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RESEARCH ARTICLE

The Effect of Planting Media Type and Ab Mix Concentration on the Growth and Yield of Hydroponic Bok Choy *(Brassica rapa L.)*

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ABSTRACT

Vegetables are usually classified by the part of the plant used for food, which is an essential source of many nutrients, including vitamins A and C, potassium, calcium, dietary fiber, and folate. Leafy greens are an abundant source of vitamin A and iron. The lack of fertile agricultural land has led to a decrease in the area of agricultural land, resulting in a decrease in the well-being of farmers. However, plant cultivation using the hydroponic method can be applied to solve this problem. Hydroponics is a method of growing crops without soil. Hydroponic farming is clean, simple, and efficient. This research aims to determine the effect of planting media type and AB mix concentration on hydroponic bok choy. The research used a Completely Randomized Design (CRD) with two factors and three replications, resulting in 27 experimental units. The first factor was planting media (M): Rockwool (M1), husk charcoal (M2), and sand (M3). The second factor was AB mix concentrations: 3 ml/l (K1), five ml/l (K2), and seven ml/l (K3).

1. INTRODUCTION

Bok choy *(Brassica rapa L.)* is a vegetable plant belonging to the Brassicaceae family. It originated in China and was widely cultivated after the 5th century in Southern and Central China and Taiwan. This vegetable is a new introduction to Japan and is still in the same family as Chinese vegetables. Bok choy is widely developed in the Philippines, Malaysia, Indonesia, and Thailand. Bok choy is very useful in relieving itchy throat in people suffering from cough, curing headaches, using blood cleaning agents, improving kidney function, and facilitating digestion. The seeds of Bok Choy are used as oil and food additives. The nutrients contained in bok choy are calories, protein, fat, carbohydrates, fiber, Ca, P, Fe, Vitamin A, Vitamin B, and Vitamin C (Widadi, 2003).

According to the BPS (2017), the average weekly consumption of bok choy reached 0.064 kg/person in 2016 and continues to increase. Since then, bok choy has become popular in Indonesia and can be found in many markets. The demand for these vegetables has increased along with the increase in population. However, the condition of agricultural land is decreasing. This threatens the vegetable farming sector as the area of agricultural land continues to shrink due to the ongoing conversion of productive agricultural land into non-agricultural land. The land holdings of farmers are - then decreasing, making it difficult for farmers to improve their well-being. In 2012, the area of land held per farmer was 0.22 hectares, which is expected to be 0.18 hectares by 2050 (Kementerian Pertanian, 2015).

One alternative to overcome this problem is to switch plant cultivation with hydroponic technology, where this system can be a reference for vegetable cultivation by not requiring a large cultivation area. Hydroponics is a way of farming without using soil as a medium for growing plants. Some of the advantages of hydroponic farming are that it provides clean plants, the environment is protected, there is no need for land cultivation, the growing medium is sterile, and nutrient use is efficient.

The simplest hydroponics is wick hydroponics, a hydroponic system that uses a wick as a reservoir. This system is classified as passive, and the nutrients that flow into the plant are assisted by a wick usually made of flannel cloth. This system has advantages such as plants' continuous supply of water, low manufacturing costs, easier plant maintenance (because there is no need for water), no dependence on electricity, and space savings (because it does not require a large area). However, the disadvantage of this system is that the nutrient basin must be controlled frequently to ensure that the nutrient conditions do not produce sediment as the nutrient water

does not move.

The success of hydroponic plant cultivation is also supported by the type of growing medium used. Planting media is a place for plant roots to absorb the elements needed by the plants. A proper growing medium can support plant growth and life. The primary support for the success of hydroponic cultivation is porous and well-aerated media, as well as sufficient nutrients for plant growth. Hydroponic growing media can be divided into two, which are organic and inorganic growing media. Organic growing media is derived from components of living organisms such as sawdust, husk charcoal, wood charcoal, coconut fiber powder, fern stems, and palm fiber. Meanwhile, inorganic planting media is derived from inanimate objects such as broken roof tiles, bricks, sand, and gravel (Arisandi, 2013).

Husk charcoal is an ideal planting media in hydroponics. The nature of husk charcoal, which is porous and able to store water well, can provide moisture in the media for plant growth and development. This is to Gustina's research (2013), which stated that the addition of husk charcoal to the soil-growing medium (2:2) showed the highest plant height, number of leaves, leaf length, leaf width, wet weight, and consumption weight compared to the growing medium without the addition of husk charcoal. Furthermore, Kirani (2011) reported that 28 days after planting, charcoal husk media produced the best number of spinach leaves, which were 12.64, compared to sand, rice husk, and fern media.

