Agrotech Journal

Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Variation of the Amount of Seeds per Planting Hole to the Response of Lettuce Plant with DFT Hydroponic System

AUTHORS INFO

Akhmad Zaki
Universitas Lambung Mangkurat
akhmadzaki41@gmail.com

Akhmad Gazali
Universitas Lambung Mangkurat
a.gazali@ulm.ac.id

Nukhak Nufita Sari
Universitas Lambung Mangkurat
nukhak.sari@ulm.ac.id

ARTICLE INFO

e-ISSN: 2548-5148
p-ISSN: 2548-5121
Vol. 7 No. 1, June 2022
URL: https://doi.org/10.31327/atj.v7i1.1740

Abstract

Lettuce is a vegetable plant whose needs always increase every year according to population growth. Therefore, it is necessary to make efforts to increase the production of lettuce by increasing the number of seeds per planting hole using the DFT hydroponic system. This study aims to determine the effect of the number of seeds per planting hole on the growth and yield of lettuce plants and to determine the number of seeds per planting hole that produces the highest growth and yield of lettuce plants. Implementation This research was conducted from August to September 2021. Located in the Community Food Barn, the Department of Food Security and Fisheries, Banjar Regency. The method used in this study was a completely randomized design (CRD) with treatment S1 (control), S2 (2 seeds per planting hole), S3 (3 seeds per planting hole), and S4 (4 seeds per planting hole). The treatment was repeated 4 times to get 16 experimental unit Based on the results of the research, it can be seen that the number of seeds per planting hole has an effect on the growth and yield of lettuce.The best treatment was found in S4 which had the highest value at an average plant height of 36.25 cm, an increase in plant height at 28 DAP of 11.61 cm, an average number of leaves of 22.06 strands, and an average yield harvest of 153.75 grams. DFT hydroponic cultivation of lettuce resulted in optimal production of 4 seeds per planting hole. Useful research for the efficiency of lettuce production using hydroponics. In addition to production efficiency, it is necessary to consider plant competition to utilize existing resources for optimal growth

Keyword: DFT hydroponic system, lettuce, number of seeds per planting hole

A. Introduction

The need for vegetables in Indonesia is always increasing every year. Increased demand for vegetables in accordance with population growth. The need for vegetables in Indonesia will continue to increase in accordance with population growth. Based on statistical data, the value of imported fruit and vegetables in 2019 was 770 Tons (BPS, 2018). Lettuce economic opportunities can be seen from the growing number of hotels and international-standard foreign restaurants that serve many foreign dishes such as salads and hamburgers (Cahyono, 2019). Lettuce is a type of green vegetable that is consumed by its leaves. Many benefits are obtained from eating lettuce for health. Lettuce has a commercial value and demand from the market for lettuce commodities will continue to increase in line with an increase in population, an increase in people's income and an increase in people's preference for lettuce (Samadi, 2014).

To overcome the increasing market demand for lettuce, it is necessary to make efforts to increase crop yields by increasing the number of seeds in one planting hole. Due to the increase in the number of seeds one planting hole, the yield will increase compared to one seed in one planting hole. One of the efforts to increase the plant population is to increase the number of plants per planting hole. The plant yields obtained have an inseparable relationship with plant density and are also determined by the number of plants in one planting hole (Susilowati, 2011).

Planting vegetables using a hydroponic farming system. The hydroponic system is agriculture without using soil that only relies on water as a medium for delivering nutrients. This system does not require a large area of land, but the number of plants that can be planted is greater. Hydroponics is agricultural cultivation without using soil media, so it is only carried out using water as a soil substitute medium. Hydroponic vegetable crops are more attractive to consumers because they are cleaner and have less dirt, so it can shorten the time for consumers to clean them. The nutritional content of hydroponic vegetables is better maintained because the nutrients in circulating water are always maintained to meet their needs (Syamsul, 2014).

