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Effect of Composition Growing Media and Nutrient Solution for Growth and Yield Pakcoy (Brassica rapa L. *Chinensis*) in Hydroponic Substrate

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ABSTRACT

Pakcoy (*Brassica rapa* L. *Chinensis*) is a vegetable plant that can cultivated in hydroponics system. On hydroponic substrate cultivation, compotition of growing media and nutrient solution are the factors that affect growing plant and yield determinant. However, the prices of nutrient solution relatively expensive become obstacle for people. Therefore, alternative nutrient solution is required. The purpose of the research is to know the suitable compotition of growing media and nutrient solution on growth and yield pakcoy in hydroponic substrate. This research conducted in Tegalweru village Dau Malang from February until July 2016. The research was using factorial randomized block design with 3 replications. First factor were composition of growing media consist of 3 levels: (M1) sand and rice husk 1:1, (M2) sand and cocopeat 1:1, and (M3) sand, rice husk and cocopeat 1:1:1. Second factor were nutrient solution consisting of 5 levels: (P0) AB Mix 100%, (P1) T. diversifolia liquid manure 25% + cow liquid manure 75%, (P2) T. diversifolia liquid manure 50% + cow liquid manure 50%, (P3) cow liquid manure 50% + AB Mix 50%, and (P4) T. diversifolia liquid manure 25% + cow liquid manure 25% + AB Mix 50%. The result of this research showed that using composition of growing media M1 had higher result to lenght of plant and stem diameter than growing media M2. Using composition of the growing media M1 showed higher result to number of leaf, than growing media M3. Nutrient solution P3 and P4 significantly affect to lenght of plant higher than nutrient solution P0.

Keywords: Pakcoy, Hydroponics, Growing media, Nutrient solution.

INTRODUCTION

Pakcoy (*Brassica rapa* L. *Chinensis*), including a short-lived plant and contains many nutrients that we needs in every day life, one of them is beta carotene. On 100 grams (3.53 oz) pakcoy plants contain a variety of nutrients and vitamins that are needed by the body: proteins (25%), potassium (6%), calcium (36%), iron (15%), vitamin A (7%), as well as vitamin C (9%). Nowdays, the public demands of pakcoy vegetable are increases. According to the Directorate General of Horticulture (2015), vegetable needs in Indonesia was 10.12 million tons/year, while production was only 6.3 million tons/year. The availability of vegetable production should be enhanced through farming technologies. Hydroponic substrate is one of technology that could increase the production of pakcoy. Cultivation using hydroponic substrate are planting in medium that is not soil, nutrient solution given by watering directly or through the emitter-containing nutrients with an equivalent amount of the essential components required for the plant growth (Sumartono and Sumarni, 2013). Growing medium is a factor that affects crop production systems hydroponic substrate. Plant growth can not be separated from the growing environmental factors, especially the growing medium that will directly affect crop yield (Silvina and Syafrinal, 2008). Nutrient solution is also one of the most important factor for determining the yield and quality in hydroponic cultivation. However the price of hydroponic nutrient are relatively expensive for the community. Therefore, it required alternative nutrients for hydroponic by utilizing multiple sources of nutrients that are relatively economical. The organic materials such as liquid fertilizer T. diversifolia and liquid cow manure are the

solutions to supply nutrient which is need in hydroponic farming system.

MATERIAL AND METHODSD

The research was conducted from May to July 2016 in the Venus Orchid greenhouse, Tegalweru village, Sub-district Dau, Malang with altitude ± 700 meter above sea level. The tools were used in this research such as; measuring glass, labels, drum, LAM (Leaf Area Meter), pH-meter, EC-meter, chlorophyll meter (SPAD), calipers, seed tray, analytical balance, camera, and stationery. The materials were used in this research consist of polybag size of 15 x 15 x 20 cm, rice husk, sand, cocopeat, rockwool, AB Mix ideal, T. diversifolia liquid manure, cow liquid manure, seed varieties pakcoy , and water. The research was design in Factorial Randomized Block design. The first factor were the composition of the planting medium with 3 levels, consist of; M1 (sand and rice husk 1: 1), M2 (sand and cocopeat 1: 1), and M3 (sand, rice husk and cocopeat 1: 1: 1). The second factor were nutrient solution with 5 level of the P0 (AB Mix 100%), P1 (T. diversifolia 25% + Cow Manure 75%), P2 (T. diversifolia 50% + Cow Manure 50%), P3 (Cow liquid manure 50% + AB Mix 50%) and P4 (T. diversifolia liquid manure 25% + Cow liquid manure 25% + 50% AB ideal Mix). Each experiment was repeated 3 times on each treatment, there were 6 polybags so that the total amount were 270 polybags.

