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Strategies of Increasing The Growth and Results Pakcoy by Modification of Media and Nutrition in The Axis System Hydroponic (Wick System)

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ABSTRACT

This study seeks to determine the growth response and yield of Pakcoy plants grown in various nutrient concentrations and growing media types. This study employs a wick system and the split-plot method, which consists of the main plot, which is the Ab mix nutrition with three nutrient concentrations: 5 ml (N1), 7.5 ml (N2), and 10 ml (N3). The subplot is comprised of three kinds of planting media: Rockwool (M1), husk charcoal (M2), and cocopeat (M3). These two parameters were obtained through nine different treatment combinations. Each treatment was administered three times. The research data were analyzed with a split-plot design at a significance level of 5%. Followed by Duncan's test with a 5% significance level if there is a treatment difference. The results demonstrated a significant interaction between nutrient concentrations and the type of growing medium on the parameters of the number of leaves, plant dry weight, root fresh weight, root dry weight, root dry weight, root fresh weight, root fresh weight, root dry weight, crown fresh weight, and shoot dry weight. The results demonstrated a significant interaction between nutrient concentrations and the type of growing medium. The optimal treatment combination was found for all parameters at a nutrient concentration of 10 ml with Rockwool growing media.

Keywords: *hydroponic, modification media, nutritions, pakcoy, wick system.*

1. INTRODUCTION

Hydroponics is agricultural cultivation land that does not use soil media, but instead uses water as a medium. (Sani, 2015) Hydroponic cultivation systems take advantage of urban spaces with limited space (narrow) dimensions. Implementing a hydroponic system does not necessitate enormous tracts of land, as it can be placed in the backyard, on the home's roof, or on other land. This system maximizes the use of extant agricultural land while maximizing the quality and quantity of agricultural products. However, there are disadvantages to cultivating without land, including high costs and the need for specialized skills (Roidah, 2014). There are numerous varieties of soilless planting, including drip irrigation systems, wick systems, and Nutrient Film Technique (NFT) systems. This investigation will utilize The wick system for soilless planting (Hendra and Agus, 2016).

Farming without land is a non-seasonal agricultural system. Therefore, the sale value of crops grown without land will never diminish. Because the location is clean, the planting medium is sterile, the plants are protected from moisture, the attacks of pests and plant diseases are relatively small, the plants are relatively clean, and the yield is greater, maintenance of soilless planting is relatively simple. According to (Natalia et al., 2020), the drip irrigation system (Drip Irrigation System) is one of the horticulture techniques used for planting without soil. Planting without soil with a trickle system (fertigation) is a method of planting without soil in which a nutrient solution is dripped onto root crops to maintain moisture, thereby conserving air and fertilizer.

Mustard greens are a variety of plant that is simple to cultivate because this green leafy vegetable is resistant to rainwater and can be harvested year-round because this vegetable plant has no season. This mustard plant's harvest period is brief, lasting only 40 days after the sowing period. However, some issues frequently encountered in conventional mustard cultivation are the uneven quality of the harvest, the prevalence of parasites, and the low yield. The problem of inconsistent soil fertility in mustard plant cultivation is the cause. Hydroponics is one method for producing products with quantifiable quantity and quality. Consequently, this investigation examined the pakcoy mustard plant.

Utilizing a hydroponic system can support the growth and increase the yield of mustard greens. This is one of the agricultural techniques that utilizes water, nutrients, and oxygen without using soil media for plant growth. If plants are planted in a suitable substrate with adequate nutrient assimilation, they can produce optimal results. In hydroponic pakcoy cultivation, the quantity of nutrients required is of particular concern (Rizal, 2017). Rockwool is one of the most popular growing media used by hydroponic producers. This planting medium has advantages over other media, particularly regarding the ratio of water to oxygen that it can hold. Rice husk charcoal has excellent aeration and can store moisture for an extended period of time so that the nutrients in the rice husk charcoal planting medium are sufficient to meet plant

requirements. The benefit of husk charcoal is that it does not readily deteriorate, so it does not attract fungi or animals that harm plants. Cocopeat is composed of coconut fibers ground into a soil-like consistency. Cocopeat has the advantage of being a lightweight planting medium that can contain up to 73% water and enough nutrients to ensure that plants do not lack water and nutrients. Additionally, cocopeat is unsuitable for all plant roots because it can retain water for an extended period. Rosman et al., 2019).

