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The Effect of Hydroponic Nutrient Sources and Planting Media Types on the Growth and Production of Chinese Kale (*Brassica oleraceae* L.)

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ABSTRACT

Kale is prospective for cultivation because they have a good market. In order to get optimal plant output when growing kale in a hydroponic system, care must be taken to employ AB Mix nutrients and specific planting media types. This study aim at obtaining the right combination of AB Mix nutrients and types of growing media on the yield and growth of Kale plants, which were grown on substrates hydroponic. The study was organized in a Randomized Complete Block Design, with three replicates and factorial arrangement. The first factor was the source of nutrition AB Mix i.e. Infarm, Growrich, and Purie Garden. The second factor was the type of planting media, including husk charcoal, cocopeat, and a mixture of cocopeat and husk charcoal (1:1). Results revealed that the combination treatment of AB Mix nutrients and types of growing media was statistically different on the leaf area. The best combination was between charcoal and Infarm. The source of nutrition AB Mix significantly affected plant growth parameters such as plant height, leaf area, and dry weight of root with Infarm was found to the best nutrient. The type of growing media did not significantly influence all the parameters observed. Interaction between the type of nutrient AB Mix and type of growing media on the leaf area parameter showed with the best result M2A2 (husk charcoal + Infarm) of 700,96 cm2 , but not significantly different from the other treatment.

1. INTRODUCTION

Kailan or Chinese kale (*Brassica oleraceae* L.) is a vegetable classified in the cabbage family (*Brassicaceae*) which can be consumed from its leaves and stems with a crunchy texture. Kale cultivation has quite good prospects because of its promising market share, such as in international standard supermarkets, restaurants and hotels. The average consumer of kale plants is from the upper middle class and urban communities (Maharani *et al*., 2018).

The tendency of urban consumers today is to look for quality agricultural products that look clean and have added value for health benefits. The problem that often occurs in urban communities in cultivating a plant is the limited land for plant cultivation. One of the planting techniques with a healthy lifestyle on limited land can be done by means of hydroponic planting techniques (Laksono & Sugiono, 2017).

A simple hydroponic system that has been widely developed in plant cultivation is substrate hydroponics. The substrate hydroponic system is a method of cultivating plants in which plant roots grow in porous media other than soil which is irrigated with a nutrient solution so that plants obtain sufficient water, nutrients and oxygen needs (Abror & Harjo, 2018). According to Triana *et al*. (2018) cultivation of kale plants through substrate hydroponics has several advantages such as more efficient use of fertilizers, planting can be carried out continuously and not depending on the season, harvesting can be scheduled, and the selling price of hydroponic vegetables is more expensive.

Hydroponic cultivation requires a nutrient source called AB Mix. Several types of AB Mix nutrition are marketed under different trademarks, for example AB Mix Growrich, Infarm, and Purie Garden nutrition. AB Mix Growrich Nutrition is the newest untested product to meet the nutritional needs of growing kale plants, while Purie Garden and Infarm AB Mix Nutrition has been tested to meet the nutritional needs of kale plants. AB Mix Growrich's nutrition contains complete nutrients to produce maximum plant productivity (Growrich Nutrient, 2021).

The nutritional difference between AB Mix Growrich and other types of nutrition is in the amount of formula content that is made. The total content of the macro nutrient and micro nutrient formulas in the AB Mix Purie Garden and Infarm nutrition was greater than that in the AB Mix Growrich nutrition, but the N (8%) and K (15.68%) nutrients in the AB Mix Growrich nutrition were greater . Nutrient N is needed in large quantities to help plant growth vegetatively, especially to help the growth of leaves and stems, while nutrient K plays a role in assisting the photosynthesis process which can later affect growth especially to leaf area and number of leaves (Growrich Nutrient, 2021). The advantages of AB Mix Growrich nutrition are that these nutrients can be used to meet the nutritional needs of leaf vegetable growth, vegetative fruit and generative fruit which are easily absorbed by plants. AB Mix Growrich nutrition is expected to be able to provide optimal productivity results on the growth and yield of kale on hydroponic substrates so that these nutrients can compete in the market.

The growing media commonly used in substrate hydroponic systems are cocopeat and husk charcoal. Organic materials such as cocopeat and husk charcoal have the potential to be used as alternative planting media composites to reduce the use of top soil. Each type of media has different properties so that the use of media in hydroponics will affect the yield of cultivated plants (Rizal, 2017). Koesriharti & Istiqomah (2016) suggested that husk charcoal has very light and coarse characteristics so that air circulation is high. The black color contained in husk charcoal can absorb sunlight higher and more effectively. Rice husk charcoal is able to work by improving the structure of the biophysicochemical properties of the soil (Aksa *et al*., 2016). Meanwhile, cocopeat planting media is an organic material that has high water absorption so it can retain water content and chemical fertilizer elements and neutralize soil acidity (Yau, 2018).

