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THE EFFECT OF LIQUID ORGANIC FERTILIZER FROM CABBAGE WASTE ON THE GROWTH OF PAKCOY (*Brassica rapa* L. Var. Chinensis)

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ABSTRACT

This study aims to determine the effect of liquid organic fertilizer from cabbage waste on the growth of mustard greens (*Brassica rapa* L. Var Chinensis). This research was conducted from March to May 2022 in Sukandebi Village, Naman Teran District, Karo Regency. This type of research is an experimental study with Non Factorial Completely Randomized Design, with 5 treatments and 5 replications. Analysis of research data used analysis of variance (ANOVA) with Duncan's multiple range test or Duncan's Multiple Range Test (DMRT). The parameters observed in this study were plant height, number of leaves, root length, fresh weight and dry weight. From the results of the study it was concluded that liquid organic fertilizer from cabbage waste had a significant effect on the observation of plant height, number of leaves, root length, fresh weight, and dry weight. The best growth of pakcoy mustard (*Brassica rapa* L. Var Chinensis), was at a dose of 500 ml/polybag. Meanwhile, the lowest growth of mustard greens (*Brassica rapa* L. Var Chinensis) was found in the control.

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Introduction

Pakcoy is a type of vegetable that is easy to find and the cultivation process is relatively easy and cheap. Easy cultivation allows pakcoy to be planted in polybags and the materials are easily obtained in the cultivation process. The materials and tools needed are still relatively cheap and affordable. The ingredients contained in 70 g of pakcoy are 1.5 g carbohydrates, 0.1 g fat, 1.1 g protein, 0.7 g fiber, and 9.1 g calories (Paulina, Lumbantoruan, & Septiani, 2020). Mustard greens or known as Pakcoy (*Brassica rapa* L.) is a leaf vegetable that has high economic value. This plant can also grow in the highlands and lowlands. In general, the productivity of vegetable crops, especially pakcoy, is still very low.

According to the Central Bureau of Statistics for North Sumatra Province (2015) mustard greens production during the period 2011 to 2014 decreased by minus 1.44% per year, this was due to reduced land area. In 2014 mustard greens production was 77,147 tons, an increase of 2,036 tons, when compared to mustard greens production in 2013 of 75,111 tons. Sawi is found in almost all areas in North Sumatra. One important factor in cultivation that supports the success of plant life is the problem of fertilization. Based on BPS data (2018) mustard plant production in North Sumatra in 2015 amounted to 119.04 kw/ha, in 2016 it was 120.42 kw/ha, but in 2017 mustard plant production decreased with production only 116.31 kw / ha (Maharani, 2021).

Poor cultivation techniques will have an impact on the production of mustard greens. In other words, the process of cultivating pakcoy mustard must be correct so that it has good quality and will be increasingly in demand by the public. One of the efforts to make mustard greens have good quality is fertilization. This fertilization aims to increase the availability of nutrients in the soil. Fertilization can be given through plant roots and also fertilization through leaves (Sihombing, 2019).

Liquid organic fertilizers are liquid organic fertilizers, organic ingredients usually derived from vegetable waste, fruit waste and animal manure which contain more than one nutrient (Nugroho, 2013). The advantage of applying liquid organic fertilizer compared to solid fertilizer is that it contains micro and macro nutrients, absorbs nutrients more quickly, can improve soil structure and soil quality (Anggraini, 2021).

Sources of materials that can be used for organic fertilizers are very diverse, including from vegetable waste. The place where there is a lot of vegetable waste is in the market. Basically, the nature of vegetables is easily damaged and rot. People throw away these rotting vegetables, thus adding to the pile of garbage and causing an unpleasant odor (Frona, 2016).

One of the vegetables that can be used is cabbage. Cabbage waste can be used as organic fertilizer to help plant growth. Cabbage is a vegetable that contains complete nutrition. Cabbage contains anti-cancer compounds and is a source of vitamin C, vitamin A, vitamin B1, minerals, calcium, potassium, chlorine, phosphorus, sodium and sulfur. Cabbage is one of the products of vegetable production in Indonesia and is widely consumed by the public (Frona, Zein, & Vauzia, 2016).

