



Improving Growth and Yield of Pakcoy Plants (*Brassica Rapa L.*) growing under Hydroponic system

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Abstract - Technological developments in agriculture are increasingly rapid, one of which is an appropriate technological innovation called hydroponics. Pakcoy plants can grow both in hot and cold places, so they can be cultivated from the lowlands and highland. This study aims to determine the effect of the type of hydroponic media on the growth and yield of pakcoy plants. The research was carried out in Bente Village, Bungku Tengah District, Morowali Regency. There are five treatments and repeated four times. The treatments included P1 = rockwool, P2 = sponge, P3 = coconut fiber, P4 = areca nut husk, P5 = rice husk charcoal. The results showed that the planting media treatment had a significant effect on the observed variables such as plant height, number of leaves, plant fresh weight, root weight and leaf fresh weight, but root length and root volume had no significant effect. Rockwool (P1) planting medium gave better growth and yields on root weight and root volume of pakcoy plants. Planting media of fiber areca nut (P4) gave better growth and yield for plant height, number of leaves, plant fresh weight and leaf fresh weight. Rice husk growing medium (P5) gave better the number of leaves at 1 WAP and 2 WAP, and the length of the roots of Pakcoy plants.

Keywords - Pakcoy, Hydroponics, innovation, sustainable

I. INTRODUCTION

The need of food for humans such as vegetables and fruits is increasing along with the development of population. However, this is not accompanied by the growth of agricultural land which is even narrower [1] [2]. Technological developments in agriculture are increasing rapidly every year [1], one of which is an appropriate technological innovation called hydroponics [3]

Apart from nutrient solutions, another factor that affects plant growth is the planting medium. There are two types of planting media commonly used in hydroponic cultivation systems, namely organic and inorganic growing media. In this study, coconut coir, husk charcoal, sponges rock wool and areca nut husks were used as organic growing media. The function of the planting medium in hydroponic cultivation is as a place to grow and store nutrients needed for plant growth [4].

The absorption of plant nutrients is affected by the growing medium. The planting medium is a place for plant roots to absorb the nutrients needed by plants [5]. A good planting medium is a medium that can support plant growth and life. Supporting the success of a hydroponic cultivation system are media that are porous and well aerated [3].

Pakcoy plants can grow both in places with hot and cold temperatures, so they can be cultivated from the lowlands and highlands. Pakcoy is one type of leaf vegetable that is widely cultivated using a hydroponic system. Hydroponic Pakcoy has prospects for development due to market demand and high prices compared to other types of mustard greens [6] [7]. Pakchoi cultivation techniques with a hydroponic system, are different from conventional pakchoi cultivation techniques. Plant cultivation with a hydroponic system does not use soil as a planting medium [8].

Morowali Regency area, the number of hydroponic farmers has begun to increase, but farmers are still having difficulty getting planting media such as rock wool. Therefore, with an abundance of coconut coir, areca nut coir and rice husk charcoal, it can later be used as a hydroponic growing medium, especially for pakcoy plants. It rarely encounter pakcoy plant among farmers because of the lack of knowledge of farmers about this plant, even though this plant has high economic value because of the existence of several

companies around Morowali that really need food ingredients such as vegetables.

This research aims to find out the suitable growing medium for pakcoy plants under hydroponic system in order to increase the growth and yield of pakcoy plants.

II. METHOD

A. Research area

The research was carried out in Bente Village, Bungku Tengah District, Morowali Regency from October to December 2021. The tools used are: PVC pipes, net pots, aquarium pumps, pH meter, TDS metre, electric scales, measuring cups, calipers, knives, buckets, cameras and stationery.

The materials used are pakcoy seeds, rockwool, sponge, coconut fiber, areca nut husk, husk charcoal, water, and AB mix.

This study used a randomized block design (RBD) method, the treatment included 5 types of planting media such as: P1 = rockwool, P2 = sponge, P3 = coconut fiber, P4 = areca nut husk, P5 = rice husk charcoal. Therefore, there are five treatments and repeated four times so that 20 experimental units can be obtained.

B. Research procedure

Hydroponic Installations. At this stage the first thing to do is to punch a hole in a 2 1/2 PVC pipe with the area of the hole adjusting to the diameter of the net pot, with a spacing of 20x20 cm. After that, assemble all the pipes, attach a special PVC pipe glue to each connection and make sure that all the pipes are connected perfectly according to the design made, if the framework is finished, then it just have to connect it with a pump to the 1/2 pipe as a way for water circulation to and from the reservoir. The thing that needs to be evaluated is the ability of the water circulation to spread evenly in all pipes. Better circulation will help the plants get nutrients evenly and also need to see all sides of the pipe joints.

Preparation of Planting Media. Rockwool and sponge planting media was prepared by cutting the media 3 cm long, 3 cm wide and 3 cm high using a knife. While coconut coir, areca nut coir, and rice husk charcoal are sized according to the net pot. Place the pakcoy seeds as deep as half a centimeter from the surface of the planting medium. After that, pour enough water to make the planting medium moist, then the seeds that are sown are left in a place without sunlight for 12 hours, when the 12 hours have passed the seeds can be exposed to sunlight. The seeds are ready to be transferred to the hydroponic installation when they are 10 days old or when the fourth leaf appears.