The accessibility of nutrients greatly determines the success of plant development and production in hydroponic cultivation systems, but there is not much information about the types of nutrients and their combinations with the right types of planting media to improve the growth and yield of kale. Wibowo (2017) showed that giving AB mix nutrition 6 ml/L under growing media of husk charcoal resulted the greatest parameters including number of leaves, leaf area, plant roots, and crop yield. The research conducted by Ginanjar (2021) explained that the use of rice husk charcoal as a planting medium for the growth and production of kale was significantly greater, but the use of cocopeat as a planting medium was not significantly different from skerwool in all parameters except the number of leaves. The application of AB mix nutrition 6 and 9 ml/L significantly improve plant height, leaf area, fresh and dry weight, crown diameter, leaf color, and stem diameter. Therefore, this research was conducted with the aim to conclude the influence of the type of AB Mix nutrition and the type of hydroponic growing media on the growth and yield of kale.

2. MATERIALS AND METHODS

This research was performed from July to August 2022 in Bojonegoro, East Java. The tools used for research included analytical balances, polybags measuring 25x25 cm, measuring cups, pH meters, TDS meters, nutrient containers, sprayers, Petiole (Leaf Area Meter) applications, and cameras. The materials used are kale seeds of the Nita variety with the brand name Cap Panah Merah, AB Mix Growrich nutrition, AB Mix Infarm nutrition, AB Mix Purie Garden nutrition, water, rockwool, husk charcoal, cocopeat, Matador insecticide, Neem Oil organic pesticide, and paranet.

The experiment was carried out by evaluating several types of AB mix nutrition sources combined with organic growing media. The study employed a factorial Randomized Block Design comprising of two factors. The first factor included the source of AB Mix nutrition, namely M1 (Growrich), M2 (Infarm), and M3 (Purie Garden). The second factor involved the type of planting media, namely A1 (cocopeat), A2 (husk charcoal), and A3 (cocopeat-husk charcoal (1:1)). The study was conducted with three repetitions so that 27 experimental units were used. Figure 1 depicts lay out of the experiment.

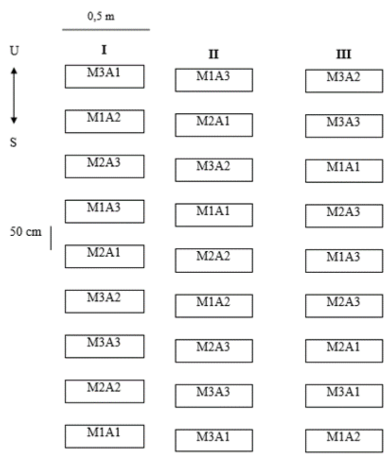

Figure 1. Lay out of the experiment (M : type of planting media, A : type of AB Mix nutrient, 1-3 : replication)

Before conducting the research, preliminary experiment was performed to define the amount of nutrient concentration needed for kale cultivation. This was conducted by applying nutrients with concentrations of 6 ml/L and 9 ml/L on kale plants. The best results for the growth of kale occurred when nutrients were applied at a concentration of 9 ml/L. The AB mix nutrient solution used in packaged form is 250 g. Nutrition A 250 g pack was dissolved using 500 ml of water in a separate container. The 250 g pack of B nutrients was dissolved in 500 ml of water in a separate container. Each of stock A and stock B was diluted with a concentration of 9 ml/L of clean water by taking 9 ml of concentrated stock A and concentrated B as much as 9 ml and then dissolving it with 1 liter of clean water. AB mix nutrition was provided to kale plants at age 7-21 DAT (day after transplanting) using a dose of 100 ml/polybag, while for plants aged 21-49 DAT using 200 ml/polybag. AB mix nutrition was given in the morning and evening.

The cocopeat planting medium was washed to remove tannins which can be harmful to the growth of kale plants. While the husk charcoal planting media was not given any treatment. Preparation for planting was in the form of filling a 25x25 cm poly bag with the media composition according to the treatment being tested without adding a nutrient solution to it. The nutrient components of rice husk charcoal are SiO_2, C, Fe_2, O_3, K_2O, MgO, CaO, MnO, and Cu. The nutrient components in cocopeat are N, P, K, Ca, and Mg.

