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Testing Alternative Hydroponic Nutrition of Wick System on Vegetable Growth Planted in Limited Land

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Abstract

This research aims to obtain suitable alternative nutrients for vegetable cultivation using the Hydroponic Wick System so that the production costs of hydroponic cultivation can be cheaper and more affordable. The research was conducted in the Tebeng area, Ratu Agung Kodya Bengkulu, at an elevation of 50 meters above sea level. The research method used was a Randomized Block Design with a Factorial pattern (RAKF). The first factor had 3 levels of vegetable types: kailan (S1), caisim (S2), and pakcoy (S3). The second factor had 3 levels of nutrients: AB Mix 100% (N1), alternative 100% (N2), and ABMix 50% + alternative 50% (N3). Thus, there were 9 treatment combinations with 3 replications. The results of the research showed that the plant height, number of leaves, wet weight, and dry weight of plants using Alternative Nutrients for kailan, caisim, and pakcoy vegetables significantly influenced the use of AB Mix nutrients, Alternative Nutrients, and the mixture of both nutrients when grown using the Hydroponic Wick system. The best results were achieved using alternative nutrients. This was evident from the tallest plant height at harvest, which was 34.20 grams at 42 days after planting (HST), 16.62 leaves, 142.69 grams wet weight, and 7.60 grams dry weight. These results were significantly better compared to using other nutrients, offering a potential solution to the high costs of hydroponic cultivation due to the expensive price and limited availability of AB Mix nutrients, especially in the region.

Introduction

The horticultural plant demand in Indonesia is increasing, and one of them is vegetables. According to the Food Security Agency, the consumption growth of vegetables per capita in Indonesia is around 7% annually, such as mustard greens, which amounted to 667,473 tons in 2020, while in 2018 it was only 635,990 tons. Currently, the government's efforts to meet the vegetable needs of the population include importing them. This is because local production has not been able to meet the domestic demand. One of the efforts to fulfill the vegetable demand is through hydroponic cultivation (Pohan & Oktoyournal, 2019; Savira & Prihtanti, 2019) using simple and cost-effective technology for planting in limited land areas, such as small home gardens. This method can optimize land usage using the Wick Hydroponic System (vertical axis system) without the need for electricity, which makes it more affordable and cost-effective.

Hydroponics is a planting system that does not use soil as its medium and requires minimal water, eliminating the need for watering like traditional soil-based plants (Hidayat et al., 2020; Wulandani et al., 2021). Hydroponic cultivation is an environmentally friendly farming technique (Izzuddin, 2016; Roidah, 2014). Vegetables grown through hydroponics are healthier

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and safer for consumption. Some people may still be unfamiliar with hydroponic cultivation due to its relatively slow development compared to other planting methods (Ratnawati, 2021; Sukaesih et al., 2019). However, hydroponic crops exhibit good quality and quantity during harvesting. The hydroponic technique is not suitable for all types of plants but is particularly well-suited for certain vegetables such as Kailan, Caisim, and Pakcoy. Hydroponically grown plants yield more abundant and satisfactory results.

Hydroponic systems are diverse, namely the Drip Irrigation System, the Wick System, and the Nutrient Film Technique (NFT) (Amri et al., 2020; Supriadi, 2020). The type of hydroponic system used in this research is the Wick Hydroponic System, which is very suitable for beginners who want to engage in cultivation, as its fundamental principle relies on utilizing water capillarity (Iskarlia, 2017; Subrata & Purnamaningsih, 2018). Hydroponic cultivation also does not require special care, it is easy to assemble, portable (can be moved), suitable for limited land areas, and can be done in small backyard spaces. Even narrow areas can be utilized to grow vegetables such as spinach, tomatoes, mustard greens, chili, and some other vegetable plants (Primasari, 2021). A suitable medium for hydroponic vegetable cultivation, such as lettuce, is by using Rockwool. Meanwhile, according to Peter, hydroponic cultivation of Pakchoy vegetables using recycled bottles with Rockwool as the medium shows the best results compared to using charcoal and rice husk as the medium. Hydroponic cultivation of Chinese Cabbage (Sawi Caisim) using the Wick system involves using tall, recycled jerry cans with the best and tallest plants, applying 900 ppm AB Mix Nutrient and 1 gram of Growmore per liter of water (Silitonga et al., 2023)

The challenges faced in increasing hydroponic production are the relatively expensive cost and limited availability of hydroponic nutrients. According to Qurrohman (2017), the availability of quality hydroponic nutrients plays a crucial role in the success of hydroponic commodity production. ABMix nutrients have an impact on the growth of pak choi and green salad at a concentration of 1000 ppm (Ramaidani et al., 2021). Selecting alternative and efficient nutrients for hydroponic use not only helps to reduce costs but also improves crop yields. Moreover, alternative nutrients are much more affordable and accessible. Researchers Sesanti & Sismanto (2016) have also conducted modifications to hydroponic nutrients by comparing ABMix nutrients with complete compound fertilizers and NPK. The results showed that ABMix provided the highest growth, but alternative nutrients need to be further improved by using various combinations of fertilizers available in the market. Therefore, it is necessary to conduct research on alternative nutrients with enhanced nutritional content for vegetable production in hydroponics.