Pakcoy plant data was divided into growth and yield observations. Growth observations were include observations length of plants and number of leaves, which done when the plant at age observation 8, 15, 22, 29, 36, 43, 50 DAP. Observations were conducted during harvest for yield observation data that include: plant stem diameter (mm), chlorophyll content, root length (cm), total fresh weight per plant (g), and the fresh weight for consumption per plant (g). Data results were analyzed using analysis of variance (F test) at 5% level. If the result was significantly different, then continued with HSD test at 5% level.

RESULTS AND DISCUSSION

Interaction between Growing Media Composition and Nutrition Solution on the Growth and Yield of Pakcoy

Treatment of growing media composition and nutrient solution showed no significant interaction on growth and yield of plants in hydroponic substrate pakcoy.

Effect of Media Composition Planting on Plant Growth and Yield Pakcoy

Treatment of growing media composition provides significant effect on the length of the plant, number of leaves and stem diameter. The composition of the media M1 (sand and rice husk 1: 1) provide higher yields than M2 (sand and cocopeat 1: 1) to the length of the plant and stem diameter (Table 1 and Table 3). The composition of the growing media M1 (sand and rice husk 1: 1) higher number of leaves than the M3 (sand, rice husk and cocopeat 1: 1: 1) (Table 2).

The composition of growing media such as sand and rice husk are able to provide good aeration and drainage, because the character of the growing media and porous charcoal lighter chaff. The composition of the growing media of sand and rice husk when splashed with water will retain moisture but not water saturated. Tejasarwana *et al*, (2009) stated rice husk is a good media to bind the nutrient solution rather than raw rice husks and sand media, because the rice husk has the character for good drainage, high permeability, and a good porosity in plant roots. Results of research Perwitasari *et al*. (2012), also showed that the combination treatment of rice husk with nutrients give good results on plant growth pakcoy.

On the second treatment using cocopeat growing media, less sterile cocopeat used in processing could affect plant growth. Silvina and Syafrinal (2008) stated cocopeat growing media which were used as planting media was formed from the coconut coir processing waste material. Sterilization cocopeat performed to remove the tannin substances that can inhibit plant growth.

Effect of Addition Nutrient Solutions on Pakcoy Growth and Yield

Treatment with nutrient solution significantly affect the length of the plant at the age of 29 DAP (Table 1). The plant length of treatment nutrient solution P3 (Cow Liquid Manure 50% + AB Mix 50%) and P4 (*T. diversifolia* Liquid Manure25% + Cow Liquid Manure 25% + AB Mix ideal 50%) higher than the treatment nutrient solution P0 (AB Mix 100%), but not significantly different from the treatment P1 (*T. diversifolia* Liquid Manure 25% + Cow Liquid Manure 75%) and P2 (*T. diversifolia* Liquid Manure 50% + Cow Liquid Manure 50%). Furthermore, the observation did not significantly affect the length of the plant.

Effect of addition nutrient solutions on pakcoy were significantly influence at age 29 DAP due to the elements contained in the nutrient solution are complete and available for plants to absorb it. It is suspected that the treatment P3 and P4 that had cow liquid manure as nutrient solution was still on a process of decomposition. According to Sukawati (2010), stated the process of decomposition organic matter carried out by microorganisms or bacteria has two functions for microflora, which is to provide energy for its growth and supplying carbon to form new cells. Decomposition of organic matter is determined by internal factor which is the organic material itself and external factors which is metabolism and the growth of microorganisms. This condition consistents with the research of Abdillah (2016), reduction doses of fertilizer AB mix by adding *T. diversifolia* liquid manure and cow liquid manure had a maximum results in composition 25% cow liquid manure + 25% *T. diversifolia* liquid manure + 50% AB mix. According to Nurrohman (2014), media *T. diversifolia* liquid manure could substitute hydroponics nutrients. Combinations *T. diversifolia* fermentation media and AB mix Joro could affect the consumption fresh weight of mustard.