Provision of liquid organic fertilizer must pay attention to the concentration given. The concentration of fertilizer used to fertilize a type of plant will be different for each type of soil and plant, because each soil has different characteristics and chemical composition of the soil. Appropriate fertilizer application can be adjusted to the growth phase of the plant. For mustard greens, the application of fertilizer is divided into several stages, including the first stage, namely basic fertilization which is given at the same time as tillage, and the next stage is the second and third fertilization which are follow-up fertilization (Hamli et al, 2015). Therefore, the authors will conduct an experiment on "The Effect of Liquid Organic Fertilizer from Cabbage Waste on the Growth of Mustard Greens (*Brassica rapa* L.)".

Based on the description above, the purpose of this study was to determine the

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effect of POC from cabbage waste on the growth of mustard greens (*Brassica rapa* L.).

Materials and Methods

1. Material

The materials used to make liquid organic fertilizer are cabbage waste, brown sugar, water, and EM4. While the materials used for the cultivation of mustard greens are green pakcoy mustard seeds, soil and water. The tools used in the manufacture of liquid organic fertilizer in this study included 20 liter barrels, knives, sacks, scales, measuring cups. While the tools used for the cultivation of mustard greens are hoes, scales, measuring cups, seedling trays, label paper, polybags measuring 35 x 35 cm, cameras, stationery and rulers.

2. Methods

The research was carried out on plantations in Sukandebi Village, Naman Teran District, Karo Regency, North Sumatra from March to May 2022. The research design used in this study was an experimental research design (pure research), using a completely randomized design (CRD). non factorial.This research was conducted with the following research procedures:

a) Making Liquid Organic Fertilizer from Vegetable Waste Cabbage

First collect the materials, namely 2 kg of cabbage waste, 250 grams of brown sugar, 7 liters of water and 10 ml of EM4. First, the vegetable waste is cut into small pieces before being put into the liquid organic fertilizer storage bin. Then dissolve the brown sugar with water, and add EM4 then stir it evenly. Mixing is done using a wooden stirrer. After that, the liquid organic fertilizer storage bin is tightly closed and ready to be fermented for 3 weeks. Mixing is done once a week.

b) Preparation of Pakcoy Mustard Seeds

1. Seeding Seeds

Seeding is done using a seedling tray then insert the soil into the seedling tray. Take the pakcoy seeds and plant the seeds in the seedling tray. One hole is filled with one to two seeds. Seeding is carried out for two weeks with the aim that plant growth can be uniform.

2. Planting Seeds

First fill each polybag that will be used with soil. Make a hole in a polybag that contains soil. Then put the mustard greens that have been sown into the polybag, and water the newly moved plants with enough water.

c) Maintenance

1. Sprinkling

Watering is done regularly as much as once a day, either in the morning or in the evening. If it rains you don't need to water it again.

2. Fertilizer Application

Fertilization is done using liquid organic fertilizer from waste cabbage according to the treatment. Liquid organic fertilizer is given 2 times, namely 2 weeks after planting and 4 weeks after planting. Fertilization is done by spraying liquid organic fertilizer to all parts of the plant using an agricultural sprayer.

3. Weeding

Weeding is done if there are weeds in the polybag and around the polybag. Weeding aims to clean and control weeds in the mustard greens so that competition does not occur in the struggle for nutrients, water and sunlight so that the growth of the mustard greens is not disturbed.

d) Harvest

Harvesting is done after the mustard greens are 30-35 days after planting and meet the harvest criteria, namely the mature leaves are oval in shape and the petioles are bright green. Harvesting is done by uprooting the plant and its roots.

The observation parameters to be observed are as follows:

1. Plant Height (cm)

Plant height was measured using a ruler by measuring from the base of the stem to the tallest leaf. Plant height measurements were carried out after the plants were 14 DAP, 21 DAP, and 28 DAP (Sari, 2021).

