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GROWTH AND YIELD OF Lettuce Plants (*Lactuca sativa L.)* WITH ALTERNATIVE NUTRITION TO SUBSTITUTE AB MIX IN HYDROPONIC SYSTEMS

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Abstract

The hydroponic system is modern agricultural cultivation with various planting media as a substitute for soil, so hydroponics is an agricultural activity that is carried out by using water as a medium for distributing nutrients. This research aims to determine the effect of alternative nutrition to substitute AB mix on the growth and yield of hydroponic lettuce (Lactuca sativa L.). The research method was an experiment in a completely randomized design(CRD), using 5treatments with 4 repetitions, namely P0 (control/with ABmix nutrition) of 700-800 ppm, P1 (800-900 alternative nutrients), P2 (900-1000 ppm alternative nutrients), P3 (1000-1100 alternative nutrients), P4 (1000-1200 alternative nutrients), were analyzed by one way ANOVA analysis with a significance level of 0.05. Parameters observed were plant height, number of leaves, root length, leaf width, and fresh weight. The results showed that providing alternative nutrition significantly affected plant height, leaf width, and fresh weight of lettuce (Lactuca sativa L.). With the best treatment of 900-1000 ppm with plant height 35-41 cm, number of leaves 15-17, leaf width 17-18 cm, and plant wet weight 120-209 grams, the lowest yield was in treatment P0 with plant height 30-33 cm. the number of leaves is 15-16, and the wet weight of the plant is 117-146 grams.

Keywords: *Hydroponics, Alternative Nutrition, Lettuce Plants.*

INTRODUCTION

The population increases every year, forcing the emergence of many necessary equipment. One of the many basic material requirements that must be met. One of the many necessities needed is vegetables because vegetables can provide continuity of life for the Indonesian people. This is because vegetables have nutritional value, which plays a vital role in the lives of living creatures (Rukmana, 2005). Salada (*Lactuca sativa L.*) is one of the many horticulture plants with good sales potential and value (Mas'ud, 2009). Currently, horticultural plant cultivation can be developed using hydroponic techniques (Suwitra *et al*., 2021).

Plant cultivation using the hydroponic method can be done throughout the year regardless of the

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season. The maintenance carried out on hydroponic plants is also relatively easy because of the clean cultivation media and sterile planting media, and plants can be protected from rainwater. Alternative nutrients in technological advances in agriculture are needed to increase public interest, tiny farmers cultivating horticultural crops by utilizing nutrient sources at relatively lower prices. The first alternative uses NPK fertilizer, KCl, Calcium Nitrate, ZA, Micro, and MgSo4. Nutrients N, P, and K are the primary nutrients plants need in relatively large amounts compared to microelements to produce better plant growth. This study aims to determine the growth and yield of lettuce plants (*Lactuca sativa L*) with alternative nutrition to replace AB mix in hydroponic systems.

MATERIALS AND METHODS

Place and time of research

This research was conducted in Sarongsong 2 sub-district, Airmadidi District, North Minahasa, from January 2022 to February 2022.

Tools and materials

The tools used in this research are making AB Mix nutrition and AB Mix substitutes, including measuring cups, stirrers, digital scales, mineral water bottles and hydroponic media tools. One Deep Flow Technique (DFT) hydroponic system installation, including a 2-inch pipe, hose, plastic bucket, and water pump. The materials used in this research are alternative fertilizer-making materials: NPK, KNO3 crystals, GRAND-K and AB mix nutrition, Rookwol, and lettuce seeds.

Research Method

The method used in this research uses descriptive research methods to test the activity of lactic acid bacteria, which can produce exopolysaccharides. Research data was obtained through laboratory experiments.

Research procedure

Experimental design, This research uses a non-factorial Completely Randomized Design *(CRD*) experimental method.

P0: Fertilization using AB mix 700 - 800 ppm
P1: Fertilize using an alternative replacement for AB mix 800 - 900 ppm
P2: Fertilize using an alternative replacement for AB mix 900 – 1000 ppm
P3: Fertilize using an alternative replacement for AB mix 1000 – 1100 ppm
P4: Fertilize using an alternative replacement for AB mix 1000 – 1200 ppm

From the factors above, 5 treatment combinations were obtained, accompanied by 4 repetitions to obtain 20 experimental plants. The data obtained were analyzed using one-way analysis of variance (*ANOVA*) with a significance level of 0.05.