The research of Adelia, *et al* (2013) stated that the use of *T. diversifolia* liquid manure combined with addition of micronutrients Fe on Red *Amaranthus* plants affect the number of leaves, stem diameter, root length and length of plant. Nutrient solution treatment were not significantly affect the number of leaves, stem diameter, root length, chlorophyll content, total fresh weight per plant and consumption of fresh weight per plant (Table 2, Table 3 and Table 4).

Table 1. The length of the treatment plant pakcoy growing media composition and nutrition solution

Treatment	Length of Plant (cm) at Observation Periods (DAP)						
	8	**15**	**22**	**29**	**36**	**43**	**50**
Composition of Growing Media							
M1 (Sand and Rice husk 1:1)	5,33 b	7,46 b	9,10 b	11,94 b	14,91 b	18,08 b	20,21 b
M2 (Sand and *Cocopeat* 1:1)	4,45 a	6,32 a	7,67 a	10,57 ab	13,13 a	15,59 a	17,34 a
M3 (Sand, Rice husk and Cocopeat 1:1:1)	4,16 a	5,91 a	7,31 a	10,38 a	13,23 a	16,08 ab	18,17 ab
HSD 5%	0,72	0,98	0,40	1,51	1,64	2,11	2,78
Nutrient Solution							
P0 (AB Mix 100%)	4,67	6,43	7,63	10,11 a	13,47	16,62	18,37
P1 (T. diversifolia 25% + Cow Manure 75%)	4,54	6,50	8,07	10,44 ab	14,59	17,24	19,39
P2 (T. diversifolia 50% + Cow Manure 50%)	4,70	7,01	8,67	10,73 ab	14,18	16,66	18,94
P3 (Cow Manure 50% + AB Mix 50%)	4,75	6,55	8,04	11,66 b	13,59	16,52	18,34
P4 (T. diversifolia Manure 25% + Cow Manure 25% + AB Mix 50%)	4,58	6,34	7,71	11,85 b	12,96	15,88	17,82
HSD 5%	tn	tn	tn	1,45	tn	tn	tn

Table 2. The number of leaves on the treatment plant media composition and nutrition solution

Treatment	Number of Leaves (leaf) at Observation Periods (DAP)						
	8	**15**	**22**	**29**	**36**	**43**	**50**
Composition of Growing Media							
M1 (Sand and Rice husk 1:1)	3,00 b	3,90 b	4,64 b	5,76 b	7,21 b	9,12 b	10,57
M2 (Sand and *Cocopeat* 1:1)	2,61 ab	3,61 ab	4,46 ab	5,46 ab	6,85 ab	8,77 ab	10,16
M3 (Sand, Rice husk and Cocopeat 1:1:1)	2,51 a	3,42 a	4,32 a	5,30 a	6,75 a	8,61 a	10,11
HSD 5%	0,39	0,41	0,31	0,44	0,42	0,39	tn
Nutrient Solution							
P0 (AB Mix 100%)	2,72	3,57	4,52	5,62	6,88	8,81	10,38
P1 (T. diversifolia 25% + Cow Manure 75%)	2,81	3,74	4,50	5,48	6,98	8,88	10,29
P2 (T. diversifolia 50% + Cow Manure 50%)	2,75	3,77	4,54	5,61	6,94	8,85	10,25
P3 (Cow Manure 50% + AB Mix 50%)	2,68	3,55	4,41	5,37	6,90	8,87	10,22
P4 (T. diversifolia Manure 25% + Cow Manure 25% + AB Mix 50%)	2,55	3,57	4,41	5,44	6,98	8,75	10,24
HSD 5%	tn	tn	tn	tn	tn	tn	tn

Remarks : Numbers followed by the same letter in rows and columns in each age observation showed no significant differences based on HSD test at 5% level; tn = not significant; DAP = days after planting.

Table 3. Stem diameter, length roots and chlorophyll content in media composition treatment plant and nutrition solution

Treatment	Stem Diameter (mm)	Length Roots (cm)	Chlorophyll Content
Composition of Growing Media			
M1 (Sand and Rice husk 1:1)	5,46 b	29,21	31,87
M2 (Sand and *Cocopeat* 1:1)	4,65 a	28,16	30,76
M3 (Sand, Rice husk and Cocopeat 1:1:1)	4,96 ab	28,25	30,91
HSD 5%	0,80	tn	tn
Nutrient Solution			
P0 (AB Mix 100%)	5,04	29,09	31,71
P1 (*T. diversifolia* 25% + Cow Manure 75%)	5,11	28,78	31,67
P2 (*T. diversifolia* 50% + Cow Manure 50%)	4,92	28,34	31,43
P3 (Cow Manure 50% + AB Mix 50%)	5,03	28,51	30,62
P4 (*T. diversifolia* Manure 25% + Cow Manure 25% + AB Mix 50%)	5,00	28,01	30,47
HSD 5%	tn	tn	tn

Remarks : Numbers followed by the same letter in rows and columns in each age observation showed no significant differences based on HSD test at 5% level; tn = not significant; DAP = days after planting.

