4 GROWTH RESPONSE OF PAKCOY (Brassica rapa L.) WITH HYDROPONIC APPLICATION OF LIQUID ORGANIC FERTILIZER FRUIT WASTE

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Submission date: 27-Apr-2023 02:05PM (UTC+0700)
Submission ID: 2076969900
File name: GROWTH_RESPONSE_OF_PAKCOY_Brassica_rapa.pdf (193.49K)
Word count: 4286
Character count: 21380

TRANSPUBLIKA INTERNATIONAL RESEARCH
IN EXACT SCIENCES
(TIRES)
VOLUME 1 ISSUE 2 (2022)

GROWTH RESPONSE OF PAKCOY (*Brassica rapa* L.) WITH HYDROPONIC APPLICATION OF LIQUID ORGANIC FERTILIZER FRUIT WASTE

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Abstract

Research on the application of fruit waste liquid organic fertilizer to the growth of pakcoy plants (Brassica rapa L.) has been carried out. The purpose of this study was to determine the growth response of the pakcoy plant (Brassica rapa L.) to the application of liquid organic fertilizer from fruit waste at various concentrations hydroponically and to determine the best concentration of liquid organic fertilizer for the research results. The design of this study used CRD (Completely Randomized Design) with experimental data collection methods. This research was conducted with one control treatment, 5 treatments and 4 replications namely D0 (100% AB mix), D1 (25%), D2 (40%), D3 (55%), D4 (70%) and D5 (85%). Data were analyzed statistically through ANOVA test and followed by 5% DMRT test. Based on the research results obtained, the application of liquid organic fertilizer from fruit waste had a significant effect on the growth response of pakcoy plants (Brassica rapa L.). This can be seen in the best treatment found in treatment D5 (85%), as evidenced by the highest average result of fruit waste liquid organic fertilizer at plant height: 22.075 cm, number of leaves: 20.25 leaves and fresh weight: 41. 25 gr/plant. Thus, the use of fruit waste as a POC affects the effectiveness of pakcoy growth.

Keywords: Fruit Waste, Organic Fertilizer, Pakcoy Plant (Brassica rapa L)

1. INTRODUCTION

Liquid organic fertilizer is the result of the decomposition of organic matter and comes from waste or plant residues, animal residues and its nutritional content is more than one element (Prasetyo & Evizal, 2021). Fermentation in the manufacture of liquid organic fertilizer is a process of decomposing or improving basic organic matter which is carried out under certain conditions by microorganisms called bioactivators (Suprihatin, (2011) in (Laginda et al., 2017)).

Fruit waste is waste that is dumped in open dumps without further processing, causing environmental pollution and unpleasant odors (Jalaluddin et al., 2017). According to Yansari et al. (2021), "organic materials can be recycled by microbes by means of fermentation, so that nutrients such as N, P and K are obtained which have potential for the growth and yield of cultivated plants". The selection of raw materials derived from waste banana and pineapple peels is due to their abundant availability in markets and fruit shops.

Banana peel contains nutrients that function for plant growth and development. These nutrients are N, P, K, Ca, Mg, Na, Zn. These elements affect plant productivity (Soeryoko,

2011). As said by Susetya (2012), and Allita et al. (2018) "because of its many component contents, banana peel has good potential to be used as organic fertilizer from natural ingredients". Pineapple skins contain carbohydrates and sugar which are quite high, so pineapple skins can be used as raw material for making liquid organic fertilizer (Parintak, 2018).

In Kalimantan itself, the productivity of vegetable crops, especially pakcoy, is generally still very low. This can be caused by several factors, namely farmers' farming techniques that are still not intensive, climatic factors and low soil fertility. Pakcoy production can be increased by using good cultivation practices, such as organic fertilizers. Fertilization is done to meet the nutritional needs of plants in order to obtain high yields.

Utilization of fruit waste from banana and pineapple peels as organic fertilizer is difficult due to the high cost of AB Mix, so additional nutrients are needed for hydroponic nutrition. The hydroponic system is a cultivation method that utilizes water for the fulfillment of nutrients in plants (Alviani, 2015). Hydroponic systems have various types, one type that can be used is the wick system. The advantage of the hydroponic system is that it can plant in narrow areas (Subandi et al. (2015) in (Istiqomah et al., 2022)).

Fruit waste, which is usually considered unused, can in fact be used as a nutrient for plant growth. Banana and pineapple peel waste can be used as liquid fertilizer or as a nutrient solution for plant growth.