2. MATERIAL AND METHODS

This study was conducted on KP2 Instiper land in Yogyakarta. With a period of + 40 days, the average temperature from January to February 2023 is between 260 and 320 degrees Fahrenheit, with an average rainfall of 5 millimeters at an altitude between 100 and 499 meters above sea level.

This study was conducted using a split-plot experiment, with the main plot consisting of three nutrient concentrations: N1 (5 ml), N2 (7.5 ml), and N3 (10 ml). And the subplot consists of three types: M1 (Rockwool), M2 (cocopeat), and M3 (chaff charcoal), resulting in nine treatment combinations. Each treatment was replicated three times, resulting in a total of 45 plants in the study (5 x 9 = 45). The data were analyzed with ANOVA (Analysis of Variance) at a significance level of 5%, followed by Duncan's test at a significance level of 5% if there was a difference in treatment using the SPSS program.

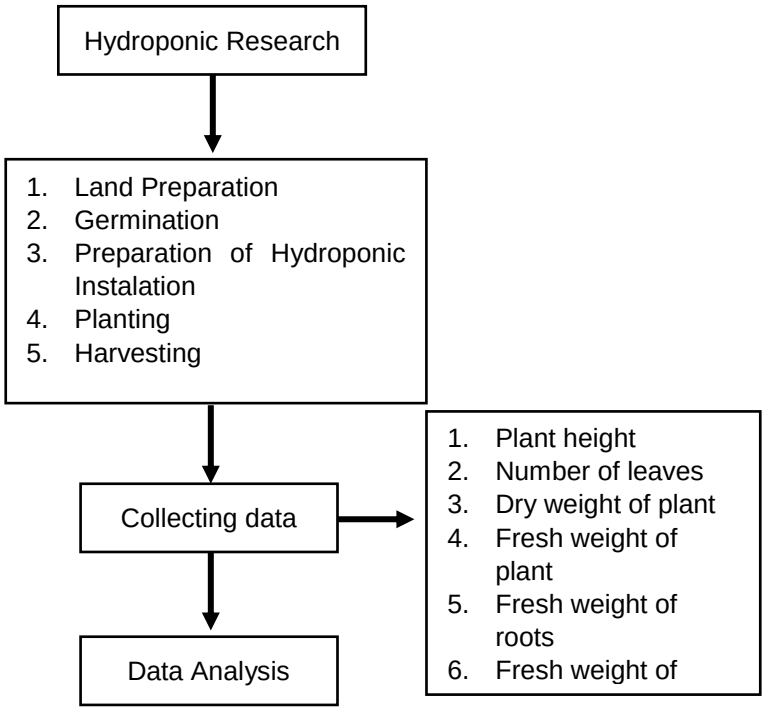

Figure 1. Research flowcard

The research parameters included: plant height, number of leaves, dry weight of plants, fresh weight of plants, fresh weight of roots, dry weight of roots, fresh weight of shoots, dry weight of shoots.

3. RESULT AND DISCUSSION

The number of foliage produced is indicative of Pakcoy plant growth. The analysis revealed a significant difference between the nutrient concentration of the 10 ml solution and that of the other regimens. This suggests that techniques for dynamic fertilization can be utilized to increase crop yields. Table 1 presents the results of the variance analysis. Demonstrates that there is a genuine interaction between nutrient concentrations and the type of planting medium on the parameter number of leaves.

Table 1. Analyses of the type of growing medium and nutrient concentrations for each variable root length (cm))

No.	Treatment		number of leaves (stran)	fresh weight of plants (g)	dry weight of plants (g)	fresh weight of roots (g)	dry weight of roots (g)	fresh weight of shoots (g)	dry weight of shoots (g)	root length (cm)	root length (cm)
1	Rockwol media	5 ml	19	74,40	4,88	4,40	0,44	70,00	4,44	22	13
		7,5 ml	20	105,80	6,54	6,60	0,64	99,20	5,9	23	18
		10 ml	24	148,00	9,38	10,20	1,02	137,00	8,36	24	18
2	Cocopeat Media	5 ml	21	124,00	7,24	7,80	0,68	116,20	6,56	21	19
		7,5 ml	21	124,20	7,32	7,00	0,80	116,80	6,52	22	21
		10 ml	21	125,40	7,88	8,20	0,80	117,20	7,08	22	26
3	Husk Charcoal Media	5 ml	22	102,60	6,52	6,80	0,58	95,80	5,94	21	15
		7,5 ml	22	115,80	7,78	6,40	0,56	115,40	7,22	23	21
		10 ml	22	105,20	6,56	6,20	0,54	99,00	6,02	22	25