Nutrient solution treatment were not significantly affect the number of leaves, stem diameter, root length, chlorophyll content, total fresh weight per plant and consumption of fresh weight per plant (Table 2, Table 3 and Table 4). Concentrations of the nutrient solution also affect the growth and yield pakcoy when using hydroponic substrate, because the concentration of nutrient solution can affect metabolism in plant organs, such as the speed of photosynthesis and the potential for ions absorption by the plant roots. Subandi *et al.,*

Table 4. Total fresh weight per plant and consumption of fresh weight per plant weights in growing media composition and nutrition solution

Treatment	Total Fresh Weight per Plant (g)	Consumption of Fresh Weight per Plant (g)
Composition of Growing Media		
M1 (Sand and Rice husk 1:1)	57,66	52,65
M2 (Sand and *Cocopeat* 1:1)	50,49	44,98
M3 (Sand, Rice husk and Cocopeat 1:1:1)	49,04	42,78
HSD 5%	tn	tn
Nutrient Solution		
P0 (AB Mix 100%)	60,01	57,94
P1 (T. diversifolia 25% + Cow Manure 75%)	51,45	44,74
P2 (T. diversifolia 50% + Cow Manure 50%)	51,79	46,24
P3 (Cow Manure 50% + AB Mix 50%)	50,29	43,49
P4 (T. diversifolia Manure 25% + Cow Manure 25% + AB Mix 50%)	48,46	41,59
HSD 5%	tn	tn

Remarks : Numbers followed by the same letter in rows and columns in each age observation showed no significant differences based on HSD test at 5% level; tn = not significant; DAP = days after planting.

reported that of a nutrient solution based on the EC value could affect the growth and yield of spinach on floating hydroponics because there is an EC showing the highest results at value EC 3.0 mS / cm.

According Sukawati (2010), the higher salt content contained in organic nutrients solution and water could make the EC value higher. High salt concentrations can damage the plant roots and interfere nutrient and water uptake by plant roots. Solution outside of a cell is called hypertonic if it has a greater concentration of solutes than the cytosol inside the cell. When a cell is immersed in a hypertonic solution, osmotic pressure tends to force water to flow out of the cell in order to balance the concentrations of the solutes on either side of the cell membrane. Therefore, the higher EC could damage the plant root system.

The nutrient content also affects the growth and yield of pakcoy on hydroponic substrate, because the nutrient solution is one of the most important determining factor on the yield and quality in hydroponic system. Perwitasari *et al.,* (2012), stated solution for hydroponic media should be rich in nutrients for plant growth. In vegetative growth, which is shown by indicator length of plant, the nutrient whose role is nitrogen. Plants that lack in nitrogen, the growth will be stunted and also the resistance to disease become low. According Motaghi and Nejad (2014), potassium has role in photosynthesis, osmotic adjustment, regulate the aperture of stomata, cation-anion balance, and the accompanying cations in the transfer of nitrogen. Warganegara *et. al* (2015), showed that the addition of nitrogen in the hydroponic cultivation techniques of concentration of 200-300 ppm boost growth variables such as, plant height, root length, and fresh weight of the plant.

CONCLUSION

The composition growing media M1 (sand and rice husk, 1: 1) showed the highest value on length of the plant and stem diameter compared with the composition of M2 growing media (sand and cocopeat, 1: 1). The composition growing media M1 (sand and rice husk, 1: 1) showed the number of leaves was higher than and M3 (sand, rice husk, cocopeat 1: 1: 1). The nutrient solution P3 (cow liquid manure 50% + AB Mix 50%) and P4 (*T. diversifolia* liquid manure 25% + cow liquid manure 25% + AB Mix ideal 50%) showed length of plants had higher value than treatment nutrient solution P0 (AB Mix 100%).

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