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Influence of Grower Agent on Growth of Bayam (*Amaranthus Sp.*) Plants with Nutrient Film Technique in Hydroponic System

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ABSTRACT

This Spinach is a plant grown to consume its leaves as green vegetables. This plant is known as a vegetable source of iron which is important for the body. The purpose of this study was to test Grower fertilizer on the growth of spinach (*Amaranthus sp*.). This study used a completely randomized design (CRD) method with two hydroponic fertilizer treatments with 3 replications. The treatment given is AB mix fertilizer and Grower fertilizer. The parameters observed were plant height (cm), number of leaves, stem diameter (cm), and plant age. Based on observations of growth parameters, AB mix fertilizer treatment showed the best results in the number of leaves, stem height, and plant age. Grower fertilizer showed the best results in weight per plant, stem diameter, and leaf length and width (cm).

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1. INTRODUCTION

Vegetables are necessary for the body. Thus, lack of vegetable intake can affect the health of the body and malnutrition, one of the occurrences of malnutrition is iron deficiency. Health problems in adolescents are very complex, iron deficiency can cause anemia such as having a short height or stunting, thinness or chronic energy deficiency (SEZ), and overweight or obesity (Hardani & Zuraida, 2019). Normal iron needs require about 20-25 mg of iron per day. One way to meet iron needs can be done by consuming vegetables that contain iron, namely spinach (Rohmatika & Umarianti, 2017). Green spinach is a vegetable that has a high iron content that is good for the body as a source of calcium, vitamin A, vitamin E, vitamin C, fiber, calcium, chlorophyll, and beta-carotene.

Land availability is one of the obstacles in cultivating spinach plants, but it can be overcome by cultivating it using hydroponics. Agriculture using a hydroponic system does not require a large area of land in its implementation. Thus, in the agricultural business, hydroponics is worth considering considering that it can be done in the yard, roof of the house, or other land. (Wali *et al.,* 2021). Hydroponic cultivation of spinach vegetables generally uses nutrient solutions that contain macro and microelements. Nutrients containing macro elements are N, P, K, S, Ca, and Mg, and microelements such as Mn, Cu, Zn, Cl, Cu, Na, and Fe. The nutrient used for spinach plants hydroponically is AB mix nutrient. AB mix nutrition consists of concentrate A (macro) and concentrate B (micro) which will be diluted in a ratio of 1:1000 (Hidayanti & Kartika, 2019).

Another alternative in the development of hydroponic technology is needed to make it easier for people, especially small farmers, to implement spinach vegetable cultivation, namely by utilizing grower fertilizer as an alternative nutrient source at a relatively cheaper price. This research aims to obtain nutrients that can replace AB mix by testing Grower (15-9-20) and AB mix on spinach (*Amaranthus* sp) cultivation. In addition, the purpose of this study is to determine the effect of Grower fertilizer (15-9-20) and AB mix on the growth components and harvest weight of spinach plants (*Amaranthus* sp) as well as to determine the dose of Grower fertilizer (15-9-20) and AB mix that can produce the highest growth components and harvest weight of spinach plants (*Amaranthus* sp).

The purpose of this study was to determine the effect of grower fertilizer (15-9-20) and AB mix on the growth components and harvest weight of spinach plants (*Amaranthus* sp) and can determine the dose of Grower fertilizer (15-9-20) and AB mix that can produce the highest growth components and harvest weight of spinach plants (*Amaranthus* sp). The results of this study are expected to provide information on proper nutrition to increase hydroponic spinach production.

2. METHODS

2.1. Place and Time of Research

The experiment was conducted at Al-Zaytun Hydroponics, Mekar Jaya Village, Gantar District, Indramayu Regency, West Java, located at an altitude of + 50 m above sea level. The experiment started from 1 September 1 to 31 October 2023.

2.2. Materials and Tools

The materials used for this experiment include spinach seeds, 1 kg of Grower fertilizer (15-9-20) 1 kg of fertilizer A and 1 kg of fertilizer B, rock wool, and net pots. Tools used in this experiment include a TDS meter, pH meter, temperature measuring instrument, spoon, ruler, vernier, syringe, NFT hydroponic installation, water pump, bucket, and analytical scales.

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2.3. Research Implementation

The following points are implemented:

(i) NFT setup preparation. This research uses one type of hydroponic system, namely NFT, which will be made in one installation.