The hydroponic system used is the deep flow technique (DFT). The DFT system is a hydroponic system in which the flow of nutrients flows continuously and circulates, and the nutrients that flow remain that settle so that the roots are in a pool of nutrients. One of the most effective and effective hydroponic farming systems productive is DFT (Junia & Sarido, 2017). Several studies have shown that the use of DFT hydroponics produces good quality plants because they are able to provide oxygen and water requirements that are suitable for growing vegetables (Fitmawati, Isnaini, Siti FN, Sofiyanti, & Rodesia MR., 2018). The use of the DFT system on leaf vegetables shows high oxygen levels in the water which are useful for the respiration process or plant respiration which affects the number of leaves and the wet weight of the plant (Asyiah, 2013). The advantage of this DFT system is that nutrients can still meet the needs of plants even when the electricity goes out, because the nutrients are still stagnant. DFT hydroponic systems are generally used to grow leafy vegetables, both those that have taller growths such as kale or those that expand such as lettuce. This study aims to determine the effect of the number of seeds per planting hole on the growth and yield of lettuce plants and to determine the number of seeds per planting hole that produces the highest growth and yield of lettuce plants.

Plant competition within a species can be seen from the distance between plants, where in fact the fiercest competition occurs between plants of the same species, so that large stands of a single species are very rarely found in nature. Competition between plants of this kind affects their growth because they are generally detrimental. Competition occurs when organisms of the same species or of different species use natural resources. In using natural resources, each competing organism will fight for something that is needed for life and growth. Competition carried out by organisms can compete for the needs of space (place), food, nutrients, water, light, air, pollination agents, dispersal agents, or other ecological factors as the resources needed by each organism to live and thrive growth (Gopal & Bhardwaj, 1979).

B. methodology

This research was conducted from August to September 2021. Located in the Community Food Barn, the Department of Food Security and Fisheries, Banjar Regency. The materials used in this study were lettuce seeds, rockwool, nutrition AB Mix, flannel, and water. Tools that used namely hydroponic installation, thermohygrometer, TDS&EC meter, netpot, label paper, camera, analytical scale, tray, ruler, and stationery.

1. Research Design and Procedure

This study used a completely randomized design (CRD). The types of treatments tested included the number of seeds per planting hole in lettuce (S). The treatment given, namely S1/control (1 plantper planting hole), S2 (2 plants per planting hole), S3 (3 plants per planting hole), and S4 (4 plants per planting hole). There were 4 treatments which were repeated 4 times, so that there were 16 experimental units. Each experimental unit contains 4 sub samples.

Seeding is done by planting lettuce seeds on rockwool media. Rockwool is first cut into cubes which are then put into a tray. Putting the seeds into rockwool according to the treatment being tested, namely 1 seed, 2 seeds, 3 seeds, and 4 seeds per tray. The seedlings were watered until all the rockwool was wet, but not submerged. Place a tray of indoor plants until the seeds germinate, which is about 2-4 days. Move plants that have germinated to the enlargement. The nursery needs to be distinguished from the place of enlargement, because Nurseries require high humidity conditions of up to 90%. Meanwhile, the magnification is around 70-80%. In addition, the nursery does not require a lot of space. A damp corner of the house can be used as a location for placing nursery trays (Trubus Editor, 2019). Caring for the seedling is done by wetting the *rockwool* periodically by pouring water on the tray every day. Watering the plant is done slowly through the side of the container. Water is poured until all the rockwool is wet again, but the seeds are not submerged. Watering is carried out for 14 days until the seeds are ready to be transplanted. Good seeds will grow 2-4 days after sowing. About 10-14 days later, 2-4 true leaves grow. That is a sign that the seeds are ready to be transplanted to the youth table or directly to the production table (Trubus Editor, 2019).

After the plants are treated for 10-14 days, the seedlings or seeds that have grown can be transferred to a hydroponic installation for enlargement. The characteristics of the seeds are ready to be transferred, namely there are 3-4 true leaves and the seeds are about 7-14 days old depending on the type of plant and the speed of growth (Trubus Editor, 2019). The transfer process was carried out by placing the seeds into a*netpot* that had been given flannel according to the experimental unit, namely 4 treatments which were repeated 4 times so that 16 experimental units were obtained, each experimental unit contained 4 sub samples. When transplanting, the seeds certainly do not have long roots to reach nutrients. If so, the solution needs to be added to the axis (Trubus Editor, 2019).