Kailan (Brassica oleracea var Alboglabra) is a type of leafy vegetable from China. It was introduced to Indonesia in the 17th century. Kailan is quite popular and in demand among the people due to its high nutritional content, such as fats, proteins, carbohydrates, vitamins, and fiber. It belongs to the group of leafy vegetables with thick, flat, and green-colored leaves, along with thick and segmented stems (Ali et al., 2021; Amilah, 2012). Kailan has high economic value and promising prospects for cultivation. Its high economic value is due to its marketing to the middle and upper-class society and its presentation in international standard restaurants (Naiborhu et al., 2021; Samadi, 2013). According to the data from the Central Statistics Agency, cabbage production, including kailan, in Indonesia has experienced fluctuations in the past six years. The peak production was in 2016, reaching 1,513,326 tons, but in 2019, it decreased to 1,413,060 tons. However, in 2021, there was a slight increase in production, reaching 1,434,670 tons.

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Caisim (Brassica juncea L) is the most widely cultivated and consumed vegetable commodity, making it highly favored and resulting in a significant increase in demand for caisim vegetables. Therefore, there is a need for an increase in production and quality of mustard greens to meet the demand for vegetables, especially caisim. In 2018, the import volume of caisim vegetables reached 45,130.1 tons per year, with a value of Rp267.6 billion. Meanwhile, in 2019, it reached 17,908.7 tons per year, and the market demand continues to increase each year. Hence, further research is necessary to meet the growing demand for vegetables. The best nutrition for hydroponically grown Caisim plants using used jerrycans involves using 900 ppm AB Mix Nutrient with an additional 1 gram of Growmore per liter of water, which showed excellent plant growth at 5 days after planting, reaching 27.19 cm in height (Pratama, 2022).

Pakcoy (Brassica rapa L) is a leafy vegetable with high economic value, a short lifespan, and high nutritional content. Pakcoy, belonging to the mustard green vegetable family, is highly sought after due to its rich vitamin and mineral content, which is beneficial for maintaining health and preventing diseases (Damayanti et al., 2019). The cultivation of vegetables like kailan, caisim, and pakcoy using the Wick Hydroponic System is claimed to be healthier, as it avoids the use of hazardous chemicals. Based on the reasons, this research aims to find suitable alternative nutrients for cultivating vegetables using the Wick Hydroponic System, in order to reduce production costs and make hydroponic cultivation more affordable. The research was conducted in Tebeng, Ratu Agung Kodya Bengkulu, at an altitude of 50 meters above sea level.

Methods

The method used is Factorial Group Random Design (FGRD), consisting of two factors. First, the types of vegetables, including Kailan (S1), Caisim (S2), and Pakcoy (S3). Second, the nutrients, including Nutrient AB Mix (N1), Alternative Nutrient (N2), and 50% Nutrient AB Mix + Alternative Nutrient (N3). These two factors were used to create 9 treatment combinations with 3 groups as repetitions, resulting in 27 experimental units. Each experimental unit consisted of 6 plants, making a total of 162 plants.

The research data was statistically analyzed using Analysis of Variance (ANOVA). If the obtained F value (FHitung) was greater than the tabulated F value (F tabel), the analysis continued with Duncan's Multiple Range Test (DMRT) at the 5% significance level. The data analysis was performed using the Co Stat software.

This research was conducted in Tebeng Village, Ratu Agung District, Bengkulu City, at an elevation of 50 meters above sea level, from November 2022 to January 2023.

The materials used in this study were Kailan, Caisim, and Pakcoy seeds, as well as Nutrient AB Mix, Alternative Nutrient, and rainwater. The equipment used included a 2.5-inch PVC pipe, drilling machine, saw, meter, PVC glue, pipe covers, holo iron pole frame, plastic roof, nails, digital scale, buckets, paper, ruler, micrometer screw, labels, markers, drying equipment, pH and TDS meters, net pots, flannel fabric, and rockwool.

The process of creating the hydroponic installation is as follows: 1) A 2-meter-long 2.5-inch PVC pipe is prepared. 2) Six holes are made using a drilling machine to place net pots with a 15cm distance between holes. 3) Net pots and flannel fabric, cut to 25cm in length and 1.5cm in width, are inserted. 4) Pieces of rockwool, 3x3cm in size, are placed inside the net pots.

There is also the preparation of hydroponic nutrients, as follows: 1) Nutrient AB Mix (N1) is prepared and its concentration is measured at 500-800 ppm. 2) Alternative nutrient (N2) is prepared with a concentration of 500-800 ppm. 3) Three buckets, each containing 10 liters of

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water, are prepared, and then filled with the respective nutrients that have been prepared. They are mixed by adding 5 liters of N2 nutrient to the N1 nutrient and stirred until homogenous.

Next is the seeding stage: 1) Preparation of rockwool media, cut into 3x3cm pieces. 2) Small holes are made in the middle of the cut rockwool using a small stick. 3) Kailan, Caisim, and Pakcoy seeds are placed into the holes using a small stick or toothpick for germination. 4) Spraying with a sprayer is done on the seeding container every morning and evening. 5) The seeding container is placed in a sunny area for 4 hours each day for 14 days. 6) Seedlings with 4 leaves are then transferred to net pots lined with flannel fabric and placed on the prepared PVC pipes with their respective frames.

The next stage of the research is nutrient application. The prepared nutrients N1, N2, and N3 are given to the plants every day at 500 ml for plants aged 7 DAS, 14 DAS, and 21 DAS for each pipe. The nutrient concentration is increased to 800 ppm and given daily at 1000 ml for plants aged 28 DAS and 35 DAS until 42 DAS.

