



The Effect of Hydroponic Planting System and Media on Lettuce Growth (*Lactuca Sativa L.*)

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Abstract. The hydroponic effect as growing systems and media on the growth of lettuce (*Lactuca sativa L.*). Based on the results of identification in the hydroponic farming group, hydroponic cultivation of plants is used as a solution to the problem of lack of land in farming, and lettuce is a top priority that is cultivated hydroponically. The research was carried out in April–May 2021 In Tulungrejo Bumiaji District, Batu City. The study applied a Randomized Block Design (RBD) with factorial factors. The hydroponic system consisted of the Deep Flow Technique system (M1), Nutrient Film Technique (M2), Wick System (M3) and hydroponic growing media factors consisting of from Rockwool (N1), Foam, Husk (N2), Cocopeat planting media (N3), so that there were 12 treatment combinations which were repeated three times with the observation parameters of plant height, number of leaves, leaf width, crown width, and yield weight. ANOVA and Duncan's Advanced Test. The results showed that the two factors had an interaction on the growth of lettuce at 5 DAP to 40 DAP observations from all observations, and from Duncan's further test, it was found that the best treatment for the influence of lettuce growth from all observation parameters were the M1 N1 treatment, namely the DFT (Deep Flow Technique) hydroponic system and the type of Rockwool growing media.

Keywords: Hydroponics · Hydroponic system · Hydroponic growing media

1 Introduction

Natural conditions and land area in the production of food crops in Indonesia sometimes become new obstacles in producing food crops; therefore, an effort to increase crop production is carried out with a cultivation technique that has high efficiency and effectiveness for agriculture. From the problems that exist today where agricultural land is getting narrower, there is a need for a technology needed in farming that can save on the use of agricultural land in food production that has high quality [1].

The development of hydroponics in Indonesia is an effective solution and alternative that can be used in production and increase plant productivity, especially in narrow areas. Hydroponic cultivation is considered easier than conventional cultivation because the place in plant cultivation is relatively clean and can maintain the quality of crop yields and minimize pest attacks and thus increase plant productivity. Hydroponics is referred

to as a solution to farming today because cultivation activities are relatively simple and straightforward to reduce the use of synthetic chemicals so that agricultural products are protected from harmful toxins if consumed directly so that the resulting product has quality standards.

In Tulungrejo, Bumiaji Subdistrict, Batu City, there is an excellent opportunity in implementing agriculture that refers to modernization; the application of hydroponics is a great opportunity based on that because it is one of the villages that implements the tourism village system for the welfare of its people. Tourism in Tulungrejo village has four significant tours, namely: selecta tourism, Coban Talun waterfall, apple picking tours, village garden agrotourism, which is still in the early development stage. The development of tourism in Tulungrejo village cannot be separated from the application of hydroponic farming. Through the Sustainable Food House Area (SFHA) program in Tulungrejo Village, the application of hydroponics will be very suitable, which is a community activity where the community can manage or utilize unproductive vacant land in producing vegetable crops.

The purpose of the study was taken based on the results in the farming group and on farmers, which is a top priority in hydroponic cultivation because lettuce is a vegetable needed by the community and has a relatively short life, market demand for lettuce is quite high in the rainy season.

2 Research Methods

The location of the study is SFHA (Sustainable Food House Area) Jungho Hamlet at Tulungrejo, Bumiaji District, Batu City, which is a private hydroponic installation that will be carried out from May 2021 to June 2021, which begins with identifying potential areas, collecting data, processing data to writing reports.

Research on the effect of hydroponic growing systems and media on lettuce (*Lactuca sativa L*) growth was applied in a Randomized Block Design (RBD). By following environmental conditions in the study using two factors, the first factor was the hydroponic system, and the second factor was the planting medium. The hydroponic system consisted of the Deep Flow Technique system (M1), Nutrient Film Technique (M2), Wick System (M3) and hydroponic growing media factors consisting of from Rockwool (N1), Foam, Husk (N2), Cocopeat planting media (N3). Hydroponics so that in the study design, 12 treatment combinations consisted of 3 replications, and in each repetition, there were two plants in each treatment.

The method of collecting data on lettuce productivity is carried out by direct observation and measurement of the object of study with measuring instruments and recording the results with the help of electronic devices. The observation variables used in this study were plant height, number of leaves, leaf width, crown width, and yield.