(ii) Seeding. Spinach seeding for the NFT system was done using Rockwool. Rockwool was cut to a size that adjusted the width of the gutter, then a planting hole was made with a size of 2.5 cm x 2.5 cm. Next, the rockwool is given water until it is wet. Seeds were placed in the planting holes, each hole was planted with 2 seeds. The seedlings were placed in the NFT hydroponic installation to get water flow. Thus, the seeds grow well. After 7 days after seedling (HSS), a nutrient solution was given from 2 types of nutrients, namely AB mix, and grower, each solution was tested with ppm 1000, 1200, and 1400. Seedling seedlings were transplanted after 7 days of age.

(iii) Transplanting. Transplanting activities in the NFT hydroponic system are carried out by cutting rock wool containing spinach seeds with a size of 2.5 cm x 2.5 cm, then each rock wool is placed in the NFT circuit with a spacing of 20 x 20 cm.

(iv) Maintenance: Fertilizer Application. Nutrients are given by dissolving AB mix nutrients and Grower fertilizer into water until the value of each ppm is 1000, 1200, 1400, then the nutrient solution is circulated to the NFT circuit. Every day the nutrient solution is checked for ppm and pH values. If the ppm value drops then add nutrients to the solution, otherwise if the ppm value is high, add water to the solution. The water acidity (pH) used is between 6.5-7. The pH value is measured using a pH meter. If the pH value drops add KOH to the solution, and if the pH value rises add HCl until the pH becomes 6.5-7.

(v) Maintenance: Pest and disease control. Pest and disease control is done manually, by taking plants attacked by pests so that they do not spread to other plants or by taking pests that attack spinach plants.

(vi) Maintenance: Harvesting (HST). Harvesting spinach using AB mix fertilizer is done at the age of 30 HST, by pulling out the plants one by one. Harvesting spinach using grower fertilizer is done at the age of 35 HST by pulling the plants one by one.

2.4. Observations

The observations observed were:

(i) Plant height (cm). Plant height was measured by measuring the height of spinach plants from the base of the stem to the highest leaf using a ruler.

(ii) Number of leaves (strands). The number of leaves is calculated by counting the number of leaves that have opened completely.

(iii) Leaf width (cm). Leaf width is measured by measuring the width of the widest leaf on each plant using a ruler.

(iv) Plant weight at harvest (g). The weight of the plant is measured by weighing the plant at harvest.

2.5. Observation Analysis

The data obtained from the observations were analyzed using statistical analysis, namely the variance model and further tests or differences proposed (Mursalim *et al.,* 2018). In the results of data processing or analysis of variance, if there is a significant difference from the treatment or the F-calculated value is greater than the F-table at a real level of 5%, the test is continued using the Scott-Knott Cluster test.

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3. RESULTS AND DISCUSSION

3.1. Supporting Observations

Supporting observations are observations about the ecological conditions around plants that show the state of plant development while in hydroponics. Supporting observations in this experiment are the general conditions of the experimental site including analysis of water quality, water temperature, water pH, EC, and ambient temperature. In checking the water quality, namely water temperature, the results of varying temperatures were obtained, namely at night the water temperature was 280 to 300°C while during the day the water temperature ranged from 360 to 380°C, this condition is a fairly extreme temperature for hydroponic plants because the ideal water temperature for hydroponic plants is 300C, this is following literature (Hidayat *et al.*, 2022) which states that the ideal temperature in hydroponic plant water media is around 280^0C to 300^0C because the water temperature in the roots can affect plant root activity.

Water pH and EC for hydroponic spinach plants pH 6.5 to 7.5 and EC 2.5 to 3. If it is found that the pH and EC content in the raw water media is not ideal with the water media needed by hydroponic spinach plants. Then add the KOH element to increase the pH value and the HCl element to increase the EC value. One of the keys to success in the cultivation of NFT hydroponic systems is the provision of nutrients and setting the right pH value according to the needs of plants. Differences in pH value treatment in hydroponic nutrient solutions will affect plant growth and yield (Amri & Brijol, 2019). In hydroponic system plants, ion conductivity measurements are needed using Electrical Conductivity (EC meter) to determine the nutrient density standard. One of the plants commonly used in hydroponic systems is spinach (Elmi, 2022).

3.2. Key Observations

The main observations were made on various components of spinach plant growth and yield.

3.2.1. Plant height and stem diameter

The results of analysis of variance in measuring plant height 7 days after treatment at various ppm levels in AB mix and Grower showed that the results were not significantly different. Observations are shown in **Table 1** for plant height and stem diameter.

