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Effect of Types of Nutrients and Several Varieties of Kale (*Brassica Oleracea Var. Palmifolia*) on Growth and Production

ABSTRACT

Hydroponic cultivation is one technique for increasing food production on a small piece of land. Nutrient utilization in hydroponic cultivation needs to be cautious in order to sustain plant growth. Plant growth is significantly influenced by the type of fertilizers used. Knowing the right kinds of nutrients to employ and the suitable plant varieties is essential when growing kale since, in addition to utilizing nutrients, plant varieties also influence how much is produced during the growth process. The location of the research was the Green House Pokmas Parasku Hijau, Paras Hamlet Rt.01/Rw.02, Banjarejo Village, Ngadiluwih District, Kediri, East Java 64171. The research took place from December 2021 to January 2022, lasting two months (60 days), and it used a completely randomized design with two components and three replications (r-1). The first factor or main plot is the nutrient concentration, which has three trademark versions (N) and a 5 ml/liter value. These versions are N1 (goodplant brand mix), N2 (Flo brand blend), and N3 (high grade brand blend). The second plot point or element is made up of the three Kale variety (K) levels: K1 (green kale), K2 (red Russian), and K3 (curly kale). Based on results, the growth and productivity of kale were not significantly impacted by ABmix nutrients or other kale cultivars. When used to treat different types of nutrition, ABmix Premium Grade nutrition has the best impact on the development and production of kale plants. The best-growing kale varieties, however, when treated, were the curly and green varieties.

Keywords: Cultivation, Green house, Hydroponics, Nutrition, and Kale

INTRODUCTION

Vegetables are in high demand as a side dish for meals at every level of society. Today, the importance of maintaining one's health is being recognized by more and more people. It must be complemented with good dietary practices, such as consuming enough fruits and vegetables to stay in shape (Halim, 2020).

Kale is a vegetable plant that is rich in vitamins A, C, potassium, calcium, iron, and manganese. Green kale has a 152.18 mg/100 g vitamin C content when it is harvested 175 days after planting (Agustin & Ichniarsyah, 2018). Despite being generally known for having a high vitamin C content, kale has a higher vitamin C concentration than guava (49.86 mg/100 g) and oranges (96.8 mg/100 g) (Febrianti Yunianto, & Dhaniaputri, 2016). Agricultural growth is occurring in all areas, including the vegetable and fruit industries as well as the sector of food crops rich in carbohydrates like rice, corn, wheat, and other cereal crops.

Vegetable production increases annually. Production of vegetables reached 11,558,449 tons in 2019 and increased to 11,918,571 tons in 2020. This shows that more vegetables must be produced in order to counteract the surge in demand for those commodities brought on by Indonesia's expanding population. Hydroponics is a method for growing plants in nutrient solutions with or without artificial medium (sand, gravel, rockwool, perlite, peatmoss, coir, or sawdust) for mechanical support. The word "hydroponics" derives from the Greek words "hydro," which means "water," and "heat," which means "power." Other names for hydroponics include soilless culture and soilless plant growing. Hydroponic farming focuses on using water and stressing the nutritional needs of plants (Marlina, Triyono, & Tusi, 2015).

Compared to soil-based farming, hydroponic farming consumes less water. In areas with limited water supplies, hydroponics can be used since it uses water more efficiently. To lessen climate limits, a hydroponic system can address issues with constrained land areas, poor soil properties, uncontrollable pests and diseases, and a shortage of irrigation water (Wibowo, Suryanto, & Nugroho, 2018).

Compound compound nutrients, also called AB mix, are fertilizers or nutrients that contain both micro and macro constituents. Fe, Mn, Cu, B, Zn, Mo, and N, together with Ca, K, Mg, S, and P, are microelements that are normally included in their general 12-part formula. Because the AB mix comprises a variety of nutritional components, research must be done to determine how certain nutrient types affect various species of kale (Alviana, 2015).

RESEARCH METHODS

This research will take place at Green House Pokmas Parasku Hijau, Paras Hamlet Rt.01/Rw.02, Banjarejo Village, Ngadiluwih District, Kediri, East Java 64171. The study will be conducted over the course of two months, from December 2021 to January 2022. (60 days).

Tools used in this study included a netpot, flannel cloth, measuring cup, bucket, styrofoam, plastic, ruler, analytical scale, furnace, and measuring tools like a pH meter, nursery container, pH meter, ruler, scales, container for storing nutrients (plastic bucket), nutrient stirrer, spectrophotometer, and measuring cup (1 l, 50 ml). Kale seeds, green, premium grade water, goodplant nutrition solution, and rockwool as a planting media were the materials employed in this study.