Analysis of the data used in this study uses analysis of variance or analysis of variance (ANOVA) with a level of 5%. If there is a significantly different variance ($F_{count} > F_{table 5\%}$) or a very significant difference ($F_{count} > F_{table 1\%}$), then to compare the two treatment averages, a further test is carried out using Duncan's test at 5% level using the help of SPSS version 20 program.

Table 1. Measurement of plant height

Hydroponic System	Plant Height							
	1	2	3	4	5	6	7	8
M1	5,15c	6,16c	8,05c	10,85c	12,23c	13,33c	14,10c	14,61c
M2	4,60b	5,32b	7,20b	9,80b	10,89b	11,69b	12,75b	13,40b
M3	4,14a	4,93a	6,09a	9,07a	10,00a	10,85a	11,74a	12,60a
DMRT 5%								
Growing media	Plant Height							
	1	2	3	4	5	6	7	8
N1	5,64d	6,47d	8,23d	11,17d	12,37d	13,21d	14,05d	14,75d
N2	4,67c	5,62c	7,47c	10,35c	11,60c	12,43c	13,17c	13,80c
N3	3,87a	4,71a	5,94a	8,56a	9,68a	10,67a	11,65a	12,32a
N4	4,32b	5,08b	6,81b	9,54b	10,50b	11,52b	12,56b	13,30b
DMRT 5%								

The Deep Flow Technique system (M1); Nutrient Film Technique (M2); Wick System (M3); Rockwool (N1); Foam, Husk (N2); Cocopeat planting media (N3).

3 Results and Discussion

3.1 Plant Height

The results of statistical analysis with the ANOVA test and Duncan’s further test showed that the treatment that showed the results had a significant effect on the factors of the hydroponic growing system and media as well as the occurrence of an interaction between the treatments on the average growth of lettuce plant height. Measurement of plant height was carried out when the plant had an age of 5 days DAP as the first observation carried out until 40 DAP with eight observations presented in Table 1.

Duncan’s further tests that have been carried out get data values that show that in the hydroponic system, there is a significant difference in the hydroponic system factor and the hydroponic growing media factor on lettuce plant height. With an accuracy level of 95% on the hydroponic system factors, all showed significantly different results between the system and the hydroponic growing media factor.

Duncan’s Advanced Test results became the best treatment in superior treatment compared to all hydroponic system treatments for the observation of lettuce plant height, the M1 treatment with the DFT hydroponic system (Deep Flow Technique) treatment, and the Duncan test results on the hydroponic growing media factor. The best treatment was obtained in the N1 treatment, which is a Rockwool hydroponic growing medium.

3.2 Number of Leaves

The statistical analysis results with the ANOVA test and Duncan’s follow-up test showed that the treatment that showed the results had a significant effect on both system factors

Table 2. Measurement of number of leaves

Hydroponic System	Number of Leaves							
	1	2	3	4	5	6	7	8
M1	4,75b	5,5b	6,25b	6,66b	8,25b	9,41b	11,66c	12,50c
M2	3,83a	4,75a	5,58a	6,00a	6,91a	8,75a	10,91b	11,66b
M3	4,16a	4,75a	5,25a	5,83a	6,75a	8,41a	10,16a	11,16a
DMRT 5%								
Growing media	Number of Leaves							
	1	2	3	4	5	6	7	8
N1	5,66d	6,22d	6,88c	7,22d	8,88d	10,77d	12,88d	13,66d
N2	4,66c	5,33c	5,88b	6,44c	7,55c	9,22c	11,55c	12,22c
N3	3,11a	4,00a	4,77a	5,88a	6,11a	7,33a	9,22a	10,22a
N4	3,55b	4,44b	5,22a	5,11b	6,66b	8,11b	10,00b	11,00b
DMRT 5%								

The Deep Flow Technique system (M1); Nutrient Film Technique (M2); Wick System (M3); Rockwool (N1); Foam, Husk (N2); Cocopeat planting media (N3).

and hydroponic growing media and the interaction between treatments on the average growth of the number of lettuce leaves. Measurement of plant height was carried out when the plant had an age of 5 days DAP as the first observation was carried out until 40 DAP with a total of 8 observations presented in Table 2.

It was stated that there was a very significant difference between all the factors of the hydroponic system and the factors of the hydroponic growing media that affected the growth of the number of lettuce leaves. From the results of Duncan's further test on the observation of the number of leaves. It shows a type of treatment with the highest average and the best treatment, namely the M1 treatment as a Deep Flow Technique System treatment, which significantly influences the growth of the number of lettuce leaves. And in the N1 treatment became a treatment with the highest average of the other four treatments and became the best growing media treatment, which was Rockwool ever-increasing media.