The AB Mix nutrients used are crystalline nutrients that can be extracted with a mixture of water into 5 liters of nutrient A and 5 liters of nutrient B. The hydroponic water reservoir is filled with water first to the brim, then pours each nutrient A and nutrient B with the same amount the flat one. Entering AB Mix nutrients until the concentration reaches ±800 ppm and the EC value is ± 1.5 mS/cm.

Every week the tub water is measured using a TDS&EC meter to measure and keep the EC value in the range of 1.5 mS/cm - 2 mS/cm. The concentration was measured every week using a TDS&EC meter to determine and keep the nutrient concentration in the tank in the range of 780 ppm - 820 ppm.

The parameters observed in this study were divided into two, namely daily and weekly parameters. Daily parameters include observations of temperature (^{o}C) and humidity (%). The weekly parameters included observations of plant height, widest leaves, number of leaves, and yields.

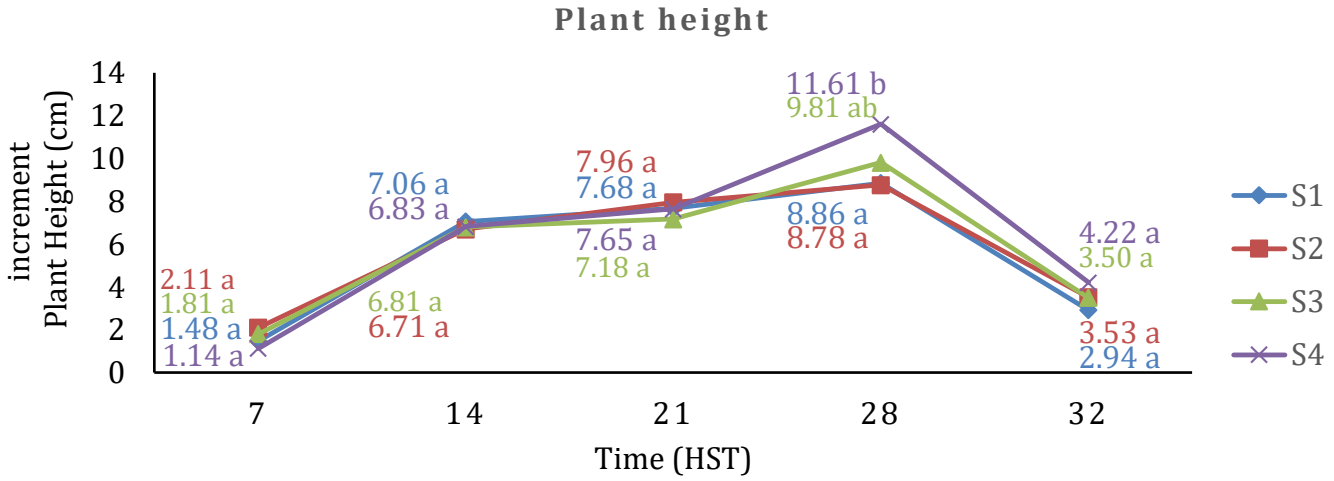
2. Data analysis

To see the effect of the number of seeds per planting hole on the growth and yield of lettuce, analysis of variance (Anova) was carried out. Prior to the analysis of variance, the homogeneity test was carried out first variance using the Bartlett Test. If the analysis of variance showed that the number of seeds per planting hole had a significant effect on the observed variables (P 0.05), then a different treatment test was conducted using the DMRT test at the level of 5%.

C. Results and Discussion _

1. Results

The results of the analysis of plant height variance at 7, 14, 21, and 32 DAP showed that the variation in the number of seeds per planting hole was not significantly different from the increase in lettuce height and at 28 DAP it was significantly different to the increase in lettuce height. Lettuce plant height increase can be seen in picture 1 below:

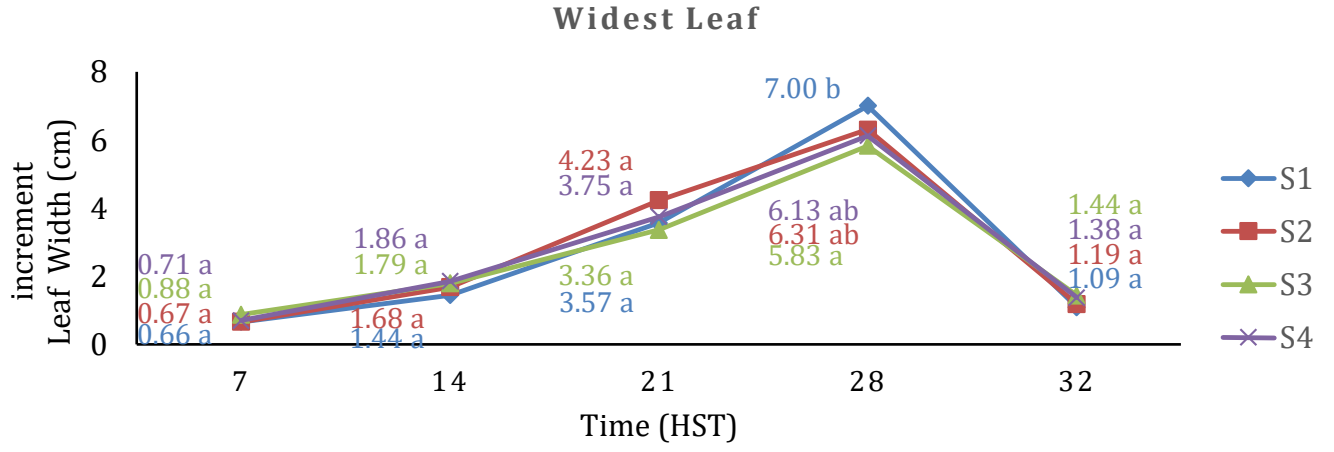


Picture 1. Graph of average plant height on a lettuce plant

Note: Numbers followed by the same letter are not significantly different. Based on DMRT test at 5% level. S1 = 1 plant per planting hole (control) , S2 = 2 plants per planting hole , S3 = 3 plants per planting hole , and S4 = 4 plants per planting hole.

Based on picture 1, it is known that at 7, 14, 21, and 32 DAP the increase in plant height in S1, was not significantly different from S2, S3, and S4. At 28 DAP, S1 was not significantly different from S2 and S3, but significantly different from S4. The highest increase in plant height was in S4 with 4 seeds per planting hole of 11.61 cm at 28 DAP.

The results of the calculation of the analysis of plant leaf width at 7, 14, 21, and 32 DAP showed that the variation in the number of seeds per planting hole was not significantly different from the increase in lettuce leaf width and at 28 DAP it was significantly different to the increase in lettuce leaf width. The increase in the width of the lettuce leaves can be seen in picture 2 below:

