed significant differences in Duncan's Multiple Range Test at the 5% level.

CONCLUSION

The treatment of growing media composition had a significant effect on the stem diameter in 3-12 weeks after planting and the weight of plant/fruit with the highest average in M3. The volume of nutrient solution application significantly affected plant length, stem diameter, number of fruit per plant, and fruit weight per plant. The treatment of growing media composition and the volume of nutrient solutions application did not significantly affect the parameters of flowering age, number of branches and number of segments per plant. The interaction treatment of growing media composition and the volume of nutrient solution application did not significantly affect cherry tomato plants' growth and production.

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