Table 1 shows that the results of the Scott-Knott test for plant height and stem diameter which were influenced by fertilizer concentration at the age of 7 DAP were not significantly different. It is suspected that at the age of 7 DAP, the various fertilizer treatments above did not affect plant height and stem diameter in each treatment, because in the initial phase of plant growth the need for nutrients, especially nitrogen, which influenced growth was not too much, so various fertilizer doses did not affect height and diameter. spinach plant stems (Kustiani *et al.*, 2021).

At 14 and 21 HST, it showed that the results of the Scott-Knott test, plant height, and stem diameter had a significant effect on plant height and stem diameter. It is suspected that the various fertilizer treatments above have an effect on plant height and stem diameter in each treatment. The nitrogen element in ab mix and grower fertilizers affect the height and stem diameter of spinach plants. Providing various doses of ab mix and grower fertilizer affects the N element in each dose.

The higher the N dose will affect the increase in plant height. An increase in plant height indicates an increase in the number and size of cells as well as tissue formation which will

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influence the growth and size of the stem (Kustiani *et al.,* 2021). Based on the results of research conducted by (Aullia *et al.,* 2023) it was stated that giving AB mix doses, namely 1000, 1200, 1400 ppm, actually increased growth, increasing plant height and stem diameter.

Table 1. Effect of AB mix and Grower fertilizer on plant height and stem diameter at 7 DAP, 14 DAP, and 21 DAP.

Treatment	Plant Age		
	7 HST	14 HST	21 HST
	Plant Height (cm)		
AB mix 1000 ppm	8.4a	18.8	31.1
AB mix 1200 ppm	8.8a	19.1	33.6
AB mix 1400 ppm	8.6a	18.8	31.7
Grower 1000 ppm	8.2a	17.8	29.5
Grower 1200 ppm	8.4a	18,0	30.1
Grower 1400 ppm	8.5a	18.5b	30.6
Uji F	TN	*	*
	Bar Diameter (cm)		
AB mix 1000 ppm	0.14a	0.59	0.593
AB mix 1200 ppm	0.14a	0.60	0.597
AB mix 1400 ppm	0.14a	0.60	0.597
Grower 1000 ppm	0.14a	0.66	0.663
Grower 1200 ppm	0.14a	0.68	0.680
Grower 1400 ppm	0.14a	0.70	0.700
Uji F	TN	*	*

3.2.2. Number of leaves, leaf width, and leaf length

The results of the analysis of variance in measuring the number of leaves, leaf width, and leaf length at 7 days after treatment at various ppm levels in the AB mix and grower showed that the results were not significantly different.

Table 2. shows the results of the Skott-Knott test at 7 days of observation. the number of leaves. leaf width and leaf length did not have a significant effect on each fertilizer treatment. This is suspected at the age of 7 days after the various fertilizer treatments above did not affect the number of leaves. leaf width, and leaf length in each treatment.

At 14 and 21 HST, it showed that the Scott-Knott test results showed the number of leaves. leaf width and leaf length had a significant effect on the number of leaves. leaf width and leaf length. It is suspected that various AB mix and grower fertilizer dosage treatments affect the number of leaves. leaf width and leaf length in each treatment. An increase in the number of leaves in plants is an influence on the increased chlorophyll content in the leaves. where chlorophyll in the leaves plays an important role in absorbing light to carry out the photosynthesis process.

Giving various fertilizer doses will affect the availability of NPK elements in fertilizer so that the number of leaves will continue to increase as the plant height increases. This is confirmed that the higher the dose of AB mix fertilizer given to spinach plants. the higher the plant growth and the greater the number of leaves on the spinach plants (Hidayanti & Kartika. 2019).

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Table 2. The effect of giving AB mix and Grower fertilizers on the number of leaves, leaf width, and leaf length at the age of 7 HST, 14 HST, and 21 HST