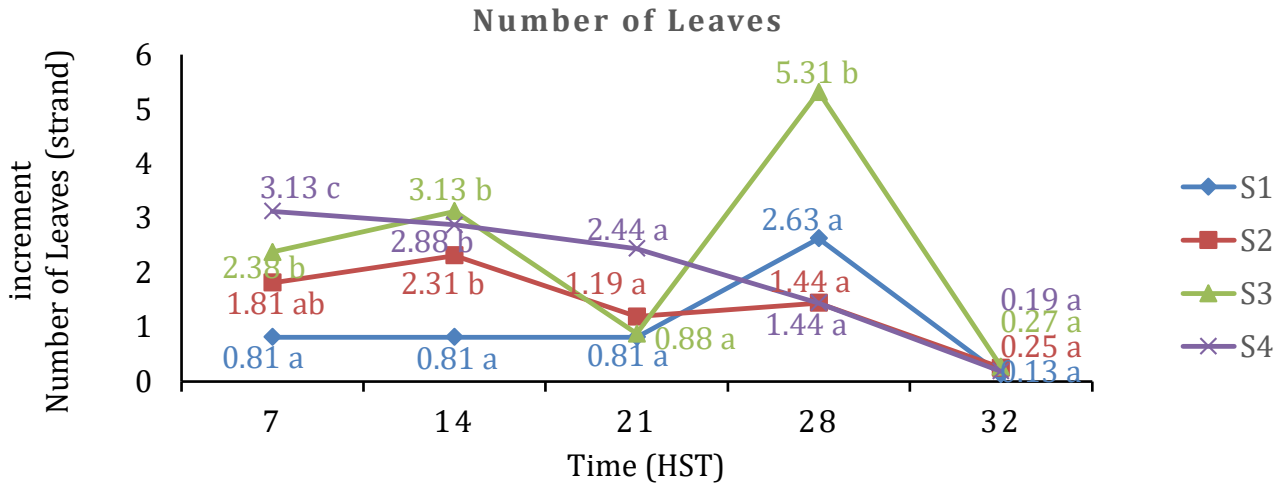


Picture 2. Graph of the widest leaf mean on a lettuce plant

Note: Numbers followed by the same letter are not significantly different. Based on DMRT test at 5% level. S1 = 1 plant per planting hole (control), S2 = 2 plants per planting hole, S3 = 3 plants per planting hole , and S4 = 4 plants per planting hole.

Based on picture 2, it is known that at 7, 14, 21, 28 and 32 DAP the increase in leaf width of S1, was not significantly different from that of S2, S3, and S4. The highest increase in leaf width was found in S1 with 1 seed per planting hole of 7.00 cm at 28 DAP.

The results of the calculation of the analysis of the number of leaves at 21 and 32 DAP showed that the variation in the number of seeds per planting hole was not significantly different to the increase in the number of lettuce leaves, at 14 and 28 DAP it was significantly different, and 7 DAP was very significantly different to the increase in the number of lettuce leaves. The increase in lettuce leaf width can be seen in picture 3 below:

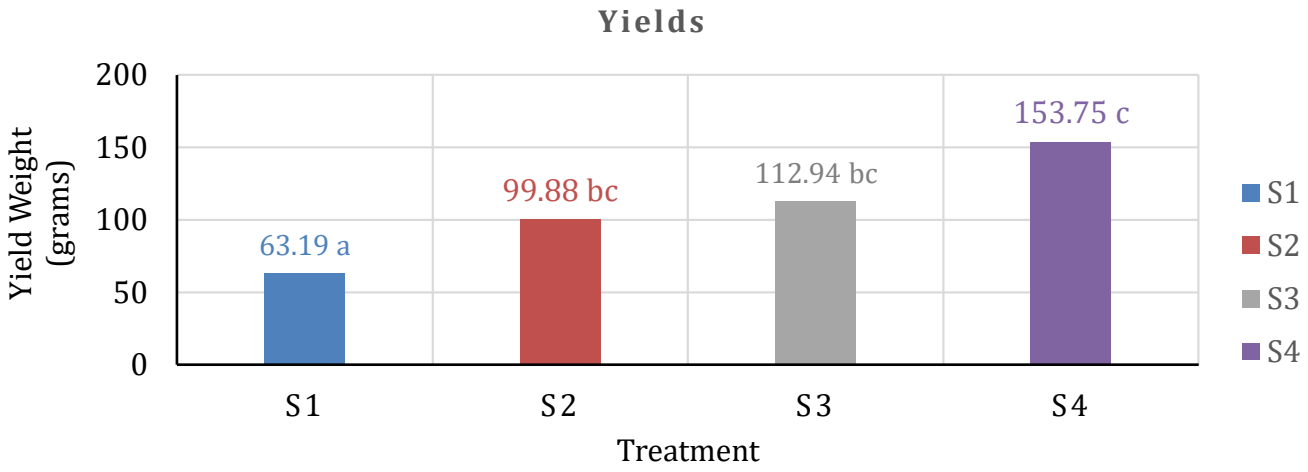


Picture 3. Graph of the average number of leaves on a lettuce plant

Note: Numbers followed by the same letter are not significantly different. Based on DMRT test at 5% level. S1 = 1 plant per planting hole (control), S2 = 2 plants per planting hole, S3 = 3 plants per planting hole, and S4 = 4 plants per planting hole.