Sowing the seeds was carried out on rockwool, in each rockwool hole one kale seed was planted. Maintenance of seedlings for 2 weeks was done by watering with water (without nutrient solution). Planting was done by transferring the seedlings aged 2 weeks after sowing to the hydroponic growing medium. Plants are ready for transplanting when the seedlings have grown 2 leaves. In each polybag, one kale plant was cultivated.

Kale plant maintenance in a hydroponic system included replanting, weeding, checking pH, checking the concentration of nutrient solutions, watering nutrients, controlling pests and diseases. Kale plants hydroponically grow optimally when given nutrients at a solution concentration (EC) of 1050-1400 pm. Kale plants grow optimally in growing media with a pH of 5.5 - 6.5. Control of pests and diseases was conducted manually and chemically. The insecticide used was Matador at a dose of 1 ml/L of water, while the natural pesticide used was Neem oil at a dose of 1 ml/L of water. Harvesting was done when the kale plants are 49 DAT when the plants reach maximum growth.

Data collection on plant height parameters was carried out by measuring plant height starting from the bottom of the stem to the growing point of each sample plant. Retrieval of data on the number of leaves parameter was done by counting all leaves that grow wide open. Observations of plant height and number of leaves were carried out once a week until harvest when the kale plants were 7, 14, 21, 28, 35, 42, and 49 DAT.

Data collection on the total weight parameter of the kale plant was carried out by weighing the roots, stems and leaves of the kale plant, then calculating the average plant weight per experimental unit. Data collection on the wet weight parameter of production was carried out directly after your plants are harvested by cutting the bottom of the plant stems, then weighing the stems and leaves of the plants using an analytical balance.

Data collection on the root wet weight parameter per plant was carried out by cutting the base of the kale plant stems, then air-drying the plant roots for 15 minutes and weighing the plant roots. Data collection on the production dry weight parameter was carried out by weighing the stems and leaves of the plants that had been baked. Weighing the root dry weight per plant was done by weighing the roots that have been baked. Data collection on leaf area parameters was carried out by measuring leaf area using the Petiole (Leaf Area Meter) android application. Leaf area measurements were carried out on each sample of the plants tested. Data collection on the parameters of average plant weight, root wet weight per plant, production wet weight per plant, production dry weight per plant, root dry weight per plant, and leaf area per plant were carried out when the plants were 49 DAT.

Data analysis was accomplished using analysis of variance (ANOVA) at the 5% level. If significant differences were found (F count > F table, 5%) then the least significant difference (LSD) test was continued at the 5% level.

3. RESULTS AND DISCUSSION

3.1. Plant Height

The results of ANOVA revealed that the combined treatment with the type of AB Mix nutrition and the type of growing media had no significant effect on the height of the kale plants at ages 14, 21, 28, 35, 42, and 49 DAT. The results of the average plant height (Table 1) showed that the AB Mix nutritional treatment resulted a very significant effect on the height of kale starting of age 14 to 49 DAT. Plant height at age 21, 28, 35, 42 DAT, however, was not statistically different due to type of planting media alone.

Table 1. Effect of AB mix nutrients and types of planting media on the average plant height of Kale

Treatment	Plant height (cm)						
	7 DAT	14 DAT	21 DAT	28 DAT	35 DAT	42 DAT	49 DAT
Planting Media							
M1	4.24	6.32	9.42	11.71	15.47	19.80	24.54
M2	4.13	5.80	8.52	10.70	15.02	19.69	24.95
M3	3.98	6.14	8.43	10.40	14.92	19.69	24.46
LSD 5%	ns	ns	ns	ns	ns	ns	ns
AB Mix type							
A1	4.04	5.42 a	7.90 a	9.713 a	13.64 a	16.96 a	21.50 a
A2	4.20	6.30 b	8.92 ab	11.12 ab	16.04 b	21.22 b	26.23 b
A3	4.13	6.54 b	9.56 b	11.94 b	15.74 b	20.99 b	26.22 b
LSD 5%	ns	0.86	1.47	1.21	1.97	2.02	2.028

Note: The numbers followed by the same letters are not significantly different on the LSD test (a = 5%). DAT = Day After transplanting; ns = not significantly different.

The mean value of Kale plant height with the highest yield was at 49 DAT with AB Mix A2 (Infarm) nutritional treatment of 26.23 cm but no significant effect with AB Mix A3 (Purie Garden) nutritional treatment of 26.22 cm. Plant height in the AB Mix A2 (Infarm) and A3 (Purie Garden) nutrient treatment aged 35-49 DAT had the highest yield.

3.1.1.Number of Leaves

The results of ANOVA divulged that the combination treatment of AB Mix nutrient types and types of growing media had no significant consequence on the number of leaves of kale plants at age of 7 to 49 DAT. The mean values of the number of leaves of the Kale plant is shown in Table 2.