Results and Discussion

The use of different nutrients on several vegetable plants grown using the Hydroponic Wich System from 7 to 42 DAS (Days After Sowing) showed significant variations. Among your vegetables, at 42 DAS, it exhibited the tallest plant height, with an average of 37.70 cm, which is higher compared to caisim plants with an average plant height of 31.81 cm, and pakcoy plants with an average height of 26.56 cm. The analysis of variance showed a highly significant effect, influenced by the nutrients provided during the planting process.

Table 1. Plant Height of Various Vegetable Plants (cm)

Handling	7 HST	14 HST	21 HST	28 HST	35 HST	42 HST
Kailan	7,38a	11,67a	16,26b	21,48b	26,12b	31,81b
Caisim	6,41b	11,45a	20,19a	26,28a	30,97a	37,70a
Pakcoy	6,98ab	10,54a	16,28b	17,51c	24,88b	26,56c
KK(%)	12,26%	15,03%	15,41%	9,99%	12,77%	13,23%

Note: Numbers followed by different letters in the same column are significantly different in the 5% DMRT test

Table 1 shows the height of Kailan, Caisim, and Pakcoy vegetable plants at 14 DAP (Days After Planting) did not significantly differ in all treatments of AB mix Nutrition, Alternative Nutrition, and the combination of both nutrients. The harvested height of Kailan plants at 35 DAP averaged 26.12 cm, and an increase was observed if harvested at 42 DAP, with an average plant height of 31.81 cm. On the other hand, at 21 DAP and 35 DAP, Caisim plants showed a significant difference in height compared to Kailan and Pakcoy. Additionally, at 28 DAP and 42 DAP, the effect of nutrition on vegetable plants significantly differed, with the highest average height of Caisim plants at 37.70 cm compared to an average plant height of 31.81 cm for Kailan and 26.56 cm for Pakcoy. According to da Silva et al. (2019), the height of Pakcoy plants ranges from 15 to 30 cm, but with more suitable nutrition treatments, higher results can be achieved. As for Caisim plants, Klimes (2007) states that they have short true stems and buds. Vinolina & Sigalingging (2022) research on Caisim plants grown hydroponically with different systems showed an average height of 9.33 to 16.33 cm at 5 WAP (Weeks After Planting). The results of their study, using different nutrient treatments, indicated that the harvested height of Caisim plants at 35 DAP was 30.97 cm, while at 42 DAP, the average height was 37.70 cm.

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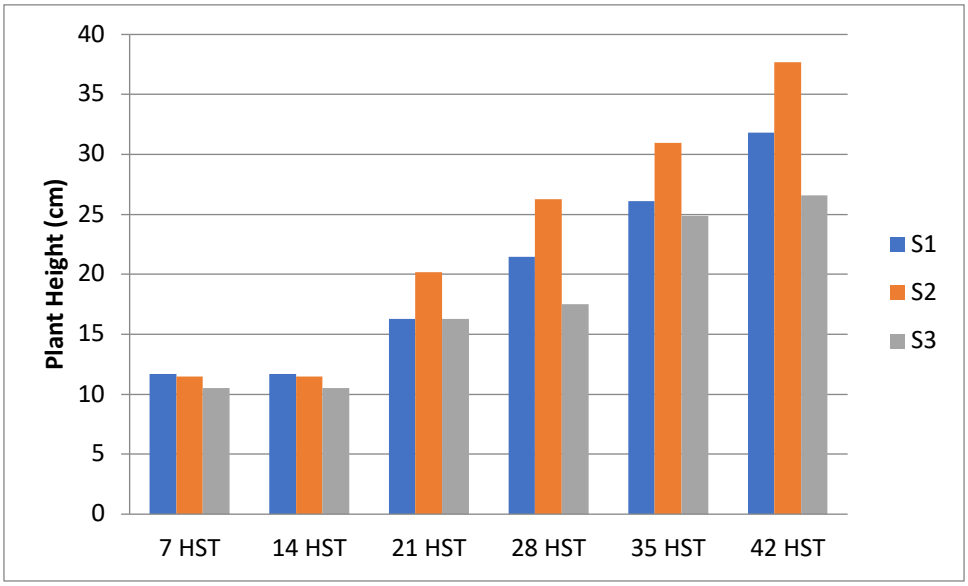

Figure 1. Plant height at the age of 7 to 42 HST on some vegetables (kailan, caisim and pakcoy)

Graph 1 shows the highest height of caisim vegetable plants with an average height of 37.70 cm compared to kailan and pakcoy vegetables, from 21 DAS (Days After Sowing) to 42 DAS. According to Desta & Amare (2021), plant growth will increase as the age of the plants increases. Harahap et al. (2020) added that the macro elements in AB Mix greatly influence plant growth.

Table 2. Plant Height for Several Nutrients (cm

Handling	7 HST	14 HST	21 HST	28 HST	35 HST	42 HST
AB Mix Nutrients	6,95b	11,79a	17,50b	21,48ab	27,26b	32,07a
Alternative Nutrients	8,07a	12,23a	19,54ab	23,13a	30,88a	34,20a
AB Mix Nutrients 50% + Alternative 50%	5,75c	9,64b	16,68b	20,71b	23,83b	29,80a
KK(%)	12,26%	15,03%	15,41%	9,99%	12,77%	13,23%

Note: Numbers followed by the same letters in the same column do not show significant differences in the DMRT test at 5% level of significance.