Planting seedling. Seedlings that are 10 days old and have 4 leaves can be transferred directly to the net pot without removing the planting medium and then transferred to the hydroponic structure, one pakcoy seed is planted in each planting hole. Furthermore, planting is carried out in accordance with the research design that has been determined. The nutrient tanks were filled with AB Mix nutrient solution with a concentration of 700 ppm in the first and second weeks and 1,200 ppm in the third and fourth weeks. The pH value of the AB Mix nutrient solution is maintained between 5.5 to 6.

C. Observational Variables Plant height

Plant height was measured using a ruler from the base of the stem to the tip of the longest leaf. These measurements are carried out once a week (1 WAP, 2 WAP, 3 WAP, 4 WAP).

D. Number of Leaves

Observation of the number of leaves is counting the number of leaves that have opened perfectly. Observations were made once a week (1 WAP, 2 WAP, 3 WAP, 4 WAP).

E. Plant Fresh Weight

Observation of the fresh weight of the plants was carried out after harvest, namely after the plants were 4 WAP by weighing all the fresh parts of the pakcoy plant.

F. Plant Root Length

Observation of plant root length was carried out after harvest, namely after the plant was 4 WAP by measuring the roots using a ruler from the base of the root to the tip of the root.

G. Root Weight

Observation of plant root weight was carried out after harvest, namely after the plants were 4 WAP by weighing plant roots starting from the base

III. RESULTS AND DISCUSSION

A. Results Plant height

Data on observation of pakcoy plant height from various ages of observation showed that various planting media had a significant effect on the height of pakcoy plants at the age of 1 WAP, 2 WAP, 3 WAP and 4 WAP. The average height of pakcoy plants at various ages of observation is presented in Table 1.

B. Number of Leaves

Observation on the number of leaves of pakcoy plants from various ages of observation showed that various planting media had a significant effect on the number of leaves of pakcoy plants at the age of 1 WAP, 2 WAP, 3 WAP and 4 WAP. The average number of leaves of the pakcoy plant at various ages of observation is presented in Table 2.

C. Plant Fresh Weight

Data on the fresh weight of the pakcoy plants showed that various types of growing media had a significant effect on the fresh weight of the pakcoy plants. The average fresh weight of pakcoy plants is presented in Table 3.

TABLE 1. AVERAGE PAKCHOY PLANT HEIGHT (CM) ON VARIOUS TYPES OF GROWING MEDIA.

Treatments	Average plant height (cm)			
	1 WAP	2WAP	3WAP	4WAP
P1	4,5 ^{ab}	10,75 ^b	17,5 ^b	23,25 ^b
P2	2,5 ^a	6,25 ^a	12,25 ^a	17,75 ^a
P3	5,5 ^b	10,75 ^b	17,25 ^b	22 ^b
P4	6,5 ^b	11,75 ^b	19 ^b	23,5 ^b
P5	5,5 ^b	11,75 ^b	17,5 ^b	22,25 ^b
HSD 5%	2,79	3,16	3,21	2,8

Note: Numbers followed by the same letter in the same column indicate that the treatment is not significantly different at the 5% test level.

TABLE 2. AVERAGE NUMBER OF PAKCHOY PLANT LEAVES ON VARIOUS TYPES OF GROWING MEDIA.

Treatments	Average number of leaves			
	1 WAP	2 WAP	3 WAP	4 WAP
P1	4 ^{ab}	7,25 ^{ab}	9,50 ^{ab}	14,25 ^b
P2	3 ^a	5,75 ^a	8,25 ^a	11,25 ^a
P3	3,75 ^{ab}	6,75 ^{ab}	9,50 ^{ab}	14,75 ^b
P4	4,25 ^{ab}	7,50 ^{ab}	11,25 ^b	16,50 ^b
P5	4,50 ^b	7,75 ^b	10,25 ^{ab}	14,75 ^b
HSD 5%	1,26	1,67	2,37	2,50

Note: Numbers followed by the same letter in the same column indicate that the treatment is not significantly different at the 5% test level.

TABLE 3. AVERAGE FRESH WEIGHT OF PAKCHOY PLANTS (G) IN VARIOUS TYPES OF PLANT MEDIA.

Perlakuan	Berat Segar (g)	HSD 5%
P1	78,5 ^{ab}	
P2	41,5 ^a	
P3	80,75 ^b	37,03
P4	94,75 ^b	
P5	80,25 ^b	

Note: Numbers followed by the same letter in the same column indicate that the treatment is not significantly different at the 5% test level.

C. Root Length

Observation data on the length of the roots of the pakcoy plant showed that various types of planting media had no significant effect on the length of the roots of the pakcoy plant.

D. Root Weight

Data on the weight of the roots of the pakcoy plants showed that various types of planting media had a significant effect on the weight of the roots of the pakcoy plants. The average weight of pakcoy plant roots is presented in Table 4.