Treatment	Plant Age		
	7 HST	14 HST	21 HST
	Number of Leaves (pieces)		
AB mix 1000 ppm	5.20a	9.63b	11.23a
AB mix 1200 ppm	5.43a	9.93b	13.37b
AB mix 1400 ppm	5.27a	9.60b	11.80a
Grower 1000 ppm	4.67a	9.40a	11.60a
Grower 1200 ppm	4.73a	9.43a	12.50b
Grower 1400 ppm	5.03a	9.50b	12.10b
Uji F	TN	*	*
	Leaf Width (cm)		
AB mix 1000 ppm	2.67a	6.97a	9.40a
AB mix 1200 ppm	3.08a	7.07a	9.50a
AB mix 1400 ppm	2.80a	7.03a	9.30a
Grower 1000 ppm	2.51a	7.37a	9.60b
Grower 1200 ppm	2.58a	7.50a	10.70b
Grower 1400 ppm	3.09a	7.80b	11.30b
Uji F	TN	*	*
	Leaf Length (cm)		
AB mix 1000 ppm	6.53a	10.60b	12.80a
AB mix 1200 ppm	6.57a	10.60b	12.30a
AB mix 1400 ppm	6.50a	10.40a	12.27a
Grower 1000 ppm	6.50a	10.60b	13.80a
Grower 1200 ppm	6.67b	10.40a	13.67b
Grower 1400 ppm	7.03b	10.80b	14.13b
Uji F	TN	*	*

Based on the **Table 3**. the harvest of spinach plants was carried out 30 days after planting with the highest plant height obtained at the AB mix dose of 1200 ppm. namely 45 cm. This result was not significantly different from all AB mix treatments and 1400 ppm Grower fertilizer. but was significantly different from the Grower fertilizer dose of 1000 ppm and 1200. It is suspected that the effect of administering the AB mix fertilizer dose has a real effect on plant height at harvest. however. the yield of 1400 ppm for AB mix fertilizer is lower compared to 1200 ppm. Based on the results of research that has been carried out. it is known that the higher the dose of AB mix nutrients given to spinach plants. the higher the plant growth and the greater the number of leaves on the spinach plants. However. if the nutrient dose exceeds the limit of hydroponic plant needs. the plant will show a decline (Hidayanti & Kartika, 2019).

In terms of weight per plant. the highest yield was obtained in the grower at 1400 ppm and was significantly different from all AB mix treatments. The lowest number of plants per 250 g was obtained in the 1000 ppm grower. This is thought to vary in dose levels AB mix and grower affect the yield of plant height. plant weight. and number of plants per 250 g. Wet weight is a variable to measure plant growth. Plant growth rate can be measured in various ways. one way is to measure growth in fresh weight or wet weight per plant and total wet weight. The difference in plant fresh weight is due to the response of different nutrient doses to plant growth. Providing different nutritional doses to the growth of spinach plants has a real

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influence on the observation parameters. namely plant height. number of leaves and leaf area so that this will also affect the wet planting weight (Hidayanti & Kartika, 2019).

In plants. nitrogen (nitrate and ammonium) functions to increase leaf size and increase the protein percentage. The N element that enters plants is mostly used to form proteins. Many proteins form the basic material of protoplasm. most of which form enzymes. Many proteins are the basic ingredients of protoplasm and most of them form enzymes. Enzymes enter the meristem areas which cause growth and formation of leaves and roots. The large leaf size and stem diameter greatly influence the photosynthesis process. Thus, it will affect the wet weight (Krisdianto *et al.,* 2020).

Table 3. The effect of giving AB mix and Grower fertilizers on spinach harvest at 30 HST.

Measurement at Harvest 30 HST							
Treatment	**Plant Height (cm)**	**Bar Diameter**	**Number of Leaves**	**Leaf Length**	**Leaf Width**	**Weight per Plant (g)**	**Number of Plants per 250 g**
AB mix 1000 ppm	42b	0.66a	12.9b	13.2a	9.8a	13.4a	25b
AB mix 1200 ppm	45b	0.69b	13.8b	14.1b	10.1a	13.8a	20b
AB mix 1400 ppm	42.4b	0.68b	12.8b	13.2a	9.8a	13.7a	21b
Grower 1000 ppm	38.2a	0.74b	12.3a	14.0b	10.5a	15.1b	16a
Grower 1200 ppm	38.7a	0.74b	12.4a	14.2b	11.6b	15.4b	15a
Grower 1400 ppm	41.6b	0.75b	12.6b	14.5b	11.8b	16.1b	17a
Uji F	*	*	*	*	*	*	*

*not significantly different

4. CONCLUSION

This research concludes that the application of Grower fertilizer (15-9-20) and AB mix affects the growth components and harvest weight of spinach plants. number of leaves. stem diameter (cm). leaf area (cm^2) and fresh weight of the plant. Furthermore. at a dose of 1400 Grower fertilizer (15-9-20) and AB mix produced the highest growth components and harvest weight of spinach (*Amaranthus sp*).

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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