Table 2. Effect of AB mix nutrients and types of planting media on the number of leaves of Kale

Treatment	Number of leaves						
	7 DAT	**14 DAT**	**21 DAT**	**28 DAT**	**35 DAT**	**42 DAT**	**49 DAT**
Planting Media							
M1	1.14	2.31	3.14	4.64	5.75	7.14	8.72
M2	1.11	2.19	3.19	4.72	6.11	7.22	8.93
M3	1.17	2.17	3.28	4.69	6.22	7.55	8.56
LSD 5%	ns	ns	ns	ns	ns	ns	ns
AB Mix type							
A1	1.11	2.19	3.22	4.53	6.03	7.05	8.35
A2	1.17	2.28	3.19	4.58	5.94	7.36	8.72
A3	1.14	2.19	3.19	4.94	6.11	7.50	914
LSD 5%	ns	ns	ns	ns	ns	ns	ns

Note: DAT = Day After transplanting; ns = not significantly different.

The results of LSD test (Table 2) showed that the AB Mix type of nutrient treatment did not significantly influence the number of leaves, while the type of planting media did not significantly affect the number of leaves parameter. The highest average number of leaves was in the treatment of M2 (husk charcoal) aged 49 DAT, which was 8.94 g, while the highest mean number of leaves was in the AB Mix A3 (Purie Garden) nutrient treatment of 9.14 g but not different from the other treatments.

3.1.2. Plant Weight (g)

The results of ANOVA disclosed that the combination treatment of the type of AB Mix nutrition and the type of growing media had no significant contribution on the average weight of the Kale plant. The mean values of the number of leaves of the Kale plant is shown in Table 3.

Table 3. Effect of AB mix nutrients and types of planting media on the average plant weight of Kale

Treatment	Average Plant Weight (g)
Planting Media (M)	
M1 (cocopeat)	56.88
M2 (husk charcoal)	64.16
M3 (cocopeat : husk charcoal)	57.95
LSD 5%	ns
AB Mix type	
A1 (Growrich)	48.63
A2 (Infarm)	66.08
A3 (Purie Garden)	64.28
LSD 5%	ns

Note: DAT = Day After transplanting; ns = not significantly different.

Table 3 shows that the AB Mix nutrient type treatment did not significantly affect the average plant weight parameter for yield and growth of Kale plants in hydroponic substrates, thus the type of planting media treatment did not significantly differ on the average plant weight parameter. The average plant weight with the highest yield was in the M2 treatment (husk charcoal), which was 64.16 g. The average value of plant weight with the highest production was in the AB Mix A2 (Infram) nutrient treatment with a value of 66.08 g. The treatment with the highest yield was no different from the other treatments.

3.1.3. Wet Weight Yield (g)

The results of ANOVA concluded that the combination of AB Mix nutrient types and the type of planting media had no significant consequence on the wet weight of production. The mean values of the number of leaves for kale plants is shown in Table 4.

Table 4. Effect of AB mix nutrients and types of planting media on the wet weight yield of Kale

Treatment	Wet Weight Yield (g)
Planting Media (M)	
M1 (cocopeat)	52.58
M2 (husk charcoal)	60.81
M3 (cocopeat : husk charcoal)	55.83
LSD 5%	ns
AB Mix Type	
A1 (Growrich)	47.01
A2 (Infarm)	61.08
A3 (Purie Garden)	61.12
BNJ 5%	ns

Note: DAT = Day After transplanting; ns = not significantly different.

Table 4 shows that both the AB Mix nutrient type and treatment planting media type did not considerably influence the production wet weight parameter. The highest mean production wet weight was in the treatment of M2 (husk charcoal) planting medium, which was 60.81 g, while the highest average production wet weight was in the AB Mix A3 (Purie Garden) nutrient treatment of 61.12 g, but not different from other treatments.

3.1.4. Plant Dry Weight (g)

The results of the ANOVA revealed that the combination treatment of AB Mix nutrient source and type of growing media had no significant consequence on plant dry weight for yield and growth of Kale plants using hydroponic substrates. The average value of plant dry weight is shown in Table 5.

The results of the average plant dry weight (Table 5) showed that the type of AB Mix nutrient treatment had no significant effect on the plant dry weight parameters for the yield and growth of Kale plants cultivated under hydroponic substrates, and the treatment of the types of growing media did not significantly affect the plant dry weight parameters. The highest average plant dry weight was in the treatment of M3 growing media (cocopeat : husk charcoal) of 4.45 g. AB Mix A2 (Infarm) nutritional treatment with the highest yield of 4.88 g. The treatment with the highest yield was no different from the other treatments.