This study used a completely randomized design with 2 components, 3 replications, and the formula (t-1)(r-1)15 (9-1) to achieve 9 combinations with 27 different research sample types (r-1). Six plants total—three of which are the observed plants—make up each sample. The first aspect is the nutrient content of ABMIX 5 ml/liter 3 brand varieties. The second element is Kale Plant Varieties. The second element is Kale Plant Varieties. The experimental layout is described in the following. The first component is the ABmix nutritional solution brand, which includes (N1) Goodplant, (N2) Flo, and (N3) Premium Grade. The several kale crop varieties, such as (K1) Green Kale, (K2) Kale Red Russian, and (K3) Curly, are the second factor.

Observational parameters include plant height, leaf count, fresh weight, and root length. While parameters for plant height and leaf count were estimated 7, 14, and 35

days after planting, fresh weight and root length were measured for plants at harvest. Analysis of variance (F test) was used to analyze the collected observational data at the 5% level. By comparing the average value of the treatment combinations, Duncan's test (DMRT) 5 percent is used to identify which values are significantly different if there is a significant effect (F count > F table 5 percent). If there is no interaction and the result is significant for just one component, only a 5-percent BNT test is conducted, and no further tests performed.

RESULTS AND DISCUSSIONS

Kale Plant Height

The effects of various ABmix nutrition brands on plant height for several varieties of kale are depicted in Table 1 after statistical analysis. The statistical analysis's findings showed that there was a significant impact at plant ages 7, 14, 21, and 28 days after planting, as well as at those ages at which the plants were 14, 21, and 28 days old. for every type of kele in a single therapy.

Table 1. Average Height of Kale Plants on Treatment of Various Nutrients and Varieties of Kale Plants
The Average Height of Kale Plants on Treatment of Nutrients and Kale Plant Varieties

Treatment	Avarage of plan height (cm)				
	7 HST	14 HST	21 HST	28 HST	35 HST
ABMix Goodplant	1,98a	2,64a	3,57a	4,88a	7,49a
ABMix Flo	2,43a	2,98a	3,46a	4,16a	7,00a
ABMix Premium Grade	2,43a	3,13a	4,16a	5,61a	7,91a
BNT 5%	0,74	0,85	1,49	2,10	2,97
Green Kale	2,25a	3,07a	4,24a	6,00a	8,28a
Russian Red Kale	2,72 b	3,33b	3,89a	4,52a	6,90a
Curly Kale	1,86a	2,35a	3,07a	4,13a	7,22a
BNT 5%	0,74	0,85	1,49	2,10	2,97

Note: Numbers followed by the same letter in the same column are not significantly different at the Least Significant Difference level at the 5% level (BNT Test 0.05)

The results of the 5 percent BNT test show that interactions between plant species started at the beginning of early growth, specifically in plants from the age of 7 to 14 DAP, while there was no interaction between plants at the age of 35 days, indicating

that plant growth was at its best at 35 days after planting. The Green Kale treatment had the highest average plant height (7.91 cm), with ABmix Premium Grade nutrition had the highest maximum plant height (8.28 cm) of the kale variety treatments. One of the factors that greatly influences the growth of plant height is the availability of nutrients. This is consistent with Lawalata (2011) claim that a plant's nutritional requirements determine how much nutrient can be used to encourage plant growth.

Hydroponic fertilizers contain essential nutrients that plants need for strong growth. If there is insufficient supply of macro- and micronutrients, plants development and growth may be impeded (Pairunan, 2012). Plant growth patterns generally resemble a sigmoid curve. An initial rapid exponential growth phase, followed by a linear phase and a decelerating rate. The signoid curve slows down when the vegetative vase reaches a particular stage of plant cell proliferation (Hidayanti and Kartika, 2019).

Number of Leaves of Kale Plant

Statistical analysis is used to determine the effect of various ABmix nutrition brands on the quantity of leaves on various varieties of kale, as shown in Table 2. A single ABmix treatment, as determined by the statistical analysis, significantly affected plant age 28 days after planting.