Based on the analysis performed, it was determined that there was a significant interaction between the type of media and the nutrient concentration treatment on parameters such as the number of leaves, plant dry weight, plant fresh weight, root fresh weight, root dry weight, shoot fresh weight, and shoot dry weight. Each treatment influences the development and yield of pakcoy plants. The analysis of nutrient concentrations and media types revealed statistically significant differences for all observed parameters. Of all these variables that differ significantly, nutrition is the most notable. As a result of the high quality of the nutrition I use, my research is highly interactive and diverse.

Table 2. Number of leaves in the treatment of media types and nutrients

Nutrition Concentration	Media Type		
	Rockwool	Cocopeat	Husk Charcoal
5 ml	19,40 c	21,40 abc	22,40 ab
7,5 ml	19,60 c	21,20 bc	21,80 abc
10 ml	24,00 a	20,60 bc	21,80 abc

Note: Numbers followed by the same letter in the same column and row show no significant difference based on the Duncan test at the 5% significance level.

Table 1's variance results indicate a significant interaction between media type and nutrient concentration for the number of leaves parameter. The number of leaves a Pakcoy plant produces suggests the plant's yield. The analysis revealed that there were distinctions between the other treatments.

This demonstrates the importance of selecting a planting medium with an axle and a porous structure. Frequently used growing media in hydroponics include Rockwool, cocopeat, and husk charcoal. The composition of rice husk charcoal plays an important role in increasing the porosity of the media, and it has been demonstrated that the higher the rice husk charcoal content, the better the pakcoy growth (Anjaliza et al., 2013; Afifah et al., 2021).

In addition to the planting medium, the amount of oxygen in the roots influences plant growth. In this study, there were three concentrations of nutrients: 5 ml, 7.5 ml, and 10 ml. Hydroponics requires nutrient concentration because nutrient concentration has a significant impact on plant growth, which will be investigated. If the nutrient concentration is too low, the pH will be altered, affecting the absorption of nutrients by plants. If the concentration of nutrients is too high, the pH will become acidic, and the plant will develop. Plants will develop stunted growth and become stunted.

Utilizing dynamic fertilization can increase crop yields. Pakcoy plants are grown in the shade on UV plastic using plant nutrients provided in the form of a solution so that the level of nutrient assimilation matches that of the water solvent. Consequently, a nutrient concentration of 10 ml provides more water and nutrients for plant growth than other treatments (Albornoz et al., 2014).

Table 3. Dry weight of plants in the treatment of media types and nutrients (g)

Nutrition Concentration	Media Type		
	Rockwool	Cocopeat	Husk Charcoal
5 ml	4,88 c	7,24 b	6,52 bc
7,5 ml	6,54 bc	7,32 b	7,78 ab
10 ml	9,38 a	7,88 ab	6,56 bc

Note: Numbers followed by the same letter in the same column and row show no significant difference based on the Duncan test at the 5% significance level.

The combination treatment with a nutrient concentration of 10 ml and rockwool growing media produced good results but not as excellent as husk charcoal with a nutrient concentration of 7.5 ml and cocopeat growing media with a nutrient concentration of 10 ml. According to Yama and Kartiko (2020), the yield at the conclusion of the planting period is determined by plant growth. Dry matter accumulation can be utilized as a growth indicator. Increased CO2 assimilation during the vegetative growth of pakcoy plants results in the accumulation of plant dried weight over a given period of time. The sun's efficacy in utilizing the plant is also determined by the dry weight of each organ that makes up the plant. This determines the dry weight of the plant. Therefore, roots, stems, and foliage growth should be coordinated to form a plant. The dry weight of pakcoy plants may result from the weight of the roots or the weight of the foliage and stems, and not the number of leaves and the length of the roots.

Table 4. Fresh weight of plants in the treatment of media types and nutrients (g)

Nutrition Concentration	Media Type		
	Rockwool	Cocopeat	Husk Charcoal
5 ml	74,40 c	124,00 ab	102,60 b
7,5 ml	105,80 b	124,20 ab	115,80 b
10 ml	148,00 a	125,40 ab	105,20 b

Note: Numbers followed by the same letter in the same column and row show no significant difference based on the Duncan test at the 5% significance level.

