Growth of Two Leafy Vegetables (Brassica rapa L and Brassica oleraceae var achepala) on Three Installation Models of Hydroponic System

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Abstract

Hydroponic is known as soilless culture in agriculture cultivation. There are many models of hydroponic system such as DFT (Deep Flow Technique), NFT (Nutrient Film Technique) and Floating Raft Systems. The hydroponic system models have different kind of circulation water for flowing the nutrients.This research was aimed to know the differences growth of leafy vegetables on 3 model of hydroponic systems. The research showed that DFT system was the best system of hydroponic based on the fresh weight and Floating Raft System is best system for hydroponic based on the number of leaf and plant height.

Keywords — *Hydroponic, installation models of hydroponic, hydroponic system, growth, leafy vegetables.*

I. INTRODUCTION

Hydroponic is known as soilless culture in agriculture cultivation. Hydroponic is the technology of plant cultivation without using soil as a media as source of nutrients. Nutrients are replaced by solutions of fertilizers which are channeled to the roots of the plants.

Hydroponic uses water media as a source of nutrition, this cultivation is carried out without using soil, its mean, hydroponic is a cultivation system using media that contains a lot of water (Prihmantoro H and Indriani YH, 1998; Sameto, 2003). Plant roots are incorporated into water that has been dissolved in nutrients which serves to support the growth of plants. Hydroponic technology does not require a large area of land compared to soil culture to produce an equal productivity unit (Lonardy, 2006). Hydroponic can be cultivated all over years in all season. Hydroponic is motivated by decreasing of agricultural land, increasing number of people in the world and awareness of healthy lifestyles. Decreasing of agricultural area due to the infrastructure and housing makes the opportunity for hydroponic getting wide, because of hydroponic can be producing more products on the same land area. The growth of world population also makes increasing the need of food products, coupled with the increasing public interest in healthy products, hydroponic cultivation becomes an opportunity both in the industrial scale, household and hobby scale. Hydroponic is no chemical pesticide cultivation, controlling pests and diseases is using manual treatment and organic pesticides.

Hydroponic cultivation is generally carried out in greenhouse. Function of a greenhouse is basically to protect plants from outside influences, such as bad natural influences (wind, rain intensity and high solar radiation) and pest and disease disorders. The use of greenhouse facilitates maintenance and management of plants, minimizing the use of pesticides so the plants will be healthier. Greenhouse is basically used to create ideal environmental conditions for plants, but for commercial ventures, site selection must be considered (Prihmantoro and Indriani, 1998).

Hydroponic technology is a good alternative for obtaining better production in quality, quantity and continuity (Permana, 2001; Savvas, 2003). Although the investment in hydroponic cultivation is quite high at the beginning, but in the next, it does not require high costs because there is no repetitive cost to prepare the land. Whereas in conventional farming, every farming period is needed to prepare the land again. In general, in terms of costs, the cost of hydroponic production can be suppressed by land use, water and nutrition efficiently and by increasing production and yields (Rosario and Santos, 1990; Chow, 1990; Agustina, 2009).

Prawoto's research (2012) showed that the productivity of hydroponic curly lettuce reaches 12 tons/ha while conventional farming only reaches 3-8 tons/ha. This showed that hydroponic technology is one of the solutions to increase the quantity accompanied by good quality of agricultural products.

Hydroponics is used to cultivate vegetables, either leafy vegetables or vegetables that produce fruit. For leafy vegetables, fast and large plant growth is one of the main factors in the success of hydroponics. The leafy vegetables that popular growing for hydroponic such as *Brassica rapa* L. and *Brassica oleraceae var. achepala.* The commonly used hydroponic model systems are included the Deep Flow Technique (DFT), Nutrients Film Technique (NFT) and Floating Raft

Systems. This research aimed to know the influences of using three model hydroponic systems (DFT, NFT and Floating Raft System) to the growth of two leafy vegetables (*Brassica rapa* L. and *Brassica oleraceae var. achepala*).

II. MATERIALS AND METHOD

The research was conducted in December 2016 to March 2017 in Greenhouse of National Agricultural Training Center of Lampung. The materials and tools used are vegetable seeds (*Brassica rapa* L. and *Brassica oleraceae)*, rockwool planting media, AB Mix nutrition and materials of hydroponic model system (pipe, mild steel, PE hose, sock draft, Styrofoam, UV plastic). While tools are drill, hole saw kit, hacksaw, tweezers, ruler, tray, measuring cup, pump, pH meter, TDS and EC Meter.

Steps of the research are (1) Making hydroponic installation model system namely NFT Systems, DFT systems and Floating Rafts system. (2) Making hydroponic nutrition, hydroponic nutrition is also called AB Mix fertilizer. Making hydroponic nutrients using macro and micro compound fertilizers. The basis for making hydroponic nutrition is plant nutrient requirements based on ppm dissolved solids in nutrient solutions and the number of ions present in solution (m / S). (3) Vegetable seeding using rockwool media, vegetables used are *Brassica rapa* L. and *Brassica oleraceae*. Transfer of planting from nursery to installation is carried out at the time the nursery is 14 days old. (4) Hydroponic nutrient dilution is done by measuring the volume of water needed for each hydroponic installation. Dilution with a standard nutrient solution of A and B stock of 0.5 liters each can be used for 100 liters of ready-to-use nutrition. (5) Measurement of pH of water using a pH meter is made between pH 6 and 7. Then Total Dissolved Solute (TDS) is measured with TDS meters, for *Brassica rapa* L. and *Brassica oleraceae* at 1000-1300 ppm or 2.1 m / S. (6) Observations made were the number of leaves, plant height and plant weight measured at the age of 21 DAS, 28 DAS and 35 DAS. (7) Data were analyzed using analyses of variance and followed by Duncan's multiple range test.