This research goes through several stages of activity, for example: sterilization of equipment, the process of making liquid nutrients, the process of germination of plant material, the planting process, and the care process. The equipment and materials used are sterilized to prevent plant contamination from

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the process. The equipment is cleaned, washed using powdered soap, then rinsed and dried.

The process of making Research Nutrient Liquid Uses Two Types of Nutrients

These are ABMix nutrition and homemade nutrition. The process of making ABMix nutritional liquid is carried out by dissolving ABmix A (*200 grams*) and ABmix B (*200 grams*) each into 1 liter of water, then each of these nutrients is stored in a mineral water bottle. Making Homemade nutrients is carried out by dissolving NPK (*200 grams*) into 1 liter of water for solution A. Next, dissolve GRAND_K (*100 grams*) and KNO3 crystals (100 grams). The two liquids are then mixed into 1 liter of water for solution B, then stirred until evenly mixed, then the nutrients are stored in a water bottle.

Planting Material Germination Process

The plant material used is lettuce seeds. The media for the seeding process uses rock wool. The seeding process is carried out in a seeding container using rock wool cut into squares and wetted with water. Once the medium is ready, the plants are sprinkled with salad seeds and placed in a dark place for 24 hours. After the age of 1 week, the salad sprouts are transferred to the growing medium after sowing.

Figure 1. Sowing lettuce Source, (personal documentation 2022)

Planting

In the planting process, the nutrients distributed in each plastic pot containing the planting medium reach up to 300 ppm.

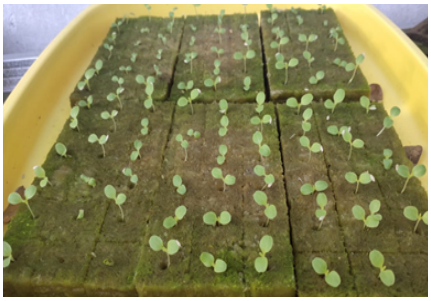

Figure 2. 6-day old salad Source (personal documentation 2022)

Maintenance process

At the age of 1-3 WAP (weeks after planting) the process of maintaining salad includes providing nutrients of 800 - 1200 ppm. Next, we check every day that if the ppm value is less than 800 ppm, nutrition will be given again so that the ppm value is in accordance with the standard, namely 800-1200 ppm.

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Figure 3. seed maintenance Source, (Personal documentation 2022)

Research variable

1) The number of leaves is the leaves that are fully formed when the plant is 32 days old. (*sheet)*
2) The height of the plant, calculated from the tip of the stem to the tip of the leaves, is the longest when the plant is 32 days old. (*cm*)
3) Root length, measured from the tip of the root to the top root, which is the longest process at the end of the process of observing 32 days. (*cm*)
4) Leaf width, measured at the end of the observation using a ruler. (*cm*)
5) Weighing the Freshness of the Crowns, carried out at the end of the observing process using the method of carrying out the stages of harvesting the crowns and then weighing the roots of the plants. (*grams*).

RESULTS AND DISCUSSION

Number of leaves

Table 1. Descriptives table Number of leaves

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
P0 700-800 ppm	4	15,75	0,957	0,479	14,23	17,27	15	17
P1 800-900 ppm	4	16,50	1,291	0,645	14,45	18,55	15	18
P2 900-1000 ppm	4	16,00	0,816	0,408	14,70	17,30	15	17
P3 1000-1100 ppm	4	16,75	2,217	1,109	13,22	20,28	14	19
P4 1100-1200 ppm	4	17,00	0,816	0,408	15,70	18,30	16	18
Total	20	16,40	1,273	0,285	15,80	17,00	14	19

The statistical analysis results in the Table show no significant effect of the source of fertilizer on the amount of salada foliage. In each figure, it appears that the distribution of fertilizer Alternative NPKMutiara + KNO3 + GRAND-K distributed the most amount of foliage (19 leaves) in the P3 treatment, compared to the distribution of fertilizer Mix (P0) distributed the amount of foliage not too far away as much as (17 leaves). The distribution of fertilizers that need to be adequately given in terms of type, dose, and timing or application method can cause plants to produce less.

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Table 2. Anova Test Table for Number of Leaves

	Number of leaves				
	Sum of Squares	df	*Mean Square*	F	Sig.
BetweenGroup	4,300	4	1,075	0,608	0,663
WithinGroup	26,500	15	1,767		
Total	30,800	19			

From the ANOVA test table above, the data collection of the results obtained on the number of leaves of salada growth 32 days after the plant is analyzed by statistical methods and the results of the analysis using a significance level of 0.05, can be seen that the significance of the test results is 0.663, the significance of the test results is> 0.05 so that the significance level on H0 is accepted. So, similar results from ABMix nutrition and alternative replacement nutrition were obtained for the sum of the leaves of salada (*Lactuca sativa L.*). According to Beben Ariananda (2020), A small amount of foliage in salada plants is produced because the nutritional liquid still needs to meet the needs of salada plants, so plants experience a lack of nutrients.