Figure 2. Design Hydroponic (Wick System)

At a concentration of 10 ml, the plants grew well in rockwool media and similarly well in cocopeat media regardless of concentration. The availability of nutrients plays a crucial role in forming proteins, enzymes, hormones, and carbohydrates, as well as other essential metabolic processes. This process influences the development of branches, roots, and leaves so that these nutrients can enhance the process of cell division in plant tissue. The ability of plants to photosynthesize more leads to the formation of more photosynthetic products, causing plants to weigh more than other plants. If plant tissue contains higher concentrations of certain nutrients than required for optimal growth (Rizal, 2017). Beyond the interaction of planting media that can support nutrient delivery to the root zone, it enables the root system to

assimilate the nutrients it requires most efficiently (Laksono & Sugiono, 2017).

Table 5. Fresh weight of roots in the treatment of media types and nutrients (g)

Nutrition Concentration	Media Type		
	Rockwool	Cocopeat	Husk Charcoal
5 ml	4,40 c	7,80 ab	6,80 bc
7,5 ml	6,60 bc	7,00 bc	6,40 bc
10 ml	10,20 a	8,20 ab	6,20 bc

Note: Numbers followed by the same letter in the same column and row show no significant difference based on the Duncan test at the 5% level of significance

From the root fresh weight parameter, the best results were observed at a concentration of 10 ml with the type of rockwool growing media and at concentrations of 5 ml and 7.5 ml with the kind of cocopeat media in this parameter's interactions. Plant nutrient requirements for each plant are distinct, but most plants require certain concentrations of limited nutrients. If plant tissue contains a higher concentration of certain nutrients than is required for optimal growth, the plant is in a state of overactivity, resulting in phytotoxicity. The increase in root biomass is because the roots must absorb nutrients from the planting medium in the appropriate amounts for the nutrients to be appropriately utilized and non-toxic. The root is an essential element of the plant because it plays a significant role in nutrient and water absorption (Pane *et al*., 2017).

Table 6. Dry weight of roots in the treatment of media types and nutrients (g)

Nutrition Concentration	Media Type		
	Rockwool	Cocopeat	Husk Charcoal
5 ml	0,44 c	0,68 bc	0,58 bc
7,5 ml	0,64 bc	0,80 ab	0,56 bc
10 ml	1,02 a	0,80 ab	0,54 bc

Note: Numbers followed by the same letter in the same column and row show no significant difference based on the Duncan test at the 5% significance level.

A nutrient concentration of 10 ml in the rockwool media type and concentrations of 7.5 ml and 10 ml in the cocopeat media type had the greatest effect on the root dry weight of pakcoy plants. The interaction between nutrient concentrations and growing medium type affected the root dry weight parameter. According to Adimihardja and Hamid (2013), dry weight results from the plant canopy's efficient absorption and utilization of available solar radiation. In general, the number of foliage correlates closely with yield. The longer leaves assimilate solar radiation, the greater the dry weight yield of straw. Radiation absorbed and the efficiency of using this energy to fix CO2 are the primary determinants of the total dry weight of crop yields. Through the roots and foliage of plants, nutrients are supplied to plants.

Table 7. Fresh weight of shoots in the treatment of media types and nutrients (g)

Nutrition Concentration	Media Type		
	Rockwool	Cocopeat	Husk Charcoal
5 ml	70,00 c	116,20 ab	95,80 b
7,5 ml	99,20 b	116,80 ab	115,40 ab
10 ml	137,00 a	117,20 ab	99,00 b

Note: Numbers followed by the same letter in the same column and row show no significant difference based on the Duncan test at the 5% significance level.

The canopy fresh weight parameter exhibited interaction effects, with the best results observed at a nutrient concentration of 10 ml with rockwool media, as well as at all concentrations with cocopeat media and at 7.5 ml concentrations with husk charcoal media. Using the nutritional ab mix that I employed led to an increase in fresh weight, as indicated by the study's title. Due to the plant's high nitrogen content, the mustard plant's stems, leaves, and roots have a high turgor pressure. Absorb nitrogen nutrients, preventing stem and leaf root moisture from evaporating and causing these plant parts to remain damp. The result is the new weight of the pakcoy plant canopy. Because the harvest will be sold by weight, the higher the harvest's fresh weight, the greater its economic value. The high value of shoot fresh weight resulted from the optimal concentration of ab mix given to pakcoy plants in accordance with their requirements (Susilo, 2019).