2. Number of Leaves (Streams)

Calculation of the number of leaves is done by counting the leaves that have opened completely from the bottom to the shoots,

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while those that are still buds are not counted. Calculation of the number of leaves was carried out after the plants were 14 DAP, 21 DAP, and 28 DAP (Sari, 2021).

3. Plant Fresh Weight (g)

Plant fresh weight was measured at 35 DAP (harvest) by removing the plants and their roots, then washing them thoroughly so that there was no adhering soil, then drying them for approximately 15 minutes until there was no running water. Plants are weighed using a scale (Sari, 2021).

4. Plant Dry Weight (g)

Measurement of plant dry weight was carried out at 35 DAP (harvest) by weighing all parts of the pakcoy plant which had been dried beforehand using a 700C oven until it reached a constant weight (Sari, 2021).

5. Root Length (cm)

Root length was measured using a ruler at 35 DAP (harvest). Root length measurement is done by measuring the longest root of the pakcoy plant starting from the base of the root to the tip of the root (Sari, 2021).

Data were analyzed using SPSS with ANOVA test. If the ANOVA results are significant, further tests will be carried out using the Duncan test or DMRT test at the 5% level to determine the effect or difference of liquid organic fertilizer in each treatment and obtain significant data on the growth of mustard greens.

Results and Discussion

Table 1. Plant Height 14 DAP

SK	JK	Db	KT	F Count	Sig.
Treatment	34,604	4	8,651	98,531	,000
Error	1,756	20	.088		
Total	36,360	24			

The results of the ANOVA test showed a significant value (0.000) <0.05, so Ho was rejected. Therefore, liquid organic fertilizer from cabbage waste given to mustard greens had a significant effect on plant height between treatments, a DMRT/Duncan follow-up test was carried out at a significant level of 5%.

Table 2. Plant Height 21 DAP

SK	JK	Db	KT	F Count	Sig.
Treatment	23,432	4	5,858	102,056	,000
Error	1.148	20	,057		
Total	24,580	24			

The results of the ANOVA test showed a significant value (0.000) <0.05, so Ho was rejected. Therefore, liquid organic fertilizer from cabbage waste given to mustard greens had a significant effect on plant height between treatments, a DMRT/Duncan follow-up test was carried out at a significant level of 5%.

Table 3. Plant Height 28 DAP

SK	JK	Db	KT	F Count	Sig.

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Treatment	23,432	4	5,858	102,056	,000
Error	1.148	20	,057		
Total	24,580	24			

The results of the ANOVA test showed a significant value (0.000) <0.05, so Ho was rejected. Therefore, liquid organic fertilizer from cabbage waste given to mustard greens had a significant effect on plant height between treatments, a DMRT/Duncan follow-up test was carried out at a significant level of 5%.

Table 4. Number of Leaves 14 DAP

SK	JK	Db	KT	F Count	Sig.
Treatment	1,440	4	,360	6,000	,002
Error	1,200	20	.060		
Total	2,640	24			

The results of the ANOVA test showed a significant value (0.002) <0.05, so Ho was rejected. Therefore, liquid organic fertilizer from cabbage waste given to mustard greens had a significant effect on the number of leaves between treatments, so a DMRT/Duncan follow-up test was carried out at a significant level of 5%.

Table 5. Number of Leaves 21 DAP

SK	JK	Db	KT	F Count	Sig.
Treatment	6,640	4	1,660	27,667	,000
Error	1,200	20	.060		
Total	7,840	24			

The results of the ANOVA test showed a significant value (0.000) <0.05, so Ho was rejected. Therefore, liquid organic fertilizer from cabbage waste given to mustard greens had a significant effect on the number of leaves between treatments, so a DMRT/Duncan follow-up test was carried out at a significant level of 5%.

Tabel 6. Number of Leaves 28 DAP

SK	JK	Db	KT	F Count	Sig.

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Treatment	5,440	4	1,360	22,667	,000
Error	1,200	20	.060		
Total	6,640	24			

The results of the ANOVA test showed a significant value (0.000) <0.05, so Ho was rejected. Therefore, liquid organic fertilizer from cabbage waste given to mustard greens had a significant effect on the number of leaves between treatments, so a DMRT/Duncan follow-up test was carried out at a significant level of 5%.