Table 5. Effect of AB mix nutrients and types of planting media on the dry weight of Kale

Treatment	Plant dry weight (g)
Planting Media (M)	
M1 (cocopeat)	4.33
M2 (husk charcoal)	4.45
M3 (cocopeat : husk charcoal)	4.38
LSD 5%	ns
AB Mix Type	
A1 (Growrich)	3.96
A2 (Infarm)	4.88
A3 (Purie Garden)	4.31
LSD 5%	ns

Note: DAT = Day After transplanting; ns = not significantly different.

3.1.5. Root Wet Weight (g)

The results of the ANOVA concluded that the root wet weight was not statistically different as affected by combination treatment of AB Mix nutrient source and types of hydroponic growing media. The means value of root wet weight per plant is shown in Table 6.

Table 6. Effect of AB mix nutrients and types of planting media on the root wet weight of Kale

Treatment	Root wet weight (g/plant)
Planting Media (M)	
M1 (cocopeat)	56.88
M2 (husk charcoal)	64.16
M3 (cocopeat : husk charcoal)	57.95
LSD 5%	ns
AB Mix Type	
A1 (Growrich)	48.63
A2 (Infarm)	66.08
A3 (Purie Garden)	64.28
LSD 5%	ns

Note: DAT = Day After transplanting; ns = not significantly different.

Table 6 shows that both the AB Mix nutrient source and the type planting media treatments did not affect significantly wet weight of root per plant. The mean value of root wet weight per plant with the highest production yield was the M2 planting medium (husk charcoal) treatment with a value of 64.16 g and the A2 nutrient treatment (Infarm) with a value of 66.08 g. The treatment with the highest yield was no different from the other treatments.

3.1.6. Root Dry Weight

Results of the ANOVA concluded that the combination of AB Mix nutrient types with the type of growing media did not significantly affect root dry weight per plant. The average value of root dry weight per plant is shown in Table 7.

Table 7. Effect of AB mix nutrients and types of planting media on the root dry weight of Kale

Treatment	Root dry weight (g/plant)
Planting Media (M)	
M1 (cocopeat)	0.51
M2 (husk charcoal)	0.58
M3 (cocopeat : husk charcoal)	0.55
LSD 5%	ns
AB Mix Type	
A1 (Growrich)	0.37 a
A2 (Infarm)	0.65 b
A3 (Purie Garden)	0.62 b
LSD 5%	ns

Note: The numbers followed by the same letters are not significantly different on the LSD test (a = 5%). DAT = Day After transplanting; ns = not significantly different.

The results of the average dry weight of roots per plant (Table 7) showed that the type of AB Mix nutrient treatment had a very significant effect on the parameter dry weight of roots per plant, but the type of planting medium did not significantly affect the parameter dry weight of roots per plant. The mean value with the highest yield of plant production was seen in the M2 treatment (husk charcoal) with a value of 0.58 g but this treatment was no different from the other treatments. The highest yield of root dry weight was found in treatment A2 (Infarm) with a value of 0.65 g.

3.1.7. Leaf Area (cm^2)

Results of the ANOVA disclosed that the combination treatment of the type of AB Mix nutrition and the type of planting media was significantly different on the leaf area parameter. The average value of leaf area is shown in Table 8.

Table 8. Effect of AB mix nutrients and types of planting media on the leaf area of Kale

	Leaf Area (cm^2)		
	A1	**A2**	**A3**
M1	517.89 ab	539.66 ab	531.39 ab
M2	363.01 a	700.96 b	581.57 ab
M3	403.59 a	523.04 ab	547.18 ab
LSD 5%	217.797		

Note: The numbers followed by the same letters are not significantly different on the LSD test (a = 5%). DAT = Day After transplanting; ns = not significantly different.

The results of the average leaf area (Table 8.) showed that the combination of AB Mix nutrient types with various types of planting media was significantly different in terms of leaf area parameters. The highest production yield for leaf area parameters was the combination of AB Mix nutrient types and the type of planting media, namely the M2A2 treatment (husk charcoal + Infarm) with an average value of 700.96 cm^2. AB Mix nutritional treatment was significantly different for leaf area, but the treatment of growing media was not significantly different for leaf area.

3.2. Discussion

3.2.1. Interaction Effect of AB Mix Nutrition and Planting Media Types

The results of the ANOVA analysis showed that there was an interaction between the types of AB Mix nutrient combined with the types of planting media, which had a significant effect on leaf area. The average of the combination of AB Mix nutrient types and types of planting media with the best average value was 700.96 cm^2 resulted from M2A2 treatment (husk charcoal + Infarm), while the lowest average value was 363.01 cm^2 from M2A1 treatment (husk charcoal + Growrich).