Based on the background and studies that have been carried out, further research is needed regarding the application of liquid organic fertilizer from fruit waste and the growth response of the Pakcoy plant (*Brassica rapa* L.).

2. RESEARCH METHOD

This research was carried out for ± 2 months starting from June to August 2022. In this research, it was carried out in two different places for the manufacture of fruit waste liquid organic fertilizer it was carried out at the Integrated Natural Sciences Laboratory and for the trial phase it was carried out at the Bioproduct Laboratory of FKIP ULM Banjarmasin. This type of research was an experimental research with Completely Randomized Design/CRD method. The technique in this study used complete randomization with different concentrations of fruit waste. Experiments were carried out by giving different treatments. In the treatment of different concentrations, fruit waste was given with concentrations of 25%, 40%, 55%, 70% and 85% which were given to the pakcoy plants.

Tool preparation was carried out including the tools used in this study, namely digital scales, measuring cups, blenders, knives, plastic buckets, plastic funnels, jigsaws, filters, trays, hacksaws, binder clips, hydroponic installations, netpots, TDS meters and rulers. The materials used in this study were fruit waste from banana and pineapple peels, water, brown sugar, EM4, Rockwool, flannel cloth, AB mix nutrition, pakcoy seeds, black plastic and water. The procedure for making liquid organic fertilizer from fruit waste is as follows: first, prepare all the ingredients and weigh all the ingredients to be used according to the dosage; second, cut the banana peels and pineapple peels into small pieces with a knife; third, put the water and brown sugar into a 2000-ml measuring cup, stirring until the brown sugar dissolves in the water; fourth, put the banana peels and pineapple peels that have been cut into the sugar solution; fifth, add the EM4 liquid and stir until smooth then transfer the

ingredients that were ready earlier into the fermentation container and let stand for 14 days. After the fermentation process is complete, filter the fermented results until the dregs and liquid are separated. Then the filtrate is ready for use, then repeating the work steps to make different concentrations. Application of fruit waste liquid organic fertilizer to pakcoy plants with varying concentrations according to treatment. Growth parameters were measured based on plant height, number of leaves and fresh weight of plants which were observed once a week in a month for 4 times.

3. RESULT AND DISCUSSION

The results of the study conducted showed the production of liquid organic fertilizer from fruit waste on the growth parameters of pakcoy (*Brassica rapa* L.)

3.1. Results of Fruit Waste Liquid Organic Fertilizer Analysis

Based on the analysis results of liquid organic fertilizer containing macronutrients nitrogen (N), phosphorus (P) and potassium (K) in fruit waste liquid organic fertilizer can be seen below.

Table 1 Macronutrient Content of Fruit Waste Liquid Organic Fertilizer

Sample Code	N-total	P2O5 ---%---	K2O
D1	0,063	0,192	0,295
D2	0,081	0,224	0,212
D3	0,094	0,242	0,174
D4	0,099	0,396	0,128
D5	0,112	0,405	0,103

The fermented organic waste liquid fertilizer is brownish in color, has white patches, and smells pungent like the aroma of tapai. The fermentation process produces by-products in the form of unpleasant-smelling gases such as ammonia and hydrogen sulfide. This is consistent with the views of Warjoto & Barus (2021), who claim that "the fermentation process is successful because there are white spots, which indicate the presence of microorganisms that decompose organic waste and manage to live on the surface".

3.2. Result of Fruit Waste Liquid Organic Fertilizer on Growth Parameters

Based on the results of the research conducted, data were obtained on plant height, number of leaves, and plant wet weight.

3.2.1. Pakcoy Plant Height

Plant height was measured once a week. Of the 6 treatments, 4 repetitions were carried out. So that the plant height data is obtained in the following table:

Table 2 Difference Data and Mean Observation Results of Plant Height

Treatment	Difference				Amount	Average
	P1	P2	P3	P4		
D0	24	23,8	23	22,5	93,3	23,325
D1	17	17,5	16,8	16,5	67,8	16,950
D2	18,3	18,5	17	18	71,8	17,950
D3	19,5	19,5	19	18,5	76,5	19,125
D4	20,8	21,8	21,5	20	84,1	21,025
D5	22,3	22,5	22	21,5	88,3	22,075
Amount					481,8	120,45

Based on the total plant height above, it can be seen that the highest plant is found here in the D5 treatment with a concentration of 85% in the application of fruit waste liquid organic fertilizer to pakcoy plants.