Table 7. Fresh Weight

SK	JK	Db	KT	F Count	Sig.
Treatment	16859,440	4	4214,860	71,511	,000
Error	1178,800	20	58,940		
Total	18038,240	24			

The results of the ANOVA test showed a significant value (0.000) <0.05, so Ho was rejected. Therefore, liquid organic fertilizer from cabbage waste given to mustard greens had a significant effect on fresh weight between treatments, a DMRT/Duncan follow-up test was carried out at a significant level of 5%.

Table 8. Dry Weight

SK	JK	Db	KT	F Count	Sig.
Treatment	9,855	4	2,464	192,684	,000
Error	,256	20	,013		
Total	10,110	24			

The results of the ANOVA test showed a significant value (0.000) <0.05, so Ho was rejected. Therefore, liquid organic fertilizer from cabbage waste given to mustard greens had a significant effect on dry weight between treatments, a DMRT/Duncan follow-up test was carried out at a significant level of 5%.

Table 9. Root Length

SK	JK	Db	KT	F Count	Sig.
Treatment	93,974	4	23,493	132,283	,000
Error	3,552	20	, 178		
Total	97,526	24			

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The results of the ANOVA test showed a significant value (0.000) <0.05, so Ho was rejected. Therefore, liquid organic fertilizer from cabbage waste given to mustard greens had a significant effect on root length between treatments, a DMRT/Duncan follow-up test was carried out at a significant level of 5%.

Based on the results of the research and data analysis conducted, it was shown that liquid organic fertilizer from cabbage waste had a significant effect on plant height at 14 DAP, 21 DAP, and 28 DAP, number of leaves at 14 DAP, 21 DAP, and 28 DAP, and length roots at 35 DAP on the growth of mustard greens (*Brassica rapa* L. Var. Chinensis).

Judging from the various treatments that have been carried out, the application of liquid organic fertilizer from cabbage waste as much as 500 ml/polybag shows that the growth of mustard greens (*Brassica rapa* L. Var. Chinensis) is the best, because at this concentration the nutrients contained in liquid organic fertilizer needed can be obtained in a balanced way to encourage better growth.

Based on the results of the research and data analysis conducted, it was shown that liquid organic fertilizer from cabbage waste had a significant effect on fresh weight and dry weight at 35 DAP on the growth of mustard greens (*Brassica rapa* L. Var. Chinensis). Judging from the various treatments that have been carried out, the application of liquid organic fertilizer from cabbage waste as much as 500 ml/polybag shows that the growth of mustard greens (*Brassica rapa* L. Var. Chinensis) is the best. This is because the nutrients needed by the pakcoy plant have been fulfilled.

Based on the results of the research and data analysis conducted, it shows that the concentration of liquid organic fertilizer from cabbage waste which produces the best growth of mustard greens in the parameters of plant height, number of leaves, root length, fresh weight and dry weight is the application of vegetable waste liquid organic fertilizer. Cabbage as much as 500 ml/polybag is a dose according to the needs for the growth of pakcoy plants, where the optimal dose of nutrients can produce good plant growth and production.

Conclusion

Liquid organic fertilizer from cabbage waste has a significant effect on plant height, number of leaves, and root length on the growth of mustard greens (*Brassica rapa* L. Var. Chinensis). The best growth of mustard greens (*Brassica rapa* L. Var. Chinensis) at a dose of 500 ml/polybag. Liquid organic fertilizer from cabbage waste has a significant effect on fresh weight and dry weight on the growth of mustard greens (*Brassica rapa* L. Var. Chinensis). The best growth of mustard greens (*Brassica rapa* L. Var. Chinensis) at a dose of 500 ml/polybag. The concentration of liquid organic fertilizer from cabbage waste which produces the best growth of mustard greens in the parameters of plant height, number of leaves, root length, fresh weight and dry weight is a dose of 500 ml/polybag.

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