Besides growing media, nutrition is another factor that determines plant growth and yield. Nutrition is an essential factor that must be considered in hydroponic cultivation. The nutritional needs of plants must be fulfilled to obtain optimal growth. The primary nutrient used in hydroponics is AB mix. Pohan and Oktoyournal (2019) stated that AB mix nutrition contains essential nutrients the plants need. Nutrients play an important role in forming chlorophyll and protein in plants. Nutrients needed for plant growth include macronutrients (Ca, Mg, N, P, K) and micronutrients (Fe, Zn, Mn, B). The best AB mix nutrient solution for mustard plants is at a concentration of 7 ml (Siregar, 2017).

The research aimed to determine the effect of planting media type and AB mix concentration on the growth and yield of hydroponic bok choy.

2. MATERIALS AND METHODS

This research was conducted in the Screen House of the Agriculture Faculty, Universitas Malikussaleh. The research was conducted from October to December 2020.

The tools used in this research are styrofoam tubs, net pots, flannel cloth, ruler, analytical scales, 1000 ml plastic measuring cup, TDS meter, cutter, black plastic, camera, stationery, syringe, gauze, and chlorophyll meter. The materials used were water, rock wool, husk charcoal, sand, AB mix nutrients, and bok choy seeds.

This research used a factorial completely randomized design (CRD) with two treatment factors, which are the planting media type (M) and AB mix concentration (K). Factor I: The planting media type (M) consists of three levels: M1 (Rockwool), M2 (Husk Charcoal), and M3 (Sand). Factor II: AB mix concentration (K) consists of three levels, which are K1 (3 ml/liter of water), K2 (5 ml/liter of water), and K3 (7 ml/liter of water). Thus, there are nine treatment combinations with three replications and 27 experimental units. Each experimental unit consisted of 5 plants, so the total number of plants was 135 plants.

The implementation of this research consists of the seedling process, transplanting plants, providing nutrients, maintenance, and harvesting. The variables observed in this research were plant height (cm), number of leaves (leaflet), leaf chlorophyll content, root length (cm), root fresh weight (g), leaf fresh weight (g), and plant fresh weight (g). Data analysis was done with ANOVA. If the analysis shows different results, it will be continued with Duncan's Multiple Range Test (DMRT) at the 0.05 level.

3. RESULTS AND DISCUSSIONS

3.1 Results

3.1.1. Plant Height, Number of Leaves and Chlorophyll Content

The interaction between the planting media type and AB mix concentration did not affect the plant height, number of leaves, or chlorophyll content of bok choy plants. However, individually, both showed a significant effect. The results of further tests on the planting media type and AB mix concentration on plant height, number of leaves, and chlorophyll content of bok choy plants are presented in Table 1.

Table 1. The Effect of Planting Media Type and AB Mix Concentration on Plant Height, Number of Leaves and Chlorophyll Content of Bok choy Plants

Treatment	Plant height (cm)	Number of Leafs (Leaflet)	Chlorophyll Content
Planting Media Type (M)			
M1 (Rockwool)	25.71 a	15.63 a	21.44 a
M2 (Husk Charcoal)	23.61 b	16.07 a	22.61 a
M3 (Sand)	24.37 ab	16.66 a	22.03 a
AB Mix Concentration (K)			
K1 (3 ml/liters of water)	25.00 a	15.85 a	22.46 a
K2 (5 ml/liters of water)	23.99 a	15.96 a	21.09 a
K3 (7 ml/liters of water)	24.70 a	16.55 a	22.52 a

Note: The numbers followed by the same letter in the same column are not significantly different according to the 5% DMRT test.

Table 1 shows that the planting media type can increase the height of bok choy plants. The best treatment is M1 (Rockwool). At the AB mix concentration, it can be seen that it does not affect the plant height, number of leaves, and chlorophyll content of bok choy plants.

3.1.2. Root Length, Root Fresh Weight, Leaf Fresh Weight and Plant Fresh Weight

The interaction between the planting media type and AB mix concentration did not affect root length, root fresh weight, leaf fresh weight, or plant fresh weight. However, individually, both showed a significant effect. The results of further tests on the planting media type and AB mix concentration on root length, root fresh weight, leaf fresh weight, and fresh weight of bok choy plants are presented in Table 2.

Table 2. The Effect of Planting Media Type and AB Mix Concentration on Root Length, Root Fresh Weight, Leaf Fresh Weight and Plant Fresh Weight of Bok Choy

Treatment	Root Length (cm)	Root Fresh Weight (g)	Leaf Fresh Weight (g)	Plant Fresh Weight (g)
Planting Media Type (M)				
M1 (Rockwool)	33. 57 ab	10.89 a	94.44 a	114.87 a
M2 (Husk Charcoal)	31. 11 b	11.34 a	100.94 a	123.82 a
M3 (Sand)	37.55 a	12.03 a	105.47 a	125.37 a
AB Mix Concentration (K)				
K1 (3 ml/liters of water)	38.33 a	11.01 a	106.20 a	131.39 a
K2 (5 ml/liters of water)	32.46 a	11.91 a	92.69 a	112.02 a
K3 (7 ml/liters of water)	28.39 a	11.21 a	99.90 a	116.18 a

Note: The numbers followed by the same letter in the same column are not significantly different according to the 5% DMRT test.