The results of the variety analysis in Table 2 show that different nutrient provisions have an impact on the height of several different vegetable plants. The comparison of the plant height for several vegetables, namely Kailan, Caisim, and Pakcoy, with the provision of Alternative Nutrition harvested at 42 DAS (Days After Sowing), indicates that the tallest average plant height is 34.20 cm. Meanwhile, with the provision of AB Mix, the plant height is 32.07 cm, and the combination of AB Mix and Alternative nutrition results in an average plant height of 29.80 cm. The statistical analysis results demonstrate that different nutrient provisions will yield different plant heights. According to Anas et al. (2020), Nitrogen plays a vital role in improving the vegetative growth of plants. Hence, with sufficient availability of Nitrogen, the plant's needs can be adequately met, allowing the plants to grow optimally.

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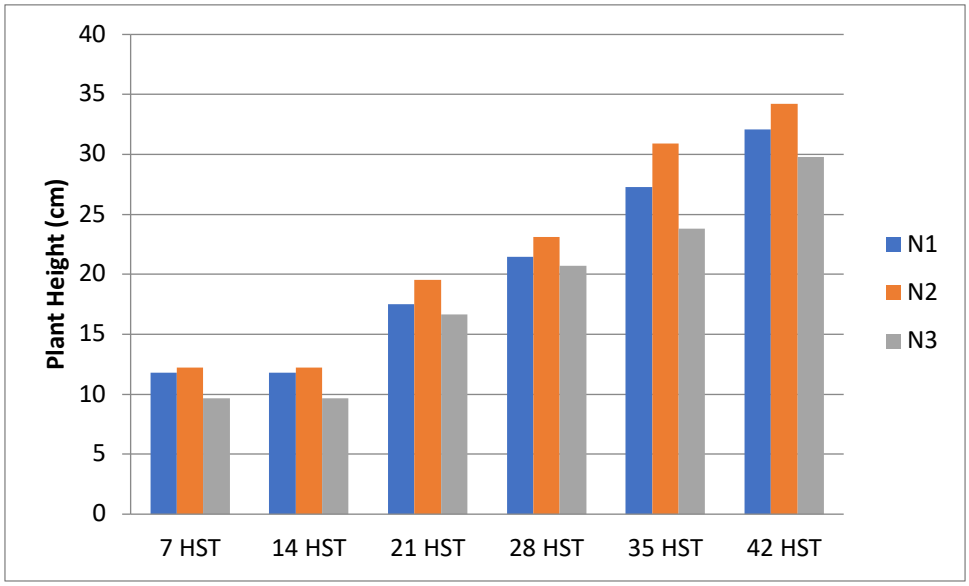

Figure 2. Plant height chart at age 7 to 42 DAP with several nutrients (ABMix, Alternative Nutrition, and ABMix 50% + Alternative Nutrition 50%)

The picture 2 illustrates the administration of alternative nutrition with the same concentration as AB Mix. The obtained average height is higher, which is 34.20 cm compared to the administration of Nutrient AB Mix, resulting in a vegetable height of 32.07 cm. According to Al Meselmani (2022), the nutrient content of the AB Mix solution is a crucial factor for the hydroponic plant's growth and quality, hence it must be precise in terms of ion composition. Using Alternative Nutrition can produce taller heights for several vegetables, with harvesting at 42 DAS.

Plant growth rate can be observed from the number of leaves produced. The analysis of variance shows the number of leaves (leaves) displayed in Table 3.

Table 3. Number of Leaves for Several Vegetables (Leaves)

Handling	7 HST	14 HST	21 HST	28 HST	35 HST	42 HST
Kailan	4,57b	6,12a	7,29c	8,08c	9,33c	10,14c
Caisim	4,71b	6.68a	8,91b	10,12b	12,44b	14,80b
Pakcoy	5,93a	7,33a	10,87a	12,65a	15,85a	18,29a
KK(%)	16,86%	21,13%	11,28%	13,76%	22,40%	17,62%

Note: Numbers followed by different letters in the same column indicate significant differences in the DMRT 5% test.

Table 3 shows the results of variance analysis on the number of leaves from several hydroponically grown vegetables, which significantly differ in the DMRT 5% test. The vegetable "Pak coy" has the highest average leaf count of 18.29, followed by "Caisim" with 14.80 leaves, and the smallest number of leaves is from "Kalian" with 10.14 leaves, harvested at 42 days after sowing (DAS). According to Ali et al. (2021), providing AB Mix 1000 ppm nutrient to hydroponically grown "Kailan" resulted in an average leaf count of 10 leaves. On the other hand, for "Pak coy," the leaf count is higher, around 18.29, because "Pak coy" has a larger root system. The development and growth of leaves are closely related to cell enlargement, cell elongation, and cell formation processes, which are influenced by protein and carbohydrate compounds. Nitrogen, present in proteins, increases photosynthesis, leading to a

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higher amount of chlorophyll in the leaves, as supported by Alifah et al. (2022) opinion that Nitrogen plays a role in the formation of leaf greenery.