Table 2. Average Number of Leaves of Kale Plants on Treatment of Types of Nutrients and Varieties of Kale Plants
The Average Number of Kale Plants on Treatment of Nutrients and Kale Plant Varieties

Treatment	Avarage of number of leaves (helai)				
	7 HST	14 HST	21 HST	28 HST	35 HST
ABMix Goodplant	4,37a	6,15a	7,44a	9,74b	12,07a
ABMix Flo	4,52a	5,89a	6,52a	7,93a	12,67a
ABMix Premium Grade	6,63a	5,85a	7,63a	9,63b	12,26a
BNT 5%	0,74	1,16	1,22	1,48	2,86
Green Kale	4,15a	5,41a	6,70a	9,15a	12,33a
Russian Red Kale	4,96b	6,19a	7,44a	8,85a	12,07a
Curly Kale	4,41a	6,30a	7,44a	9,30a	12,59a
BNT 5%	0,74	1,16	1,22	1,48	2,86

Note: Numbers followed by the same letter in the same column are not significantly different at the Least Significant Difference level at the 5% level (BNT Test 0.05)

The results of the 5 percent BNT test in the table above show that the nutritional treatment had an effect on the number of leaves, particularly in plants aged 28 DAP, whereas at this age, the plants had no effect from either of the two single factors, both ABmix nutrition and kale varieties, so that the number of leaves produced has reached the maximum. The nutritional treatment of ABmix Flo had an average leaf count of 12.67, but in the treatment of kale kinds, the K3 treatment had the highest plant height value with a leaf count of 12.59 strands. Depending on how many leaves are on the plant, the quantity of kale leaves might vary greatly. The growth of leaves is influenced by the nutrients in AB Mix, specifically the nitrogen, phosphorus, and potassium components.

Since the nutritional value of each food type is essentially the same, ab mix reacts differently to different dietary sources in a slightly variable way. According to Haryanto (2003), nitrogen is necessary for the growth of organs, notably leaves, in plants during the vegetative phase. Nitrogen is a nutrient in and of itself that aids in the synthesis of amino acids and protein, which are the building blocks of leaves, in plants. Similar arguments were made by Sarido (2017), who claimed that the amount of nitrogen (N) nutrients a plant can access influences both the number of leaves and the size of those leaves. Nitrogen availability is necessary for the production of chlorophyll, which is essential for the process of photosynthesis as well as the synthesis of proteins and organic molecules in plants. In addition to N elements, plants also absorb P and K elements, which are essential for plant cell division and the synthesis of enzymes (Marningsih, Nugroho, & Dzakiy, 2018).

Kale Plant Root Length

Statistical analysis is used to determine the effect of various ABmix nutrition brands on the root length of various kale cultivars, as shown in Table 3. The results of the statistical investigation showed that none of the two interventions, ABmix nutrition or various kale kinds, had any effect.

Table 3. Average Root Length of Kale Plants on Treatment of Various Nutrients and Varieties of Kale Plants
The Average Length of Kale Plants on Treatment of Nutrients and Kale Plant Varieties

Treatment	Average Length of Kale Plants (cm)
ABMix Goodplant	35,70a
ABMix Flo	38,14a
ABMix Premium Grade	40,88a
BNT 5%	10,88
Green Kale	39,11a
Russian Red Kale	38,05a
Curly Kale	37,56a
BNT 5%	10,88

Note: Numbers followed by the same letter in the same column are not significantly different at the Least Significant Difference level at the 5% level (BNT Test 0.05)

The results of the 5 percent BNT test, which are displayed in the table above, demonstrate that there was no variation in the root length of the kale plants under various nutrition and variety treatments. With such a root growth of 39.11 cm, the green kale variety has longer root than the other kale kinds. The premium grade brand ABmix nutrition treatment showed the best value for the final root length, which was 40.88 cm.

There are numerous factors that control how long the roots grow. Phytohormones, moisture, and soil porosity are all important factors. This is supported by Lee's (2012) claim that root length growth is significantly influenced by the presence of supportive components like proper nutrition availability, moisture, and plant hormones. According to Zulkarnain (2010), root growth is a result of the vegetative phase, which is marked by cell elongation, the stimulation of particular hormones, mainly auxin, and the availability of sufficient nutrients.

The amount of moisture present throughout the cultivation phase, in addition to hormones, might affect the lengthening of roots. Moisture is affected by plant spacing. The similar justification was also made by Vidianto, Fatimah, & Wasonawati (2013), who claimed that reduced vegetation may reduce elemental competition between plants for nutrients, sunlight, or water.

Kale Plant Fresh Weight

Statistical analysis is used to determine the effect of various ABmix nutrition brand names on the fresh weight of various kale cultivars, as shown in Table 4. The statistical analysis revealed that there was no distinction between any of the single treatments, including the brand names of ABmix and the varieties of kale.