3.3 Leaf Width

The results of statistical analysis with the ANOVA test and Duncan's further test showed that the treatment that showed the results had a significant effect on both system factors and hydroponic growing media and the interaction between treatments on the average growth of lettuce leaf width. Measurement of plant height was carried out when the plant had an age of 5 days DAP as the first observation was carried out up to 40 DAP with a total of 8 observations presented in Table 3.

Table 3. Measurement of leaf width

Hydroponic System	Leaf width							
	1	2	3	4	5	6	7	8
M1	2,91b	4,45b	5,92b	8,88c	11,10c	12,61c	13,62c	14,15c
M2	2,46a	3,58a	5,06a	8,23b	9,50b	11,34b	12,30b	12,98b
M3	2,33a	3,67a	5,15a	7,09a	8,68a	10,13a	11,18a	11,89a
DMRT 5%								
Growing media	Leaf width							
	1	2	3	4	5	6	7	8
N1	3,05c	4,81c	6,43d	9,45d	11,56d	13,11d	14,06d	14,63d
N2	2,63b	3,90b	5,75c	8,51c	10,16c	11,85c	12,77c	13,45c
N3	2,06a	3,15a	4,30a	6,80a	8,01a	9,77a	10,82a	11,56a
N4	2,54b	3,74b	5,03b	7,51b	9,32b	10,71b	11,82b	12,38b
DMRT 5%								

The Deep Flow Technique system (M1); Nutrient Film Technique (M2); Wick System (M3); Rockwool (N1); Foam, Husk (N2); Cocopeat planting media (N3).

From the results of Duncan's further test in the table above, which shows the value of the hydroponic system has a significant difference between the two factors of the hydroponic system and hydroponic growing media, which influence the growth of lettuce leaf width. The application of this further test is expected to obtain data that has a high value to the lowest data from the real difference in the results of data analysis. The application of the level of accuracy of 95% in each treatment to the treatment factor to get a real difference.

From Duncan's further test, it was found that the hydroponic system factor that was the best treatment was the Deep Flow Technique System which had a significant influence on the growth of lettuce leaf width. And on the planting media treatment factor, the best treatment was Rockwool planting media which was a treatment that had a significant influence on the growth of lettuce leaf width.

3.4 Header Width

The results of statistical analysis with the ANOVA test and Duncan's further test showed that the treatment that showed. The results had a significant effect on both system factors and hydroponic growing media and the interaction between treatments on the average growth of lettuce canopy width. Measurement of plant height was carried out when the plant had an age of 5 days DAP as the first observation carried out until 40 DAP with a total of 8 observations which are presented in Table 4.

Table 4. Measurement of header width

Hydroponic System	Leaf Width							
	1	2	3	4	5	6	7	8
M1	5,21b	7,75c	11,55c	14,78c	17,37c	19,13c	21,03c	21,83c
M2	4,29a	6,72b	9,87b	13,36b	15,28b	17,01b	19,55b	20,35b
M3	4,42a	5,97a	8,88a	10,29a	12,18a	14,12a	17,44a	18,27a
DMRT 5%								
Growing media	Leaf Width							
	1	2	3	4	5	6	7	8
N1	5,55d	7,92d	11,27d	15,03d	17,07d	18,83c	20,98d	21,78d
N2	4,82c	7,25c	10,62c	13,78c	15,73c	17,87c	19,98c	20,74c
N3	3,97a	5,58a	8,72a	10,38a	12,77a	14,08a	17,73a	18,60a
N4	4,22b	6,51b	9,80b	12,04b	14,20b	16,23b	18,66b	19,47b
DMRT 5%								

The Deep Flow Technique system (M1); Nutrient Film Technique (M2); Wick System (M3); Rockwool (N1); Foam, Husk (N2); Cocopeat planting media (N3).

From the value of Duncan's test data analysis in the table above, the Duncan test results with a data accuracy level of 95% show the values presented in the table above, which means that in all treatments, the hydroponic system factors show significantly different values and in the treatment of planting media factors. In hydroponics, there was a pretty different value on the effect of changes in the shape of the lettuce canopy width.

Based on the results of the Duncan test, which showed the best treatment with a tremendous change in the width of the lettuce canopy.