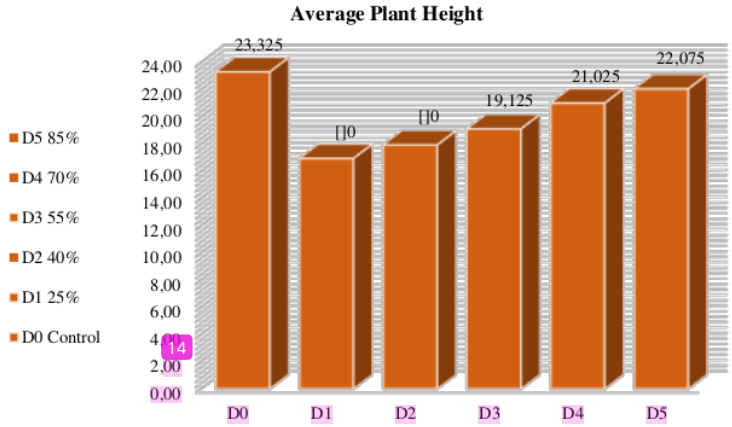

Figure 1 Graph of Average Plant Height

The data from the graph shows that the height growth of the pakcoy plant (*Brassica rapa* L.) on the application of fruit waste liquid organic fertilizer gave the best results, namely in the D5 treatment with a concentration of 85% with an average amount of 22.075 cm and not much different from the D0 treatment (control). with an average amount of 23.325 cm, this is because the content of fruit waste liquid organic fertilizer in treatment D5 is sufficient to meet the needs of the pakcoy plant and provide results that are not much different from AB Mix nutrition.

The highest pakcoy plant height in the POC treatment was in the D5 treatment (85%), the macronutrient content of the fertilizer was sufficient to meet the needs of the pakcoy plants. Differences in pakcoy plant height can also be caused by differences in the nutrient content of liquid organic fertilizer containing nitrogen, phosphorus and potassium in plant waste. This is in accordance with the opinion of Murbandono (1982) that "when sufficient nutrients are available, the plants that grow produce optimal production".

Data is processed with statistical calculations to prove the hypothesis that has been proposed before. Plant height data met the assumption test requirements in terms of normality and homogeneity. Next, an ANOVA test was carried out. The results of the ANOVA test are shown in the following table:

Table 3 ANOVA Test Results for Plant Height

SK	DB	JK	KT	Fstatistic	Ftable 5%
Treatment	5	117.464	23.493	50.81	2.77
Error	18	8.323	1.462		
Total	23	125.786	-		

Table 3 above shows that Fstatistic > FTabel at a significant level of 5%, namely 50.81 > 2.77 or sig. < 0.05 means significantly different or liquid organic fertilizer from fruit waste affects the height growth of pakcoy plants (*Brassica rapa* L.) The analysis of the calculation results shows that the D5 treatment with a concentration of 85% has the most effective effect.

The results of the ANOVA analysis show that the height of the pakcoy plant has a significant effect. This means that H1 is accepted and H0 is rejected, then it is continued with the DMRT (Duncan Multiple Range Test) at 5%.

Table 4 Duncan Test Results for Pakcoy Plant Height

Treatment	Average Plant Height
D0	23,325^{c}
D1	16,950^{a}
D2	17,950^{a}
D3	19,125^{a}
D4	21.025^{b}
D5	22,075^{bc}

Based on the results of the Duncan Test at 5% level, that liquid organic fertilizer from fruit waste had a significantly different effect on the height of the pakcoy plants. Table 4. Further test results showed that the growth in height of the D0 treatment plants was not significantly different from the D5 treatment, but significantly different from the D1, D2, and D3 treatments. The notation of the letter "a" is the smallest growth and the notation of the letter "c" is the largest growth. Whereas the same letter notation as in treatments D5 and D0 (control) shows that the two treatments are not significantly different or have a significant difference.

3.2.2. Number of Pakcoy Plant Leaves

Observation on the number of leaves of the pakcoy plant is by observing the pakcoy leaves which have opened perfectly.

Table 5 Data and Mean Yields of the Number of Pakcoy Plant Leaves

Treatment	Difference				Amount	Average
	P1	P2	P3	P4		
D0	22	22	21	20	85	21,25
D1	15	16	14	14	59	14,75
D2	17	16	16	15	64	16,00
D3	18	18	17	16	69	17,25
D4	19	18	19	17	73	18,25
D5	22	21	19	19	80	20,25
Amount					428	107,75

Table 5 above shows that the highest average was obtained in treatment D5, namely the application of POC fruit liquid waste at a concentration of 85% in treatment D5 gave the best results. This can prove that the application of POC fruit waste affects the growth of pakcoy plants.