Table 4. Average Fresh Weight of Kale Plants on Treatment of Nutrients and Varieties of Kale Plants
The Average Fresh Weight of Kale Plants on Treatment of Nutrients and Kale Plant Varieties

Treatment	Avarage wet weigh (gr)
ABMix Goodplant	61,85a
ABMix Flo	69,79a
ABMix Premium Grade	61,89a
BNT 5%	38,34
Green Kale	64,93a
Russian Red Kale	61,59a
Curly Kale	66,93a
BNT 5%	38,34

Note: Numbers followed by the same letter in the same column are not significantly different at the Least Significant Difference level at the 5% level (BNT Test 0.05)

The result of the 5 percent BNT test shown in the table above show that the kind of nutrition treatment had no effect on the fresh weight of kale plants. When it came to nutrition type treatments, the Flo brand outperformed those utilizing the Goodplant brand and Premium Grade nutrition. The wet weight that was obtained under the conditions of the ABmix nutrition therapy for the Flo brand was 69.79 g. As opposed to the fresh weight of kale plants, which was unaffected by the treatment of several kale cultivars.

Discussions

Based on the outcomes of the experiments conducted for this study, it was found that Kale Curly, which weighs 66.93 gr, offered the best therapy for various kale varieties. This is consistent with a study by Moctava & Koesriharti (2013), who discovered that a plant's fresh weight is determined by the amount of water and other plant components it owns. Afolabi research (2020) indicates that kale is a variety of leaf vegetable plant

from the Brassicaceae and Cruciferae families that has a high economic worth, strong production possibilities, and a high nutritional content. Oagile, Ramalekane, Mojeremane, Matsuane, Legwaila, & Mathowa (2016) claim that there are a number of strategies for growing kale plants, including using both conventional methods and tech-based methods. Only 40 to 56 days after the seeds are planted, kale is an annual vegetable that only stays in the ground for a short time. He added that areas with direct sunshine are ideal for kale plant growth. pH levels between 6-7 are ideal for kale soil. If the soil is excessively acidic, lime should be applied. A high nitrogen content is necessary for healthy leaf development in plants. Plants that grow kale prefer cooler temperatures. Due to the cold, the kale will taste sweeter. Kale plants thrive in highland areas.

The use of appropriate spacing will minimize weed growth while preventing nutrient competition between plants to maximize kale growth and yield. Plants can compete less ferociously for resources like nutrients, sunlight, and water by being spaced apart sufficiently (Vidianto, Fatimah, & Wasonawati, 2013). The amount of kale produced per bed rose with close spacing because there were more plants per bed than with broad spacing (Naik & Gupta, 2010). With a row spacing of 45 to 60 cm, kale plants can grow and produce their finest harvest (Heriteau, Stonehill, Ball, Fizzel, & Lamp'l, 2012).

The change in the plant's wet weight was explained by the plant's reaction to the nutrient supply. This is in line with Perwitasari (2012) study's conclusions, which showed that wet weight growth is greatly influenced. The macronutrients (N, P, K, Mg, Ca, S, C, H, and O) and micronutrients in AB mix nutrition are listed below (B, Cu, Fe, Mn, Zn, Mo). Large amounts of macronutrients are absorbed by plants, whereas only trace amounts of micronutrients are needed. The majority of micronutrients function as building blocks for vitamins and enzymes, whereas macronutrients support growth, the synthesis of amino acids and proteins, the expansion of seeds and roots, cell division in plants, the toughness of plant stems, and an improvement in disease resistance in plants. (Winda, 2013).

According to studies by Sutiyoso (2013), Naik and Gupta (2010), and Helaly (2017), nutrients with concentrations of 70–250 ppm nitrogen, 15–80 ppm phosphorus,

150–400 ppm potassium, 150–400 ppm calcium, and 15–80 ppm magnesium are necessary in a hydroponic system for the growth of kale and other kinds of stem and leaf vegetables. The fact that kale contains vitamins and minerals that are both high-calorie and low-calorie causes this condition. Kale contains a lot of the anti-oxidants quercetin, beta-carotene, and anthocyanins. This chemical is good for overall health because it can fight cancer and heart disease (Yuan & Li, 2009). If fertilizer is utilized and plants are spaced properly, kale can grow more quickly and produce more.

The distance between plants affects how well they can absorb nutrients, water, and sunlight. The method by which these nutrients are absorbed will have an effect on the development and production of kale (Dewanti, Fuskhah, & Sutarno, 2019). According to Shackley (2016), a high C/N ratio causes decomposer bacteria to absorb nitrogen from the soil and store it in their body tissues, making it difficult for plants to acquire the N elements they need from the soil.

CONCLUSION

Based on the results of research done on how various types of ABmix nutrition and various types of kale plant varieties with a hydroponic wick system interact, it can be said that (1) there is no interaction between ABmix nutrients and kale varieties; (2) various types of ABmix nutrition brands have different advantages in each observation parameter, and the best ABmix nutrition with Premium Grade types is able to provide the best results on p The kale is green and curly, as can be seen from the study's criteria.

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