III. RESULT AND DISCUSSION

A. *Effect Type of Installation Models on Number of Leave*

The plants tested in this study are *Brassica rapa* L. and *Brassica oleraceae*. *Brassica rapa* L. and *Brassica oleraceae* are leafy vegetables that can be harvested at 35 days after planting. Both of these vegetables are included in the vegetables that have high economic value. Various food and cuisine can be made with these two types of vegetables.

The number of leaves indicates good or not the growth of plants. For vegetables with leaves as the main composition to be utilized, it is very important to make the plants become dense leaves. The number of Brassica rapa leaves and Brassica oleraceae at the age of the plant 21 days after planting and 28 days after planting can be seen in the following table.

Table 1. Effect of type of installation models on the number of leaves

Hydroponic Systems	Vegetables			
	Brassica rapa		*Brassica oleraceae*	
	21 DAS	28 DAS	21 DAS	28 DAS
DFT	7.33 a	12.88 b	4.88 a	7.00 a
NFT	7.77 ab	12.33 ab	5.88 a	6.88 a
Floating Raft	8.33 b	12.00 a	6.00 a	8.00 b

The measurement results showed that the *Brassica rapa* plants aged 21 days in the DFT installation were not significantly different from the NFT, NFT was not significantly different from the floating rafts. The results that show a real difference are between DFT and Floating Raft. The highest average number of leaves is found in floating raft installations, followed by NFT and DFT.

Brassica oleraceae did not show a significant difference in the measurement of the average number of leaves of the three installations, so it can be said that at phase 21 the DAS installation did not have an effect on growth.

At the age of 28 days, the average number of leaves of the *Brassica rapa* plant of DFT system was not significantly different from the NFT and was significantly different from the Floating Raft. While the NFT system is not significantly different from the Floating Raft. Changes occur at the highest average number of leaves at the age of 28 DAS. The highest number of leaves obtained in the DFT installation followed by NFT and floating rafts. This happens because maybe, in the DFT installation the plants get enough nutrients and oxygen so that the growth gets better. Whereas in floating rafts, it is likely that dissolved oxygen has been reduced in the nutrient solution because this system is not circulated and only added an aerator to add dissolved oxygen to the solution. Whereas in the NFT system, system failure may have an effect on vegetable growth so that this system does not show strong growth.

In contrast to your plants at the age of 28 DAS, the average number of leaves in floating rafts is significantly different from the other two plants, namely DFT and NFT. The highest average number of leaves was obtained on floating rafts, followed by the installation of DFT and NFT.

B. Effect of Types of Installation Models on Plant Height

Table 2. Effect of type of installation on plant height

Hydroponic Systems	Vegetables			
	Brassica rapa		*Brassica oleraceae*	
	21 DAS	28 DAS	21 DAS	28 DAS
DFT	1.66 a	1.55 a	0.27 a	8.22 a
NFT	1.05 a	1.16 a	.88 a	5.72 a
Floating Raft	2.05 a	2.33 a	3.50 b	3.77 b

Plant height also plays an important role in determining the quality of vegetables in addition to the number of leaves. At the measurement of Brassica rapa, plant height at the age of 21 DAS, there were no significant differences between the DFT, NFT and Floating Raft installations. So even at the age of 28 DAS there is also no real difference between the three.

In aged 21 DAS, observations on plant height indicate that the installation of Floating Rafts is significantly different from the installation of DFT and NFT. Even at the age of 28 DAS, floating raft installations differ significantly from DFT and NFT. DFT and NFT will still not show any real difference. The highest plant average was found in plants planted in floating raft installations, then in the installation of DFT and NFT installations.

C. Effect of Types of Installation Models on Fresh Weight

Fresh weight of plants is important in the cultivation of hydroponic vegetables, this is closely related to the income that will be obtained by farmers. The faster the vegetables reach the desired weight the more promising benefits will be obtained. This is because the price of hydroponic vegetables is valued per unit weight of vegetables.

Table 3. Effect of type of installation on fresh weight

Hydroponic Systems	Vegetables	
	Brassica rapa	*Brassica oleraceae*
DFT	125.55 b	43.33 a
NFT	92.22 a	39.44 a
Floating Raft	103.33 a	63.88 b

Measurements are made at harvest, which is 35 DAS. In observing the fresh weight of Brassica rapa, it was found that there were significant differences between the DFT installation compared to the NFT or floating raft, but the NFT and floating rafts were not significantly different. The DFT hydroponic system is the best system used for Brassica rapa vegetables followed by floating rafts and NFT.

In your plants floating installation is significantly different from DFT and NFT, while DFT and NFT are not significantly different. Floating rafts show the highest fresh weight gain followed by DFT and NFT.

IV. CONCLUSIONS

DFT system is the best system used for hydroponic cultivation compared to the NFT and Floating Raft because it produces the highest fresh weight in *Brassica rapa* plants but for the *Brassica oleraceae* is floating raft system is the best system compared by DFT and NFT Systems. Floating raft system is the best installation hydroponic system to the growth of the plants in the measurement of the number of leaf and plant height. Need more research for the effectiveness of nutrients in the various installation hydroponic systems to measure the best growth of the plants.to the use of the The NFT system requires maximum attention to the circulation system, because system failure can risk reducing production output. Floating raft system is quite easy to maintain because the possibility of system failure is very small, but because the water is inundated and there is no insulation, then diseases such as fungi are very easy to attack plants.

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