Based on picture 3, it is known that at 7 DAP the increase in the number of S1 leaves was significantly different from S2, S3, and very significantly different from S4. at 14 DAP the increase in the number of S1 leaves was significantly different from S2, S3, and S4. At 21 and 32 DAP, S1 was not significantly different from S2, S3, and S4. At 28 DAP, S1 was not significantly different from S2 and S4, but significantly different from S3. The highest increase in the number of leaves was found in S3 with 3 seeds per planting hole of 5.31 cm at 28 DAP.

The results of the calculation of the analysis of the variance of lettuce yields showed that the variation in the number of seeds per planting hole was very significantly different from the weight of the lettuce yields. The weight of the lettuce crop yields can be seen in picture 4 below:



Picture 4. Graph of average yield on lettuce tanaman
Note: Numbers followed by the same letter are not significantly different. Based on DMRT test at 5% level. S1 = 1 plant per planting hole (control), S2 = 2 plants per planting hole, S3 = 3 plants per planting hole, and S4 = 4 plants per planting hole.

Based on the harvest data in picture 4. S1 treatment was significantly different from S2 and very significantly different from S3 and S4. The highest average yield weight of all treatments was 4 planting hole seeds (S4). The weight of the harvest from S1 to S4 was 63.19 grams, 99.88 grams, 112.94 grams, and 153.75 grams.

2. Discussion

The use of the DFT hydroponic system makes it possible for plant roots to absorb nutrients properly because nutrients continue to pool and soak plant roots so that plant roots do not scramble to take food. The DFT hydroponic system is a hydroponic system that provides nutrients in the form of water in the form of puddles. The nutrient solution needed by the plant is flowed as high as 4-6 cm periodically in the pipe so that it can soak the plant roots with the nutrient solution. The flow of nutrient solution in the planting pipe is then collected back in the nutrient reservoir and pumped back through the distribution pipe into the planting pipe continuously. The use of the DFT system also makes the oxygen needs of plants alwaysfulfilled so that the growth of lettuce plants is good and not hampered (Chadirin, 2007). The DFT system has advantages such as low nutrient requirements and sufficient oxygen availability due to the presence of an air cavity with a water pump that supports a good aeration system for plants. The risk of lack of movement of water during a power outage will not occur due to the presence of air voids in DFT hydroponics, so that oxygen needs in the short term can be met (Mansyur, AN, S. Triyono, & A. Tusi. 2014).

The S1 treatment had the highest value in the increase in leaf width at 28 DAP by 7 cm. However, the lowest were in mean plant height, average leaf width, average number of leaves, and average yield. The S2 treatment had the highest value on the widest leaf average of 15.22 cm. However, the lowest was the increase in plant height at 28 DAP, and the increase in the number of leaves at 28 DAP. The S3 treatmenthad the highest value in increasing the number of leaves at 28 DAP of 5.31 strands. However, the lowest wasat the widest leaf average, and leaf width increased at 28 DAP. The S4 treatment had the highest value at an average plant height of 36.25 cm, an increase in plant height at 28 DAP of 11.61 cm, an average number of leaves of 22.06 strands, and an average yield of 153.75 grams. However, the lowest was the increase in the number of leaves at 28 DAP which was the same value as the S2 treatment.

Based on the advantages and disadvantages above, the most recommended variation in the number of seeds per planting hole is S4 because it has many advantages compared to other treatments, namely having the highest average plant height value, increasing plant height at 28 DAP, average number of leaf size, and average yield. Even though it had the lowest value for increasing the number of leaves at 28 DA, it had the second highest value on the widest leaf average of 14.97 cm after S2 treatment which had a value of 15.22. S3 and S2 treatments were better than S1 (control) treatments because they had fewer shortcomings, but S4 treatment was the best treatment of all treatments because they had many advantages and the fewest disadvantages compared to other treatments. The use of 3 plant seeds per planting hole gave higher yields than the treatment of 1 seed and 2 seeds per planting hole. It is suspected that there is no competition in plant growth and there is no competition for growing space for stems or leaves in obtaining sunlight. The more the population, the more production will increase (Gintara, 2019).