Plant Height

Table 3. Descriptives table of plant height

					95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
P0 700-800 ppm	4	31,00	2,449	1,225	27,10	34,90	28	33
P1 800-900 ppm	4	33,25	1,708	0,854	30,53	35,97	31	35
P2 900-1000 ppm	4	39,00	2,828	1,414	34,50	43,50	35	41
P3 1000-1100 ppm	4	39,00	2,160	1,080	35,56	42,44	36	41
P4 1100-1200 ppm	4	39,50	4,041	2,021	33,07	45,93	36	45
Total	20	36,35	4,368	0,977	34,31	38,39	28	45

The results of the statistical analysis process in the table show that the fertilizer source significantly affects the height of the salada plant. Each figure shows that the distribution of alternative fertilizers NPKMutiara + KNO3 + GRAND-K gives the highest plant height in treatment P4 (45 cm). Applying AB Mix fertilizer (P0) gives the highest plant height (33 cm). Inappropriate fertilizer distribution, for example, the type, dose, and timing or method of application, can cause processes that result in plants not producing as dreamed.

Table 4. Anova Test Table of Plant Height

	Sum of Squares	df	*Mean Square*	F	Sig.
Between Groups	248,800	4	62,200	8,202	0,001
Within Groups	113,750	15	7,583		
Total	362,550	19			

From the ANOVA test table above on the height of the salada plant 32 days after planting and then analyzed by statistical methods, the test result is 0.001, where this level, 0.05 (sig) <0.05, so that H0 is rejected. So there are significantly different results than nutrition ABMix and alternative nutrition replacement on the height of the salada plant (*Lactuca sativa L.*). based on research by Abdullah, A., & Andres, J. (2021) The pattern of plant processes of high growth has a correlation with the location of the apical meristem. This apical meristem is found at the end of the roots and at the end of the shoots, which produce the process of growing lengthwise for the plant cells. Plants that have a lack of nutrients, namely N and K, can create results that reduce plant production and make plants smaller in effect.

Root Length

Table 5. Root length descriptives table

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
P0 700-800 ppm	4	25,50	2,380	1,190	21,71	29,29	24	29
P1 800-900 ppm	4	31,50	10,279	5,140	15,14	47,86	20	45
P2 900-1000 ppm	4	41,75	11,026	5,513	24,20	59,30	30	55
P3 1000-1100 ppm	4	39,50	9,883	4,941	23,77	55,23	30	53
P4 1100-1200 ppm	4	46,50	5,196	2,598	38,23	54,77	40	52
Total	20	36,95	10,758	2,406	31,92	41,98	20	55

The results of the statistical analysis in the table show no significant effect of the source of fertilizer on the length of salada roots. In each number, it appears that the distribution of alternative fertilizers NPKMutiara + KNO3 + GRAND-K gives a root length (of 55 cm) in treatment P2, while the provision of fertilizer AB Mix (P0) gives a root length (of 29 cm). This is in accordance with the general description of lettuce root length of 20-50 cm. Inappropriate fertilizer distribution, such as the type, dose, and time or method of application, can result in not producing as expected.

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Table 6. Anova Test Table Root length

	Sum of Squares	df	*Mean Square*	F	Sig.
Between Groups	1126,200	4	281,550	3,937	0,022
Within Groups	1072,750	15	71,517		
Total	2198,950	19			

From the ANOVA test table above, the observation data on the root length of lettuce plants 32 days after planting are statistically analyzed, and from the ANOVA test table above, with a significance level of 0.05, it can be seen that the significance of the test results is 0.022 Significance of the test results (sig) is smaller than the significance level, so H0 is rejected. This means there is a significant difference between AB Mix nutrition and alternative replacement nutrition on lettuce root length (*Lactuca sativa L.*). according to Yunindanova, M. B., R.B. Arniputri & D. Ramadhan. 2018. Root length and root volume are significantly influenced by the nutrients provided. While different media do not make a difference to root morphology, Different nutrients produce different root performances in line with the research of Siregar *et al*. (2015), which states that different nutrients affect the root length of lettuce plants and are correlated with total stalk weight.