The use of A2 nutrition (Infarm) is thought to be able to provide more complete nutrients compared to other types of nutrition while the treatment of M2 (husk charcoal) planting media has the ability to bind nutrients to support the growth of leaf area of kale plants. The nutritional composition of A1 (Growrich) consists of elements N (8.35%), P (2.88%), K (15.68%), Ca (7.6%), Mg (5.28%), S (7.15%), Fe (656.10 ppm), Zn (477.08 ppm), Cu (455.99 ppm), and Mn (76.9 ppm). The nutritional composition of A2 (Infarm) consists of 8% N-Total, 7% P_2O_3, 7.5% K_2O, 10% CaO, 3% Mg, 7.15% S, 600 ppm Fe, 100 ppm Zn, 40 ppm Cu, 300 ppm Mn, 200 ppm B, and 10 ppm Mo. The nutritional composition of A3 (Purie Garden) consists of the elements N-NO_3, P, K, Ca, Mg, S, Fe-EDTA, Zn-EDTA, Mn-EDTA, Na, B, and Mo. Nutrient N is required in large quantities and the availability of nitrogen is followed by an increase in plant growth and yield. Plants that are sufficiently supplied with N will form a wider leaf.

The ability of the growing media to bind the nutrient solution will affect the amount of nutrients absorbed. Ginanjar (2021) explained that rice husk charcoal contains 52% SiO and 31% C elements, as well as other ingredients such as Fe_2O_3, K_2O, MgO, CaO, MnO, and Cu in small amounts. The nutrients contained in rice husk charcoal are 0.32% N, 0.15% P, 0.31% K, 0.96% Ca, 180 ppm Fe, 80.4 ppm Mn, and 14.10 ppm Zn. Rice husk charcoal contains Si of 16.98% which can improve the physical properties of plants and affect the solubility of P in the soil. If the Si element is less than 5%, the upright kale plants will easily collapse and the root system will not be strong. It is suspected that the rice husk charcoal planting medium still contains nutrients from the remaining rice plants and the burned rice husks make the rice husk charcoal as a planting medium free from bacteria and disease so it is safe to be used as a planting medium.

This is supported by research of Wibowo *et al*. (2017) which stated that the growth of kale plants in the treatment of husk charcoal growing media gave the best results from fern and cocopeat growing media. Giving a dose of 6 ml/L with husk charcoal growing media gave the best results on the parameters of leaf area and number of leaves. Charcoal from rice husks are roasted to sterilize the media due to disease and bacteria present in the media material will die at high temperatures, this is why roasted husks can be safely used as a safe hydroponic growing medium.

The results of analysis of variance on leaf area parameters with interactions in both treatments showed a significant effect. This is supported by the opinion of Ginanjar *et al*. (2021) that root growth is able to absorb available nutrients, especially N which plays a very important role in leaf formation so that the leaves grow wider. Husk charcoal has a porous nature and is very light so that the nutrients provided can easily escape and be absorbed by the roots. The availability of N nutrients is needed to encourage the growth of vegetative organs related to the process of photosynthesis in the leaves. Plants that are sufficient to get a supply of N will form wider leaf blades with a high chlorophyll content so that they are able to produce more carbohydrates.

AB Mix A2 (Infarm) nutrition has a different amount of macro and micro nutrients than AB Mix A1 (Growrich) nutrition so that it is able to meet nutrient requirements for maximum leaf growth (Table 9 to 11). The amount of N element content in AB Mix A1 (Growrich) nutrition is 8.35% greater than AB Mix A2 (Infarm) nutrition by 8%.

Table 9. Nutrient content of AB Mix Growrich

Macro elements	Amount	Micro elements	Amount
N	8,35 %	Fe	656,10 ppm
P	2,88 %	Zn	477,08 ppm
K	15,68 %	Cu	455,99 ppm
Ca	7,6 %	Mn	76,9 ppm
Mg	5,28%		
S	7,15%		

Table 10. Nutrient content of AB Mix Purie Garden

Macro elements	Amount	Micro elements	Amount
N Total	8 %	Fe	600 ppm
P_2O_3	7 %	Zn	100 ppm
K_2O	7,5 %	Cu	40 ppm
CaO	10 %	Mn	300 ppm
Mg	3 %	B	200 ppm
		Mo	10 ppm

Table 11. Nutrient content of AB Mix Infarm

Macro elements	Micro elements
$N\text{-}NO_3$	Fe – EDTA
P	Zn – EDTA
K	Mn – EDTA
Ca	Na
Mg	B
S	Mo

3.2.2. Effect AB Mix Types on the Growth and Yield of Kale

ANOVA analysis showed that AB Mix nutrient type treatment had a very significant effect on plant height (14-49 HST), root dry weight per plant, and leaf area. The type of nutrient treatment AB Mix A2 (Infram) gave the highest average yield on the parameters of plant height, root dry weight per plant, and leaf area. The highest mean plant height was 26.23 cm at 49 HST. The highest average yield on the root dry weight parameter per plant was 0.65 g. The average yield of leaf area parameters with the highest production was 593.18 g.