Table 2 shows that the planting media type can increase the root length of bok choy plants. The best treatment is M3 (Sand). The AB mix concentration shows that it does not affect the root length, root fresh weight, leaf fresh weight, and plant fresh weight of bok choy.

3.2 Discussions

The observations on the use of planting media types carried out for four weeks showed a very significant effect on the number of leaves at the age of 2 weeks after planting (WAP), not significantly different at 3 WAP and significantly different in weeks 4 and 5. In chlorophyll levels, the age of 3 WAP showed significantly different results, while at 4 and 5 WAP, the results were not significantly different. Additionally, root length, leaf fresh weight, root fresh weight, and plant fresh weight showed no significant difference.

Plant nutrient absorption is affected by the planting media. Planting media is a place where roots absorb the nutrients needed by plants. A proper growing medium can support the plant's growth and life. The success of the hydroponic cultivation system is supported by porous and good aeration as well as sufficient nutrients for plant growth (Perwitasari et al., 2012). The use of hydroponic growing media has its advantages and disadvantages. Husk charcoal media can store and remove excess water so plants do not experience root and stem rot. Bok choy plants are succulent, so they quickly experience rotting roots or stems if they absorb excessive water.

The results of statistical data with the highest average value are in the single treatment of sand planting media (M3) on the number of leaves, root length, leaves fresh weight, root fresh weight, and plant fresh weight. Sand planting media has larger bottom pores to store more water and nutrients. Sand media is the most accessible medium for applying hydroponics anywhere and is widely used for large- or small-size hydroponics. Sand media can usually strengthen roots and stems.

Asmarawati (2010) reported that the planting media and concentration in tomato cultivation interacted with the average number of branches and the wet and dry weight of roots. The combination of sand media with ten cc/liters nutrient concentration gave the highest average number of branches (4.56) at the age of 45 DAP. In comparison, sand media with 15 cc/liters concentration gave the highest average root wet weight (2.55 g) and root dry weight (0.29 g).

Data from variance analysis showed that AB mix concentration showed no significant difference in plant height and number of leaves, significantly different in chlorophyll content at the age of 4 WAP, but not significantly different at 3 and 5 WAP, and significantly different in root length, while on other variables such as leaf fresh weight, root fresh weight and plant fresh weight showed no significant effect. The single treatment of 3 ml AB mix concentration (K1) showed the highest average value in plant height, root length, leaf fresh weight, and plant fresh weight. Syafruddin et al. (2012) stated that nutrients such as N, P, and K, which are essential for plant growth, play a significant role during the vegetative phase.

Giving the right concentration significantly affects plants' growth. According to Laksono (2014), the availability of nutrients in the metabolic process plays a vital role in forming proteins, enzymes, hormones, and carbohydrates. It will increase the process of cell division in plant tissues, which will affect the formation of shoots, roots, and leaves, increasing stover wet weight and dry weight. To obtain the optimal efficiency of nutrient applications, they must be given in sufficient amounts to meet the requirements of the plants. If the plants are given too many nutrients, it can cause a reduction in vegetative development. It can inhibit root development, thus disturbing the absorption of plant nutrients, even without any visual symptoms of deficiency.

Narulita et al. (2019) suggested that the elements that play a role in chlorophyll formation are nitrogen (N),

phosphorus (P), and magnesium (Mg). Magnesium is absorbed by plants in the form of Mg2+ ions. Plants lacking in magnesium (Mg) are usually identified by chlorosis symptoms, eventually making them fall off. To prevent plant deficiency in magnesium (Mg), they must be given to plants in a suitable amount to meet their needs.

Data from the variance analysis showed no interaction between the planting media types and AB mix concentrations on the growth and yield of hydroponic bok choy plants in all variables observed for four weeks. This shows that AB mix concentration and planting media have not been able to affect the physiological activation pattern of the plants because the treatments do not support each other. This is the opinion of Hayati (2006), who stated that proper plant growth can be achieved if the factors that influence it are balanced and beneficial.

The absence of interaction between the planting media and the concentration of AB mix used is by Manullang et al. (2019), who stated that if one factor has a more substantial effect, the other factors will be hidden, resulting in the properties in each of the factors have a far effect from their working nature so that they will produce an influential relationship to affect the growth of the plants. Two factors are said to interact if the effect of a factor changes when there is a change in the level of other treatment factors. Furthermore, it is stated that if the effect of the interaction is not significantly different, it can be concluded that among these factors are acting independently from one another.

4. CONCLUSIONS

Using sand media (M3) provides the best results for the growth and yield of hydroponic bok choy plants. Similarly, applying AB mix with a concentration of 3 ml/liter of water (K1) yields the best outcomes for the growth and yield of hydroponic bok choy plants. However, there is no interaction between the type of planting media and the concentration of AB mix on the growth and yield of hydroponic bok choy plants.

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