The effect is on the M1 treatment of lettuce crown width, which is the Deep Flow Technique treatment. There is a significantly different value on the impact of shape lettuce canopy width changes on the hydroponic growing media treatment factor.

Based on the results of the Duncan test, which showed the best treatment with a tremendous change in the width of the lettuce canopy.

The effect is on the M1 treatment of lettuce canopy width, the Deep Flow Technique treatment, and on the planting media treatment factor, which is the best treatment, the N1 treatment, which is a treatment with Rockwool planting media type which influences the growth of lettuce canopy width.

3.5 Harvest

The statistical analysis results with the ANOVA test and Duncan's further test showed that the treatment that showed the results had a significant effect on both system factors and hydroponic growing media and the interaction between treatments on the average growth lettuce yields. Measurement of plant height was carried out when the plant had

Table 5. The result of harvesting

Hydroponic System	Harvest Result
M1	24,79c
M2	22,79b
M3	7,92a
DMRT 5%	
Growing media	Harvest Result
N1	26,78d
N2	22,11c
N3	9,11a
N4	16,00b
DMRT 5%	

The Deep Flow Technique system (M1); Nutrient Film Technique (M2); Wick System (M3); Rockwool (N1); Foam, Husk (N2); Cocopeat planting media (N3).

an age of 5 days DAP as the first observation carried out until 40 DAP with a total of 8 observations presented in Table 5.

As a result of Duncan's further test, it was found that the value that influenced the weight of the lettuce was in the M1 treatment, which was the treatment of the Deep Flow Technique System in giving the most significant influence on the lettuce plant weight and the planting media factor which became the best treatment was in the N1 treatment which is a Rockwool growing media treatment that has a significant influence on the weight of lettuce plants.

The data analysis results show that M1 is the treatment of the Hydroponic Deep Flow Technique System, which offers the best type of treatment in every observation parameter. M1 treatment has the greatest influence on the growth of lettuce plants. Will continue to absorb nutrients in substantial quantities [2].

From the results of data analysis on the use in observing hydroponic planting media on lettuce plant growth, the results showed that there was an influence of planting media on lettuce plant growth. The results showed that the N1 treatment, which was Rockwool planting medium, showed that it was the treatment that had the most significant influence on lettuce plant growth with the highest score. This indicates that the use of Rockwool Planting Media influences maintaining moisture for plant root growth and subsequently binding nutrients in large quantities, so that plant roots directly absorb nutrients for lettuce plant growth [3].

From all the results of data analysis, it can be interpreted that there are significant differences in all treatments of hydroponic systems and hydroponic growing media. Things like this are caused by the influence of each other on the growth of lettuce plants. According to Wahyuningsih et al., [4], Nutrient absorption in lettuce plants is

directly influenced by the use of growing media. The use of planting media in hydroponic cultivation systems has an essential role in plant growth and development. The use of good planting media has the properties to maintain maximum nutrient availability for plants, maintain moisture in plants, and have good aeration.

4 Conclusion

The results showed that the Hydroponic System and Hydroponic Growing Media could be used as an Effort to Increase the Productivity of Lettuce (*Latuca Sativa L*) in Tulungrejo, Bumiaji District, Batu City. The best treatment and had a significant effect on lettuce growth was the DFT (Deep Flow Technique) hydroponic system (M1), while the best growing media was Rockwool for lettuce growth (N1).

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References

1. A. Rakhman, B. Lanya, R.B. Rosadi, and M.K. Kadir, "Mustard Plant Growth Using Hydroponic and Aquaponic Systems," *J. Agric. Eng. Lampung*, pp. 245–254, 2015.
2. Nurdin, *Accelerate Hydroponic Vegetable Harvesting*. Jakarta: PT Agro Media Pustaka, 2017.
3. Maulana, M. Ato, Wijaya, Human, Suroso, and Bejo, "Growth Response of Lettuce (*Latuca Sativa*) To The Provision Of Nutrients And Several Kinds Of Planting Media NFT Hydroponic System (Nutrint Film Technique) Hydroponic System," *Agritrop*, vol. 18, no. 1, 2020.
4. A. Wahyuningsih, S. Fajriani, and N. Aini, "Composition of Nutrients and Planting Media on Growth and Yield of Pakcoy (*Brassica Rapa L.*)," *Hydroponic Syst. J. Crop Prod.*, pp. 595–601, 2016.

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