Treatment of nutrient solution A2 (Infarm) was significantly different from A1 (Growrich) but not significantly different from nutrient solution A3 (Purie Garden). This shows that the production of plants produced with AB Mix A1 (Growrich) nutrient treatment is able to meet the nutritional needs for optimal growth and development of Kale plants just as AB Mix A2 (Infarm) and A3 (Purie Garden) nutrients but with the lowest average value of all parameters tested. AB Mix A2 (Infarm) and A3 (Purie Garden) nutrition is an old product that has been tested in meeting the nutritional needs for plant growth and development, so as to be able to provide good crop production results in leaf vegetables, especially in Kale plants.

The availability of nutrients is important as an energy source so that the level of nutrient adequacy plays a role in influencing the biomass production of a plant. The nutrients contained in AB Mix A1 (Growrich), A2 (Infarm) and A3 (Purie Garden) have the same formula composition but the amount of nutrient content is different. The nutritional composition of A1 (Growrich) consists of elements N 8.35%, P 2.88%, K 15.68%, Ca 7.6%, Mg 5.28%, S 7.15%, Fe 656.10 ppm, Zn 477.08 ppm, Cu 455.99 ppm and Mn 76.9 ppm. The nutritional composition of A2 (Infarm) consists of 8% N-Total, 7% P2O3, 7.5% K2O, 10% CaO, 3% Mg, 7.15% S, 600 ppm Fe, 100 ppm Zn, 40 Cu ppm, Mn 300 ppm, B 200 ppm and Mo 10 ppm. The nutritional composition of A3 (Purie Garden) consists of the elements N-NO3, P, K, Ca, Mg, S, Fe-EDTA, Zn-EDTA, Mn-EDTA, Na, B, and Mo. The composition of the micro-nutrient formula in AB Mix A2 (Infarm) nutrition is more complete than A1 (Growrich), but only a small amount of micro-nutrients is needed for plants. The N content in A1 (Growrich) nutrition is higher than A2 (Infarm) nutrition, so that the results of crop production using A1 (Growrich) nutrition are not much different from other nutrients. According to Bahzar & Santosa (2018) that AB Mix nutrition has complete nutrients needed by plants, especially in the large amount of Nitrogen (N) nutrients needed by plants to help cell division in leaves.

Nitrogen nutrients function in spurring growth in the vegetative phase. For plants, nitrogen plays an important role in stimulating the growth of roots, stems and leaves, so it can affect the yield of plant height, root dry weight, and increase in leaf area. This is in accordance with the statement of Rofiyana *et al*. (2021) who said that if the need for element N is fulfilled, it can increase plant growth. Element N can increase leaf growth so that the number of leaves grows more, the leaf area grows wider, and the color of the leaves looks greener which can increase protein levels in the plant body. Incomplete availability of macro nutrients and micro nutrients can inhibit the growth and development of Kale plants in hydroponic substrates.

Ali *et al*. (2021) states that plants will grow well if all the nutrients needed are in sufficient and balanced quantities. AB Mix nutrition has a fairly complete nutrient content in macro nutrients and micro nutrients so that it can support plant growth optimally. According to Sutedjo (2018), giving too much nutrition can reduce vegetative development and cause poisoning in plants. Conversely, if the provision of nutrients is too little, there may be inhibition of root development, thereby interfering with the uptake of plant nutrients even though the plants do not show any visual symptoms of deficiency (Suarsana *et al*., 2019).

According to Siregar (2015), testing of several types of nutrients showed that Goodplant (N1) and Nutrimix (N5) nutrient solutions could provide better plant production results with the highest average yields on the parameters of plant height, number of leaves, root length, weight total stove, top stove weight, and bottom stove weight. Goodplant (N1) and Nutrimix (N5) nutrition contain relatively high levels of nitrogen (N) to help the growth of lettuce plants. The nitrogen element for plants functions to stimulate the growth of leaves and stems, because nitrogen is absorbed by plant roots in the form of NO_3^- and NH_4^+.