Lettuce plants in all treatments had an average plant height range of 31-36 cm and an average leaf width of 14-15 cm. The plant height was in accordance with the described morphology, but some treatmentson the widest leaf average did not fulfill it. Lettuce is a type of leaf vegetable plant and is classified as an annual plant (short-lived). Plants grow short with a height ranging from 20-40 cm or more, depending on the type and variety. Leaf lettuce plant height ranges from 30-40 cm and head lettuce plant height ranges from 20-30 cm. Lettuce leaves have broad petioles and pinnate veins. The petiole is strong and smooth. The leaves are soft and crunchy when eaten, and have a slightly sweet taste. Leaf lettuce generally has a length of20-25 cm and a width of 15 cm or more. The stems are sturdy, sturdy, booky, and strong with diameters ranging from 5.6-7 cm (stem lettuce), 2-3 cm (leaf lettuce), and 2-3 cm (head lettuce) (Cahyono, 2019).

The unfulfillment of the appropriate plant width is thought to be caused by temperatures and humidity that are less or more than the optimal growth conditions for lettuce. At the time of the research, the temperature and humidity around the hydroponic building ranged from 28-38 ^{o}C and 41-91%. Lettuce plants need an environment to grow in the highlands (mountains) with cool and cool temperatures, namely at a temperature of 15-29 ^{o}C and a fairly high humidity (Rh) of 60-80%, as well as an open place or sufficient sunlight. Plant growth is affected by air temperature. For example, the process of germination, sprouting, flowering, and so on. High air temperatures of more than 20 ^{o}C can cause lettuce plants cannot grow properly (grow imperfectly), because high air temperatures are more than the maximum limit desired by plants can cause the photosynthesis process of plants to not run perfectly or even stop, resulting in production. starch (carbohydrates) also stops, while the process of breathing (respiration) increases even more. As a result, the production of starch as a result of photosynthesis is used more for respiratory energy (respiration) than for plant growth, so that plants are not able to grow perfectly. Thus, at high temperatures,lettuce plants do not grow fertile, the plants are thin, and the production is low, and the quality of the leaves is also low. Very high air temperatures cause plants to lose a lot of water due to evaporation (transpiration) that exceeds the limit. Low air temperature also causes lettuce plants cannot grow well and productivity is low. Lettuce plants are grown in areas that have temperatures in accordance with the desired plants (15-20^{o}C), then the plants can carry out photosynthesis properly for the formation of carbohydrates in large quantities, so that energy sources are more available (enough available) for the respiratory process, plant growth (enlargement and formation of new cells, and leaf formation), and production (good leaf quality). High air humidity of more than 90% adversely affects plant growth, namely plants grow imperfectly, plants are not fertile, leaf quality is bad. High humidity does not match what plants want, causing the leaf mouth (stomata) to be closed so that the absorption of carbon dioxide gas CO^2 is disrupted. This causes CO2 gas levels cannot enter the leaves, so the CO2 gas levels needed by plants for the photosynthesis process are inadequate. Finally, the process of photosynthesis does not go well so that all growth processes in plants decline. Air humidity also affects the process of nutrient absorption by plants, which is followed by increased plant growth. Low air humidity makes it difficult for plants to absorb nitrogen (N) and phosphorus (P) nutrients. Likewise, if the humidity is too high, nitrogen (N) is also difficult for plants to absorb. As a result, plants grow infertile and poor leaf quality (Rukmana, 2016).

The concentration of nutrients and the value of the EC meter which is always maintained to thespecified value makes plant growth and yields better. Light intensity and setting EC values affect the yield and quality of lettuce (Stagnari, F., Galieni, A., & Pisante, M., 2015). The quality of the nutrient solution can be controlled based on the EC value. The higher the concentration of the solution, the more concentrated the salt content in the solution, so that the ability of the solution to conduct electric current is higher, which is indicated by a high EC value. Electrical conductivity in solution affects plant metabolism, namely in terms of photosynthetic speed, enzyme activity and the potential for absorption of ions by roots. The concentration of the nutrient solution will also determine the duration of the use of the nutrient solution in a hydroponic system (Sutanto, 2002).