E. Shoot Fresh Weight

Data on the fresh weight of the pakcoy shoots showed that various types of planting media had a significant effect on the fresh weight of the pakcoy shoots. The average fresh weight of the pakcoy plant canopy is presented in Table 5.

F. Root Volume

Observation data on plant root volume showed that various types of planting media did not significantly affect the root volume of pakcoy plants.

TABLE 4. AVERAGE WEIGHT OF PAKCHOY PLANT ROOTS (G) IN VARIOUS TYPES OF PLANT MEDIA.

Treatments	Root weight (g)	HSD 5%
P1	15,75 ^b	
P2	6,25 ^a	
P3	13,5 ^{ab}	8,59
P4	15,5 ^b	
P5	13,5 ^{ab}	

Note: Numbers followed by the same letter in the same column indicate that the treatment is not significantly different at the 5% test level.

TABLE 4. AVERAGE WEIGHT OF PAKCHOY PLANT SHOOT WEIGHT (G) IN VARIOUS TYPES OF PLANT MEDIA.

Perlakuan	Berat Segar tajuk (g)	HSD 5%
P1	62,75 ^{ab}	
P2	27,5 ^a	
P3	62 ^{ab}	35,71
P4	72 ^b	
P5	61,75 ^{ab}	

Note: Numbers followed by the same letter in the same column indicate that the treatment is not significantly different at the 5% test level.

IV. DISCUSSION

The results showed that rockwool growing media gave better growth and yield on the root weight of the pakcoy plant with an average value of 15.75 (g) and the root volume of the pakcoy plant with an average value of 25.75 cm³. In the planting medium, areca nut husk gives better growth and yield on plant fresh weight with an average value of 94.75 g and shoot fresh weight with an average value of 72 g. Areca nut husk planting media also provides better growth and yield of pakcoy plant height with an average value at 1 WAP age of 6.5 (cm), at 2 WAP age of 11.75 (cm), at 3 WAP age of 19 (cm), at the age of 4 WAP which is 23.5 cm and the number of leaves has an average value of 11.25 at the age of 3 WAP and 16.5 at the age of 4 WAP. While the rice husk charcoal planting media gave better growth and yield on the root length of the pakcoy plant with an average value of 20.25 cm and the number of leaves at the age of 1 WAP with an average value of 4.5 and 2 WAP with an average value -the average is 11.75.

This type of rockwool growing media provides better growth and yield on root weight and root volume of pakcoy plants. Areca nut husk growing media gave better growth and yield of plant height, plant fresh weight, crown fresh weight and number of leaves at 3 WAP and 4 WAP. Rice husk charcoal growing media gave better growth and yield on root length and number of leaves at the age of 1 WAP and 2 WAP. It is suspected that rockwool, areca nut and rice husk charcoal planting media have advantages in terms of porous media and good aeration, therefore do not have the potential to cause disease, and do not interfere with the absorption of water and nutrients by the roots [9].

Based on several hydroponic studies that have been carried out, it shows that various types of growing media affect plant growth and yield. Different nutrients and growing media give different results on plant growth and yield. A good planting medium must have requirements as a place for plants to stand, have the ability to bind water and supply the nutrients needed by plants, be able to control excess water and have good circulation and air availability, and it can retain moisture around plant roots [10].

Rockwool has a large number of particle substrates and has good drainage so that it is easier for roots to absorb water and nutrients. Pakcoy plants with rockwool growing media fed with 1000 ppm nutrients have been effective because they have been shown to increase plant height, number of leaves, leaf length and root length. The results of

pakcoy plants were obtained at 1200 ppm nutrition using rockwool growing media, namely at a plant height of 20 cm at 28 days of age and 12 leaves at 28 days of age. This is because the rockwool planting medium has the nutrients phosphorus and potassium so that it can help during photosynthesis.

Areca nut husk has the potential to be used as a planting medium and as a raw material for making liquid organic fertilizer. Areca nut powder has potential to be used as a planting medium and compost raw material. The level of availability of raw material for areca nut powder is also very adequate for use as a planting medium and for making organic fertilizer. Areca nut husk has a fiber that is similar to wood fiber.

Rice husk charcoal media is a good medium for binding nutrient solutions compared to raw husk and sand media. The ability of the media to store these nutrients will affect the availability of nutrients in the media. Low nutrient availability will hamper plant physiological processes. The results of observing the number of leaves of the pakcoy plant were the most abundant in the treatment of the composition of the rice husk charcoal planting medium. Rice husk charcoal as a planting medium that easily binds water, does not rot easily, is a source of potassium needed by plants and does not easily agglomerate or condense so that plant roots can grow perfectly compared to plants using cotton and rockwool growing media [10].

The treatment of the composition of the planting media gave valuable results different at each plant age. In terms of plant length, the number of leaves on the plant, and the final weight on the plant. Each planting medium has its own advantages and disadvantages[5].

IV. CONCLUSIONS

It can be concluded that the treatment of the planting medium had a significant effect on the plant height, number of leaves, plant fresh weight, root weight and shoot fresh weight, but root length and root volume had no significant effect. Rockwool and rice husk charcoal growing media gave better growth and yield. Meanwhile, sponge growing media gave the lowest growth for all observation variables.

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