3.2.3. Effect of Planting Media Types on the Growth and Yield of Kale

The results showed that the treatment of growing media was not significantly different in all observation parameters, namely plant height, number of leaves, average plant weight, production fresh weight, plant dry weight, root wet weight per plant, root dry weight per plant, and leaf area. . This is because M1 (cocopeat), M2 (husk charcoal), and M3 (cocopeat: husk charcoal (1:1)) planting media are good organic growing media for the growth and yield of Kale plants on hydroponic substrates.

Even though it was not statistically significant, the treatment of growing medium A2 (husk charcoal) showed the highest number of leaves, average plant weight, production wet weight, plant dry weight, root wet weight per plant, dry weight per plant, and leaf area, so plant production was greater than other growing media treatments. This is presumably because the burned husks still contain nutrients from the rest of the rice plants so that they are able to provide nutrients for the kale plants. This is supported by the opinion of Purba *et al*. (2021), that burnt husk charcoal can be used for hydroponic growing media. The husks that have been burned still contain nutrients from the remaining rice plants that have been harvested so that they are able to provide nutrients for the Kale plants. This is also supported by the opinion of Bahzar & Santosa (2018), that burnt husk charcoal has special characteristics that can be used for hydroponic growing media. The chemical composition of roasted husks is 52% SiO_2 and 31% C, the other ingredients consist of Fe_2O_3, K_2O, MgO, CaO, MnO, and Cu with small amounts relatively cheap.

The results of this study are in line with Wibowo *et al*. (2017) who reported that rice husk charcoal growing media showed the best results compared to fern and cocopeat growing media. This can be caused by several factors, including the husk charcoal media which does not have a better ability to hold water compared to cocopeat and skerwool, because the husk charcoal is porous, very light and coarse so that the nutrients given to the plants easily escape. Husk charcoal planting media contains a lot of potassium and carbon which are useful for the growth and development of Kale plants.

The use of rice husk charcoal as a planting medium is able to provide good aeration, drainage and porosity to help plants in root formation. This is also supported by research by Perwitasari *et al*. (2012) that rice husk charcoal planting media tends to be more stable in storing nutrients and good drainage to dispose of nutrients if excessive nutrition is given so that plants do not get excess nutrients which cause root and stem rot.

The results of the study with the lowest average planting media treatment in the M1 (cocopeat) treatment. This is because the cleaning of tannins in the cocopeat growing media is not sterile so that it can inhibit the growth of Kale plants using hydroponic substrates. Cocopeat is actually a planting medium that has the ability to bind water strongly, but this is related to the nutrient content and physical properties of the planting medium itself. This is in accordance with the opinion of Wibowo (2017) that cocopeat comes from chopped coconut fiber and separated from the fiber and then boiled with the aim of removing harmful chemical compounds that can inhibit plant growth so that less sterile processing of coconut fiber can affect the quality of cocopeat.

The results of the research conducted were not in accordance with the research by Taofik *et al*. (2019) that the ratio of cocopeat and rice husk charcoal as a medium for growing plants affects the growth of kale plants. The results showed that the composition of growing media 75% cocopeat + 25% rice husk charcoal affected plant height, plant fresh weight, and shoot-root ratio. Giving the composition of the planting media can increase the storage capacity of water and nutrients around the roots and can increase aeration so that the planting media can store and release water optimally. This is presumably due to the inaccurate combination of planting media in the treatment of rice husk charcoal and cocopeat (1:1).

According to Mahdalena & Aini (2018) showed that the growth and production of Kale plants on cocopeat growing media were not significantly different from rockwool, but significantly different compared to husk charcoal growing media on the parameters of plant height, number of leaves, crown diameter, stem diameter, average fresh weight, dry weight and leaf area. The number of leaves of the Kale plant on the rockwool growing medium was significantly greater than that of the cocopeat and husk charcoal growing media.

4. CONCLUSION AND SUGGESTION

The combination treatment of AB Mix nutrient types and types of growing media for the yield and growth of kale through hydroponic substrate cultivation was significantly different on leaf area parameters. Combination treatment with the best leaf area results in the charcoal + Infarm treatment of 700.958 cm2. The AB Mix nutrient treatment differed significantly with plant height (14-49 DAP), root dry weight per plant, and leaf area, however, the growing media treatment was not significantly different for all parameters. The type of AB Mix nutrition with the best production results in the Infarm nutrition treatment.

For further research, it is recommended to test the concentration treatment for each type of AB Mix nutrient and add more detailed observed parameters such as chlorophyll content, harvest index, and vitamin content to see the effect of treatment on Kale yields using hydroponic substrates.

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