Leaf Width

Table 7. Descriptives table of leaf width

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
P0 700-800 ppm	4	16,00	0,816	0,408	14,70	17,30	15	17
P1 800-900 ppm	4	18,25	1,893	0,946	15,24	21,26	17	21
P2 900-1000 ppm	4	16,75	0,957	0,479	15,23	18,27	16	18
P3 1000-1100 ppm	4	18,50	1,915	0,957	15,45	21,55	17	21
P4 1100-1200 ppm	4	16,75	0,957	0,479	15,23	18,27	16	18
Total	20	17,25	1,585	0,354	16,51	17,99	15	21

The statistical analysis results in the Table show a significant effect of fertilizer sources on the height of lettuce plants. The figures show that the alternative fertilizer NPK Mutiara + KNO3 + GRAND-K gives the widest leaf width (21 cm) in treatments P1 and P3, while the fertilizer AB Mix (P0) gives the widest leaf width (17 cm). Inappropriate fertilizer application, both the type, dose, time and method of application, will result in plants not producing as expected (Rukmana, 2005).

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Table 8. Anova Test Table of Leaf Width

	Sum of Squares	Df	*Mean Square*	F	Sig.
Between Groups	18,500	4	4,625	2,372	0,099
Within Groups	29,250	15	1,950		
Total	47,750	19			

From the ANOVA test table above, the significance level of 0.05 shows that the significance of the test results is 0.099. The importance of the test results (sig) is greater than the significance level, so H0 is accepted. This means there is no significant difference between AB Mix nutrition and alternative replacement nutrition on the width of lettuce leaves (*Lactuca sativa L.*) According to Haryadi *et al*. (2015), the content of nutrients in the planting media can affect the number of plant leaves. The content of nutrients in the planting media can support the formation of new cells that make up organic compounds that can help the vegetative growth of plants, such as increasing the number and width of leaves.

Fresh Weight

Table 9. Fresh weight descriptives table

					95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
P0 700-800 ppm	4	132,25	12,553	6,277	112,28	152,22	117	146
P1 800-900 ppm	4	150,75	45,544	22,772	78,28	223,22	117	214
P2 900-1000 ppm	4	164,50	36,991	18,495	105,64	223,36	120	209
P3 1000-1100 ppm	4	208,25	38,759	19,379	146,58	269,92	169	244
P4 1100-1200 ppm	4	184,25	10,720	5,360	167,19	201,31	177	200
Total	20	168,00	39,430	8,817	149,55	186,45	117	244

The statistical analysis results in the table showed no significant effect of fertilizer source on the weight of lettuce. In numbers, it can be seen that the provision of alternative fertilizers NPK Mutiara + KNO3 + GRAND-K gives the weight of lettuce as heavy as (244 grams) in the P3 treatment. In comparison, the AB Mix fertilizer (P0) provides a weight of (146 grams). The relationship between nutrition and canopy wet weight can be known. One indicator to determine the results of plant growth can be seen from the weight of the plant. Plant growth will affect plant weight. According to Maryani (2012), plant dry weight is the result of photosynthate assimilation, where there is an increase in protoplasm due to the rise in the number and size of cells.

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Table 10. Anova Test Table of Fresh Weight of Lettuce

	Sum of Squares	df	*Mean Square*	F	Sig.
Between Groups	13888,000	4	3472,000	3,327	0,039
Within Groups	15652,000	15	1043,467		
Total	29540,000	19			

From the ANOVA test table above, with a significance level of 0.05, it can be seen that the significance of the test results is 0.039. The significance of the test results (sig) is smaller than the significance level, so H0 is rejected. This means there is a significant difference between AB Mix nutrition and alternative replacement nutrition to the fresh weight of lettuce (*Lactuca sativa* L.) According to Nanda Guluh Pangestika (2023), the relationship between nutrition and canopy wet weight is one indicator to determine plant growth results, which can be seen from plant weight. Plant growth will affect plant weight.

CONCLUSIONS

Of the five measured levels of alternative fertilizer NPK Mutiara + KNO3 + GRAND-K, the results of this study can conclude that the source of fertilizer / alternative nutrients affects plant height, root length, and fresh weight. With the best treatment of 900-1000 ppm with a plant height of 35 - 41 cm, number of leaves of 15 - 17 strands, leaf width of 17 - 18 cm, and wet weight of plants 120 - 209 grams, the lowest results in the P0 treatment with plant height 30-33 cm, number of leaves 15-16 strands and wet weight of plants 117-146 grams.

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