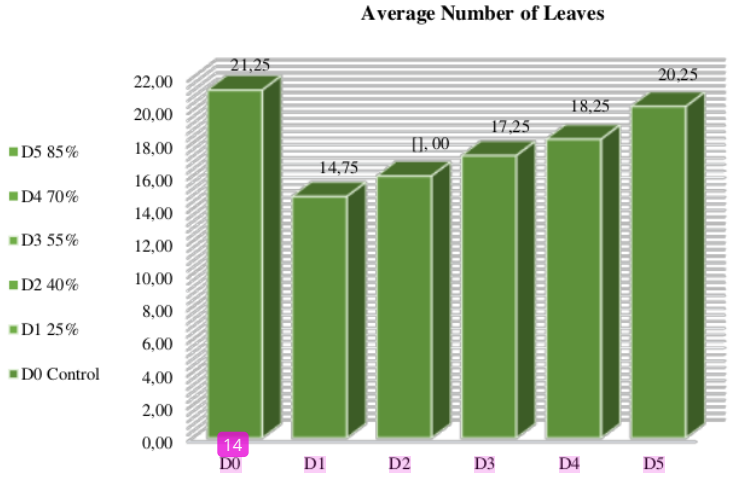

Figure 2 Graph of Average Number of Leaves

The data from the graph shows clearly that from one control treatment (D0) and 5 treatments, treatment D5 with a concentration of 85% with a total of 20.25 strands is the best concentration for applying liquid organic fertilizer to fruit waste.

Based on the data on the average number of leaves, the data was analyzed using ANOVA and a significant value was obtained from the number of leaves of the pakcoy plant. The following data analysis results are presented in the following table.

Table 6 ANOVA Test Results for Number of Leaves

SK	DB	JK	KT	Fstatistic	Ftable 5%
Treatment	5	104.708	20.942	16.21	2,77
Error	18	23.250	1.292		
Total	23	127.958	-		

Table 6 above shows that at Fstatistic > FTabel Fstatistic = 16.21 at a significant level of 5%, namely 16.21 > 2.77 or sig. < 0.05, it is significantly different or there is an effect on the growth of the number of leaves on the application of fruit waste liquid organic fertilizer.

Based on the results of the ANOVA analysis, it had a significant effect on the number of leaves of the pakcoy plant (*Brassica rapa* L). This means that H1 is accepted and H0 is rejected, followed by the DMRT (Duncan Multiple Range Test) at 5%.

Table 7 Duncan Test Results for Number of Pakcoy Plant Leaves

Treatment	Average Number of Leaves
D0	21,25[b]
D1	14,75[a]
D2	16,00[a]
D3	17,25[a]
D4	18,25[a]
D5	20,25[b]

Table 7 in treatment D0 was not significantly different from treatment D5, but significantly different from treatments D1, D2, D3 and D4. Different letter notations mean that each treatment experienced significant growth.

The results of the research on the most effective application of fruit waste liquid organic fertilizer on the number of leaves, namely a concentration of 85%. This shows that a concentration of 85% contains the elements nitrogen (N), phosphorus (P) and potassium (K) according to the needs of the pakcoy plant when compared to other concentrations. As Fairhurst et al. (2007) argue that "when plants are supplied with sufficient nitrogen, the need for other nutrients such as phosphorus increases to compensate for rapid plant growth".

The increase in the number of plant leaves is also related to the increase in plant height. As the plant grows, the number of growing points on the leaves increases, causing the leaves to grow. This is in accordance with the opinion of Utami et al. (2020), the number of leaves on a plant is directly proportional to the height of the plant, where the longer the plant grows, the more leaves are formed because the leaves emerge from the pakcoy stem segments.

3.2.3. Wet Weight of Pakcoy Plants

Observation on the wet weight is by weighing the wet weight when the plants are still alive and weighed directly after harvest. The average harvest period for Pakcoy (*Brassica rapa* L) based on observations is as follows:

Table 8 Average Data of Observations on Wet Weight of Pakcoy Plants

Treatment	Difference				Amount	Average
	P1	P2	P3	P4		
D0	45	44	43	42	174	43,50
D1	32	32	29	30	123	30,75
D2	34	33	34	32	133	33,25
D3	36	35	37	34	142	35,50
D4	38	38	37	37	150	37,50
D5	43	42	41	40	165	41,25
Amount					887	221,75

Based on the total plant weight above, it can be seen that the D5 treatment showed the best plant weight in the application of fruit waste liquid organic fertilizer.