Table 8. Canopy dry weight in the treatment of media types and nutrients (g)

Nutrition Concentration	Media Type		
	Rockwool	Cocopeat	Husk Charcoal
5 ml	4,44 c	6,56 b	5,94 bc
7,5 ml	5,90 bc	6,52 b	7,22 ab
10 ml	8,36 a	7,08 ab	6,02 bc

Note: Numbers followed by the same letter in the same column and row show no significant difference based on the Duncan test at the 5% significance level.

It can be concluded that there is an interaction between nutrient concentrations and the type of growing medium in terms of the parameters of shoot dry weight, with the greatest results occurring at a nutrient concentration of 10 ml with rockwool media. Likewise, 10 ml of the cocopeat media type and 7.5 ml of the husk charcoal media type produced the same positive results. Plant dry weight indicates successful plant growth as a measure of photosynthetic sediment yield net of water loss. A sufficient supply of nutrients from liquid organic fertilizer will accelerate the process. Plants undergo photosynthesis, with the process of photosynthesis increasing photosynthetic yields. Then it affects the plant's dry weight production. The dry weight indicates the plant's ability to acquire nutrients necessary for growth and metabolic function. Consequently, the greater the desiccated weight, the more efficient the process of photosynthesis. the greater the dried weight, the more effective the photosynthesis process What affects the productivity and growth of tissue cells? The better the plant growth, the greater its height and rate (Sarif, *et al* 2015).

Table 9. Effect of media type on the growth and yield of pakcoy plants

Parameter	Media Type		
	Rockwool	Cocopeat	Husk Charcoal
Tinggi tanaman (cm)	23,03 p	21,97 q	21,93 q
Panjang akar	16,53 q	21,80 p	20,33 p

Note: Numbers followed by the same letter in the same column and row show no significant difference based on the Duncan test at the 5% significance level.

Rockwool growing media has a higher water absorption capacity than cocopeat growing media and husk charcoal. It shows that a good planting medium for water and nutrient absorption is rockwool media. The higher the nutrients contained in the planting medium, the better the growth and yield of these plants.

Table 10. The effect of nutrient concentration on the growth and yield of pakcoy plants

Parameter	Nutrition Concentration		
	5 ml	7,5 ml	10 ml
Plant height (cm)	21,37 b	22,80 a	22,77 a
root length	15,60 b	20,33 a	22,73 a

Note: Numbers followed by the same letter in the same column and row show no significant difference based on the Duncan test at the 5% significance level.

The effect of nutrient concentrations on plant height and root length parameters was substantial (Sundari et al., 2016). The concentration of nutrients is suspected to provide plants with optimal and sufficient nutrients. This demonstrates that AB Mix is an effective fertilizer for bok choy in soilless cropping systems due to the rapid assimilation of plant nutrients. In terms of average plant height and root length, the administration of the appropriate AB fertilizer mix produced favorable results for plant growth, as indicated by the results of the observations. Facts demonstrate that the greater the concentration of AB-blended fertilizer, the greater its extraordinary effect. The root system uses the energy required to produce sufficient oxygen in solution for respiration and generates energy to extract water and nutrients from the solution. So that the respiration process can operate efficiently and plants can absorb more nutrients, nutrient intake increased, as did crop yield. In addition, the time difference between the morning, afternoon, and evening causes fluctuations in solution temperature, which affects plant nutrient absorption processes differently.

4. CONCLUSION

In terms of the number of leaves, plant dry weight, plant fresh weight, root fresh weight, root dry weight, shoot fresh weight, and shoot dry weight, there was an interaction between the varieties of growing media and the concentration of nutrients, as determined by the results of the study. The optimal interaction of parameters is a 10 ml concentration with a particular variety of rockwool growing medium. On the parameters of plant height, fresh plant weight, root dry weight, and root length, the type of growing medium had a significant effect. The ideal media type is rockwool media. The effect of nutrient concentrations on plant height, plant dry weight, plant fresh weight, root fresh weight, root dry weight, root length, shoot fresh weight, and shoot dry weight was significant. The optimal concentration of nutrients is 10 ml.

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