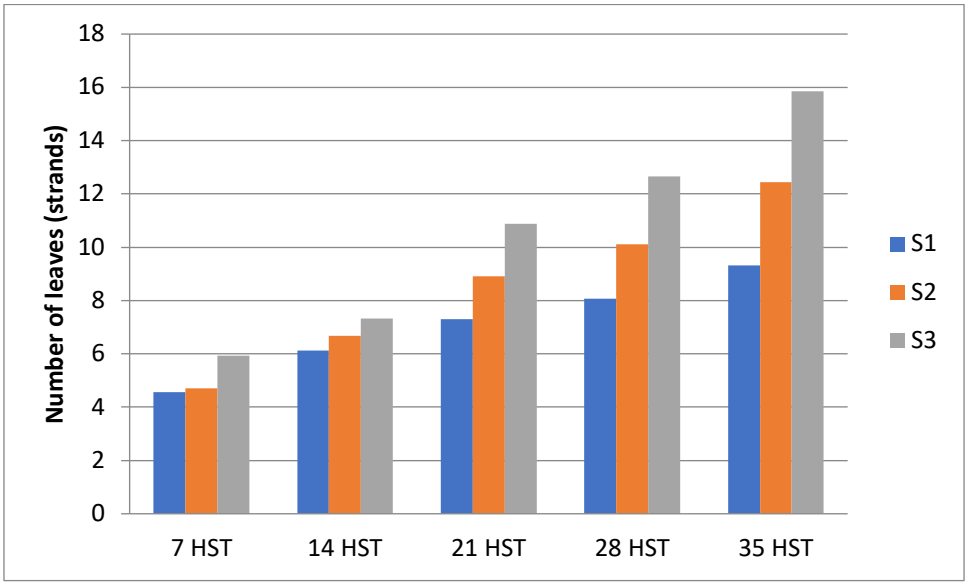

Figure 3. is incorrect. The graph shows the Number of Leaves at ages 7 to 42 DAS for several vegetables

The results of the variation analysis in Graph 3 indicate the number of leaves for Kailan, Caisim, and Pak Coy vegetables grown using the Wick hydroponic system and harvested at 42 DAS. The graph shows that Pak Coy vegetable has the highest number of leaves. According to Khatun (2021), the number of leaves at 6 MST is 16 pieces. The application of high-dose Nitrogen fertilizer can promote the formation of high protein, thereby increasing the width, length, and number of leaves, expanding the leaf surface available for photosynthesis. Meanwhile, according to Leghari et al. (2016), N (Nitrogen) benefits the plant's leaf, stem, and root growth.

Table 4. Number of leaves for some nutrients (strands)

Handling	7 HST	14 HST	21 HST	28 HST	35 HST	42 HST
AB Mix Nutrients	5,42a	7,17a	8,77b	9,27b	11,62a	13,47b
Alternative Nutrients	4,91a	6,48a	9,88a	11,77a	14,05a	16,63a
AB Mix 50% Nutrients + Alternative 50%	4,88a	6,48a	8,41b	9,80b	11,95a	13,14b
KK(%)	16,86%	21,13%	11,28%	13,76%	22,40%	17,68%

Note: Numbers followed by different letters in the same column are significantly different in the 5% DMRT test

The analysis results of Table 4 demonstrate a significant difference in the number of leaves in several vegetable plants with different Nutrient treatments. The application of Alternative Nutrient shows an average leaf count of 16.63, while the application of AB Mix shows an average leaf count of 13.47. However, when a mixture of AB Mix and Alternative Nutrient is applied, there is no significant difference in the results.

According to the research findings of La Lestari et al. (2022), hydroponically grown pakchoy plants, aged 26 days after sowing and using the wick system, with the application of Nasa fertilizer nutrient, show an average leaf count of 8.64 to 10.03 leaves.

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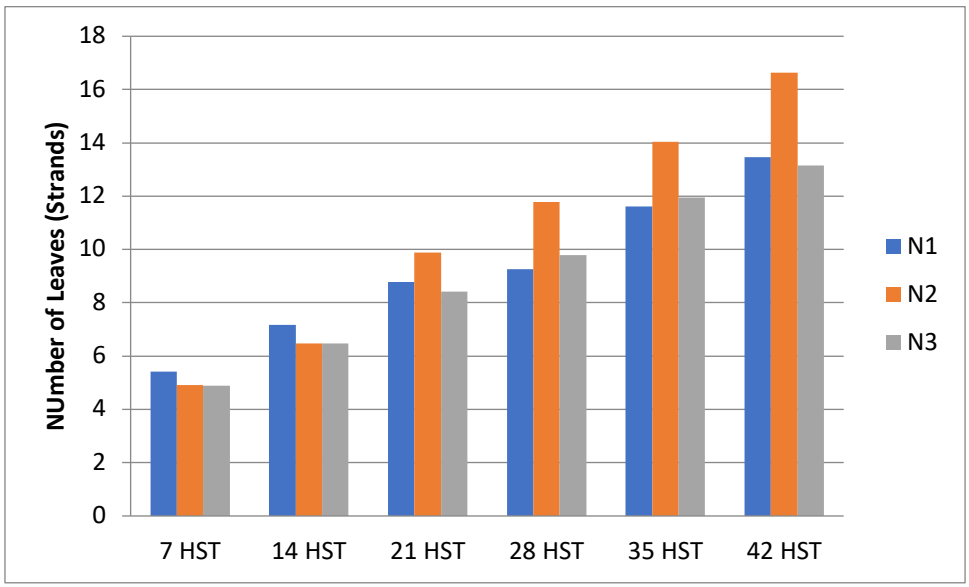

Figure 4. Graph of Number of Leaves at the age of 7 to 42 HST on several Nutrients (ABMix. Alternative Nutrients and ABMix 50% + 50% Alternative Nutrients)

The analysis of the variety in Graph 4 shows the highest number of leaves with the use of Alternative nutrition, which resulted in an average of 16.63 leaves. This is because alternative nutrition, both macro and micro nutrients, is more suitable for vegetable plants. According to Long et al. (2004) opinion, the more leaves there are, the more photosynthesis occurs. With increased photosynthesis, more photosynthate is produced, leading to an increased growth in the number of leaves.