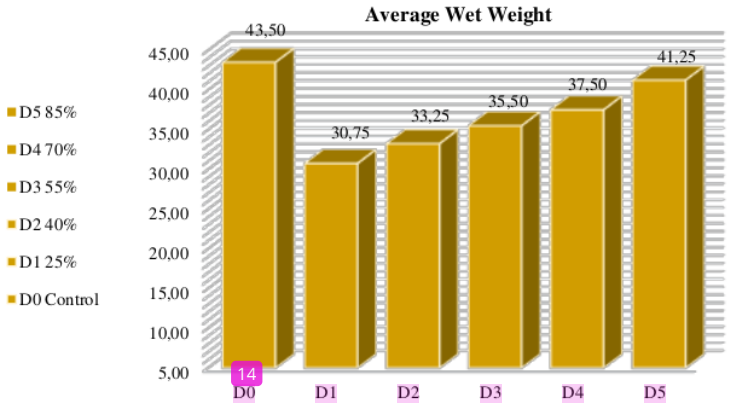

Figure 3 Graph of Average Wet Weight

From the graphic data above, it is known that the average fresh weight of pakcoy plants (*Brassica rapa* L.) shows that for all treatments the best average number is in treatment D5 which is almost close to the average number in the control treatment.

This demonstrates that the application of liquid organic fertilizer made from fruit waste at the highest concentration of 85% can have a positive effect on plants due to the nutrient content of fruit waste.

Based on the observed data on plant weight, the data was analyzed using ANOVA to obtain a significant value. The data from the analysis results are shown in the table below.

Table 9 ANOVA Test Results for Wet Weight

SK	DB	JK	KT	Fstatistic	Ftable 5%
Treatment	5	427.208	85.442	24.50	2.77
Error	18	62.750	3.486		
Total	23	489.958	-		

Table 9 above shows that at the 5% level Fstatistic > FTabel, Fstatistic = 24.50 > 2.77 or <0.05 this means significant or has an impact on the application of POC fruit waste to the wet weight of the pakcoy plant. The results of the analysis of statistical calculations showed that the D5 treatment showed the highest weight in the use of fruit waste POC compared to other treatments. This means that it gives a pretty good effect compared to the others.

Based on the results of the ANOVA analysis, it significantly affected the weight of the pakcoy (*Brassica rapa* L.) plant. This meant that H1 was accepted, H0 was rejected, followed by the DMRT (Duncan Multiple Range Test) at 5% level.

Table 10 Duncan Test Results for Wet Weight of Pakcoy Plants

Treatment	Average Wet Weight
D0	43,50^{c}
D1	30,75^{a}
D2	33,25^{a}
D3	35,50^{ab}
D4	37,50^{b}
D5	41,25^{c}

Table 10 shows that treatment D0 is the same as treatment D5, but significantly different from treatments D1, D2, while treatment D3 is not significantly different from D4. Different letter notations mean that each treatment experienced significant growth. The notation of the letter "a" is the lowest growth while the notation of the letter "c" is the highest growth. The results of Duncan's test calculations at the 5% level did not show any difference in the weight of the pakcoy plants in the treatment. This is because each plant has a nutrient limit, resulting in different weight differences between those given treatment and those given D0 treatment.

According to Utami et al. (2020), "the element nitrogen stimulates the production of auxin which softens the cell walls, increasing the process of water absorption due to pressure differences". This causes an increase in the size of the cell and the wet weight of the plant will be directly proportional because the cell elongates and expands.

According to Myer et al. (1994), "inappropriate nutrient intake results in an excess of nutrients even though the total intake equals the total requirement". If nutrient consumption exceeds plant requirements, there is a risk that these nutrients will be lost in an unavailable form.

4. CONCLUSION

Based on the result of the research that has been done, we can be conclude that:

1) The use of liquid organic fertilizer obtained from fruit waste has a significant effect on all growth parameters. Of all the treatments, the application of liquid organic fertilizer derived from fruit waste resulted in a response of vegetative growth parameters, namely height, number of leaves and fresh weight in pakcoy plants.
2) The best concentration accelerated the growth of pakcoy plants in this study with a concentration of 85% in treatment D5. The higher the concentration of liquid organic fertilizer, the faster plant growth will be.

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