Based on observational data, the percentage of harvests, namely S1 to S2 worth 58.06%, S1 to S3 worth 78.73%, and S1 to S4 worth 143.31%. The comparison of S3 with S4 is 64,58 %. Therefore, the use of S4 (4 seeds per planting hole) is highly recommended because it has the highest increase compared to other treatments. Only by increasing the number of seeds to 4 seeds per planting hole can increase crop yields by 143.31 %. Using 4 seeds per planting hole can make the production process more efficient because in one harvest it can produce twice as much as 1 seed per planting hole, so it can save on maintenance costs (electricity, nutrition, rockwool, etc.).

D. Conclusion

Based on the research conducted, it can be concluded that all treatments affect the growth and yield of lettuce plants. However, from all treatments that were tested per plant and the best results were in S4, namely 4 seeds per planting hole because it had the highest value at an average plant height of 36.25 cm, theincrease in plant height at 28 DAP was 11.61 cm, the average number of leaves is 22.06 strands, and the average yield is 153.75 grams and the addition of the number of seeds per planting hole makes the yield of hydroponic lettuce plants increase. The highest yield was found in the S4 treatment (4 seeds per planting hole).

E. Reference

Asyiah, S. (2013). A Study of the Use of Water and Nutrients in Hydroponic DFT System (Drip Flow Technique) on the Growth and Yield of Baby Kailan (*Brassica oleraceae* var alboglabra). Sebelas Maret University, Surakarta.

Central Bureau of Statistics. (2018). Statistics of Seasonal Vegetables and Fruits in Indonesia 2017. The Central Bureau of Statistics of the Republic of Indonesia. Jakarta.

Cahyono, B. (2019). Cultivation Techniques and Business Analysis of Lettuce Farming. Various Knowledge CV. Semarang.

Chadirin. (2007). Training on Hydroponic Technology Applications for Urban Agribusiness Development. Bogor Agricultural Institute Research Institute. Bogor.

Gopal, B. & N. Bhardwaj. (1979). Elements of Ecology. Departement of Botany. Rajasthan University Jaipur, India.

Fitmawati, Isnaini, Siti FN, Sofiyanti, & Rodesia MR. (2018). Application of Deep Flow Technique System Hydroponic Technology as an Effort to Increase Farmers' Income in Sungai Bawang Village. Riau Journal of Empowerment. 1(1), 23-29.

Junia & Sarido, L. (2017). Growth and Yield Test of Pakcoy (*Brassica rapa* L.) Plants with Liquid Organic Fertilizer in a Hydroponic System. Agrifor, 16(1), 65-74.

Mansyur, AN, S. Triyono, & A. Tusi. (2014). The Effect of Shade on the Growth of Mustard Greens(*Brassica juncea* L.) in a DFT Hydroponic System (Deep Flow Technique). Journal of Agricultural Engineering Lampung, 3(2), 103-110.

Pratama, GY. (2019). The Effect of Number of Plants per Planting Hole and Spacing on Growth and Yield of Siomak (*Lactuca Sativa* L.) Plants in the Hydroponic Method of the DFT System(Deep Flow Technique). STIPER Dharma Wacana Metro, 1(1), 1-16.

Trubus Editor. (2019). Hydroponic Cultivation Seedling Techniques. Swadaya Trubus. Jakarta.

Rukmana, R. & Yudirachman, H. (2016). Business and Cultivation of Baby Vegetables. Scholar feel. Bandung.

Samadi, B. (2014). *Secrets of Organic and Inorganic Lettuce Cultivation*. Mina's library. Jakarta. Sanyoto, Umar, UF, & Akhmadi, YN 2018. *Good at Hydroponic Planting for Beginners*. AgroMedia Library. Jakarta.

Stagnari, F., Galieni, A., & Pisante, M. (2015). *Shading and Nitrogen Management Affect Quality, Safety and Yield of Greenhouse-Grown Leaf Lettuce*. *Scientia Horticulturae* , *192*, 70–79.

Susilowati, YE. (2011). Effect of Planting Distance and Number of Seeds per Planting Hole on Baby Corn Yield. *Innovation Journal*. LPPM Tidar University Magelang, 36(2), 52-63.

Sutanto, R. (2002). Application of Organic Agriculture. Canisius. Yogyakarta.

Syamsul, Ida. (2014). Land Use Using a Hydroponic System. Faculty of Agriculture. *Journal of the University of Tulungagung Bonorowo*.