The growth rate of plants can also be observed from the Fresh Weight of several vegetables produced. The research results indicate the fresh weight of several vegetable plants as shown in Table 5.

Table 5. Fresh Weight of Several Vegetable Plants (grams)

Handling	14 HST	28 HST	42HST
Kailan	6,22a	10,67b	105,62a
Caisim	8,42a	34,50a	115,03a
Pakcoy	8,40a	33.67a	121,33a
KK(%)	7,15%	6,18 %	9,42%

Note: Numbers followed by different letters in the same column are significantly different in the 5% DMRT test

The results of the diversity analysis in Table 5 show that the fresh weight of vegetables harvested at 42 DAS (Days After Sowing) did not significantly differ for all vegetables, with the highest yield found in the average weight of pakchoi plants, which was 121.33 grams. On the other hand, the fresh weight results of vegetables, namely Kale, Chinese Mustard, and Pakchoi, harvested at 28 DAS, showed the highest yield in Kale. This means that the growth of Kale at 28 DAS was higher compared to other vegetables due to the highest photosynthesis at 28 DAS. Conversely, at 42 DAS, the fresh weight of Chinese Mustard was higher, indicating more growth in Chinese Mustard plants at 42 DAS. Each plant has parenchymal cells that vary significantly in shape, size, and composition depending on the type or variety of the plant, which affects its fresh weight. According to Kapoor et al. (2020), the productivity of plant

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metabolism requires more nutrients and increased water absorption, which is related to the plant's needs during its growth and development period. Growth rate increases when the necessary nutrients are available and utilized by the plant, such as Nitrogen. According to Novoa & Loomis (1981), if Nitrogen is available in sufficient quantities, more protein is formed, leading to better plant growth.

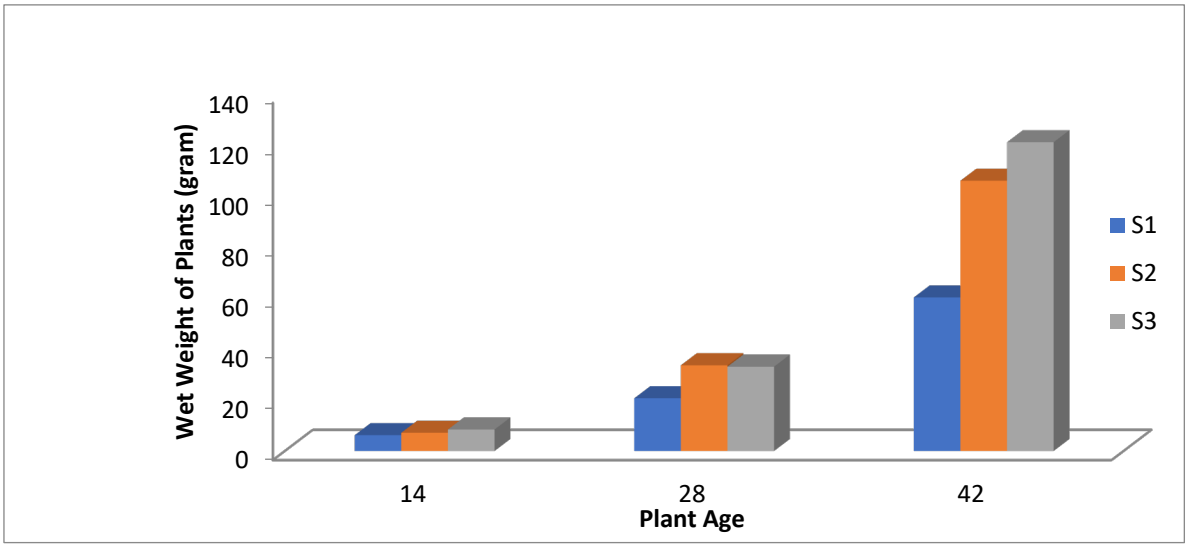

Figure 5. Graph of wet weight at the age of 7 to 42 HST on several vegetable plants (Kailan, Caisim and Pak coy)

The results of the variety analysis in Picture 5 indicate that the highest wet weight of the plants at the age of 14 and 42 DAS was obtained in the Chinese Cabbage. The wet weight of the plants is influenced by the number of leaves and plant height. According to the research, the highest number of leaves was found in the Chinese Cabbage. This aligns with Islam et al. (2009) opinion, which suggests that an increase in the number of leaves in a plant leads to a corresponding increase in the wet weight because leaves are the organs that contain the most water. Hence, as the number of leaves increases, the plant's water content also increases, resulting in a higher wet weight of the plant.

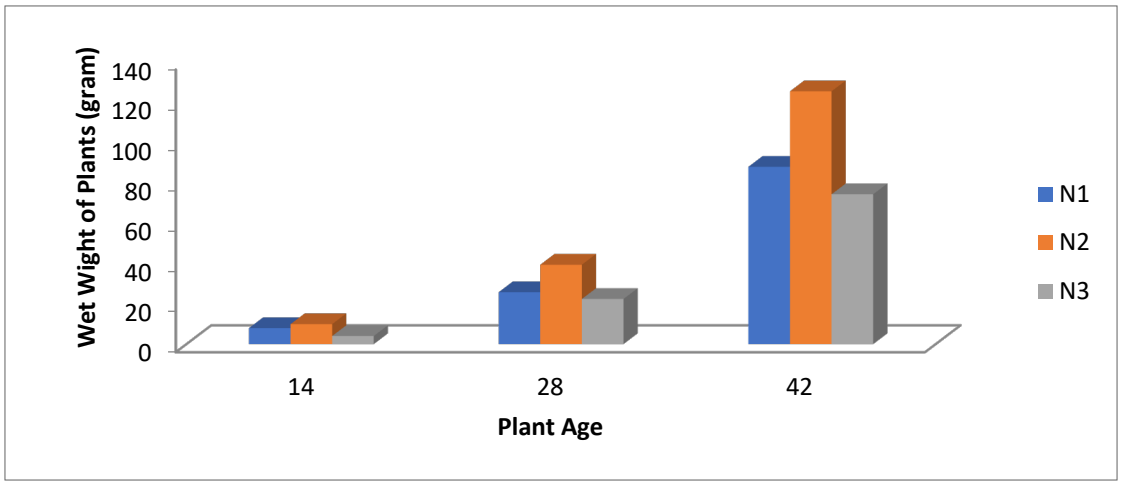

Figure 6. Graph of Wet Weight of plants at the age of 7 to 42 HST on several Nutrients (ABMix. Alternative Nutrients and ABMix 50% + Alternative Nutrients 50%)

The results of the analysis of variance in Figure 6 show the wet weight of some vegetables with the provision of Alternative Nutrients wet weight is higher with the provision of Alternative

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Nutrients compared to the provision of AB Mix and a mixture of both nutrients harvested at the age of 14, 28 and 42 HST. It is clearly seen that the provision of alternative nutrients is the best nutrition for Kaylan, Caisim and Pak Coy vegetables grown in hydroponics which were harvested at the age of 42 HST.

Table 6. Wet Weight against some Nutrients (grams)

Treatment	14 HST	28 HST	42HST
AB Mix	07,92a	25,69b	124,80a
Alternatif	11,12a	39,31a	142,69a
AB Mix 50+Alternatif 50%	04,00b	23,23b	74,49 a
KK(%)	6,82%	6.05%	16,68%

Description: Numbers followed by different letters in the same column are significantly different in the 5% DMRT test

The results of the analysis of variance in Table 6 show the response of plant wet weight of some nutrients at harvest age 14 HST, 28 HST and 42 HST. At the age of 14 HST and 42 HST due to the provision of AB Mix nutrition and Alternative Nutrition to the weight of vegetable plants, meaning that between AB Mix Nutrition and Alternative Nutrition the effect is almost the same on the wet weight of plants until harvest at the age of 42 HST, only significantly different between the provision of AB Mix and Alternative Nutrition when the plant is 28 HST with a higher average weight with the use of alternative nutrition of 39.31 grams while with the provision of AB Mix nutrition of 25.69 grams. While the wet weight of vegetable plants at the age of 42 HST with alternative nutrition has the highest wet weight of 142.69 grams compared to the use of AB Mix wet weight of 124.80 grams. This means that alternative nutrition at the age of 28 HST vegetable plants is more sufficient for the needs of macro and micronutrients for plant growth. Nutrition in hydroponic cultivation is very important, because sufficient nutrients can be absorbed by plant roots directly through the nutrient solution. The availability of nutrients directly for plants can induce faster growth so that the wet weight of plants can also increase.

Dry weight of Vegetable Plants (grams)

Tabel 7. Dry Weight of some Vegetable plants (grams)

Treatment	14 HST	28 HST	42HST
Kailan	0,25a	2,07a	5,17b
Caisim	0,31a	2,61a	7,94a
Pakcoy	0.23a	2,28a	5,76b
KK(%)	5,76%	14,01%	15,03%

Note: Numbers followed by different letters in the same column are significantly different in the 5% DMRT test

The results of the analysis of variance in Table 7 show that the dry weight of vegetable plants with several nutrients at the age of 14 HST is not significantly different in all vegetables, while at the age of 28 HST and 42 HST your vegetables are significantly different compared to Caisim and Pakcoy vegetables. The dry weight of plants increases indicating an increase in the size and number of cells through metabolic events where water, carbon dioxide and inorganic salts are converted into food reserves by the process of photosynthesis. The provision of appropriate nutrients spurs the development of leaf area, with increasing leaf area means the ability of leaves to receive and absorb sunlight will be higher so that photosynthate and dry

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matter accumulation will be more benyak. According to Fisher and Goldsworthy (1985), the addition of leaf area is the efficiency of each unit of leaf area in carrying out photosynthesis to increase the dry weight of plants.

Dry Weight

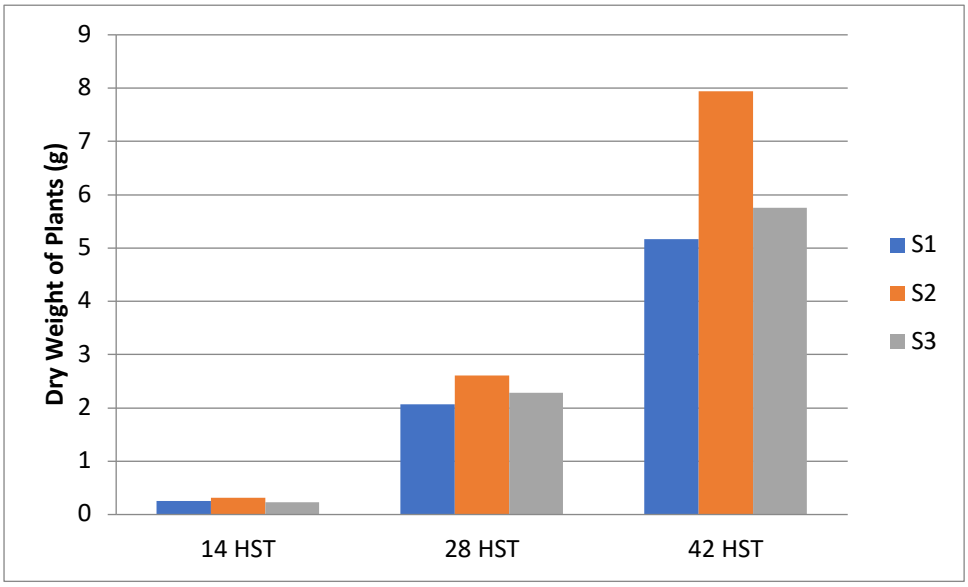

Figure 7. Graph of dry weight at the age of 7 to 42 HST on several vegetable plants (Kailan, Caisim and Pak coy)

The results of the analysis of variance in Graph 7 can be seen that the highest dry weight is obtained in Caisim vegetables grown in a hydroponic system which produces a higher dry weight compared to Kailan and Pakcoy vegetables harvested at 4 HST, 28 HST and 42 HST with the highest dry weight in Caisim vegetables which is 7.94 grams significantly different from the dry weight of Kailan and Pak Coy vegetables. According to Wijiyanti et al. (2019) Plant crting weight is a component of measuring photosynthate accumulation in plants and dry weight is the balance between photosynthesis and respiration that occurs when plants are planted Caisim plant dry weight is directly proportional to the wet weight of the plant.

Table 8. Dry weight against some Nutrients (grams)

Treatment	14 HST	28 HST	42HST
AB Mix	0,25ab	2,52ab	6,02ab
Alternatif	0,35a	2,78a	7,60a
AB Mix 50%+Alternatif 50%	0,19b	1,66b	5,25b
KK(%)	5,76%	14,01%	15,03%

Desccription : Numbers followed by different letters in the same column are significantly different in the 5% DMRT test

The results of the analysis of variance in Table 8 can be seen planting vegetables Kailan, caisim and pak coy hydroponically with the use of different nutrients harvested at the age of 14, 28, and 42 HST the provision of AB Mix Nutrition is significantly different from Alternative Nutrients and mixed nutrients AB Mix 50% + Alternative 50%. The highest dry weight results at the age of 42 HST were obtained by giving alternative nutrition 7.60 grams while giving AB mix 6.02 grams.

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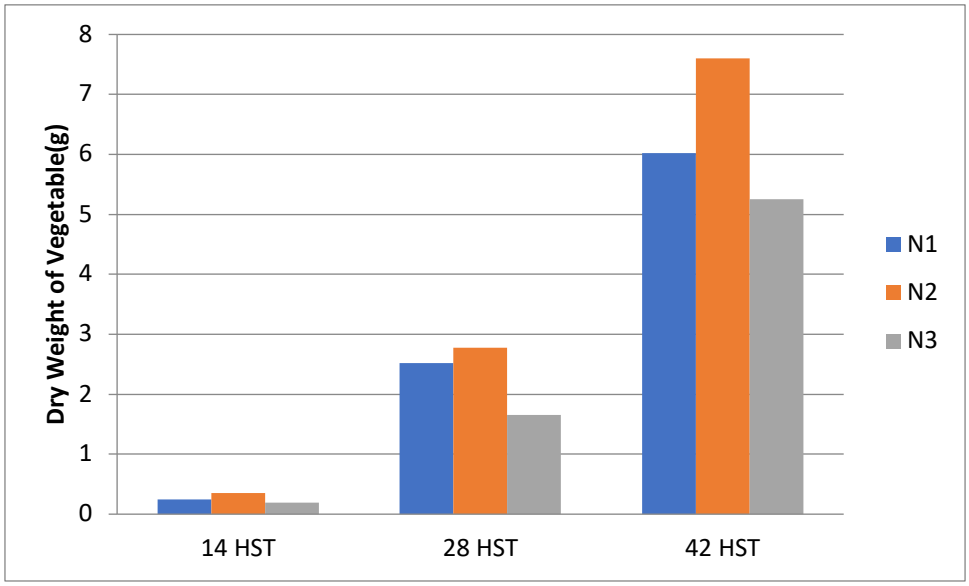

Figure 8. Dry weight of vegetable plants at 7HST, 28 HST and 42 HST on the provision of different nutrients

The results of the analysis of variance in Figure 8 can be seen the dry weight of vegetable plants grown secra hydroponic system wich with the provision of different nutrients N1 (AB mix) and N2 Alternative Nutrition) and N3 (50% Ab Mix and 50% Alternaatif). Produce with the provision of alternative nutrients the weight of the plant is higher when harvested at the age of 14, 28 and 42 HST, meaning that with the provision of alternative nutrients the assimilation of photosynthates that are translocated from the roots to all parts of the plant more. According to Maryani (2012) plant dry weight is the result of assimilation of photosynthates that are translocated from the roots to all parts of the plant and the result of the increase in ptotoplasm due to the increase in size and number of cells.

Conclusion

The use of alternative nutrients to the planting of some vegetables Kailan, caisim and pakcoy significant effect with the use of nutrients AB Mix or a mixture of both nutrients. which is planted in Hydroponic system Wick. This can be seen with the height of the plant, wet weight and dry weight of the plant is quite significant., so it can be a solution that has been the cultivation of plants in hydroponics costly due to the price of nutrients AB Mix is quite expensive and difficult to obtain, especially in the area.

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