

The Effect of Concentration Variation of Liquid Organic Fertilizer Application on the Growth of Mustard Plants

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Abstract: This study aimed to determine the effect of giving Infarm POC concentration variations on the growth of green mustard (*Brassica juncea* L). The research employed a completely randomized design (CRD) or randomized block design with 6 treatments and 5 replications, resulting in a total of 30 experimental units. The data collection method and mechanism used involved implementing a completely randomized design (CRD) with 6 types of treatment and 5 replications, leading to the cultivation of 30 mustard plants with POC concentrations ranging from 2% to 10%. The findings revealed that the application of POC fertilizer to mustard plants resulted in increased plant height, leaf count, and resistance to leaf pests. Notably, the POC concentration of 6% exhibited the most significant improvements in plant height and leaf count. However, to gain a more comprehensive understanding of the effectiveness of this POC, further research is necessary. It is recommended to extend the duration of the study until harvest to assess the weight and quality of the mustard greens, thereby providing more conclusive insights.

Keywords: Growth; Infarm; Liquid organic fertilizer; Mustard; Poc

Introduction

Mustard greens are a type of horticultural plant cultivated by the community (Zahroh et al., 2018). In Indonesia, mustard greens are one of the favorite vegetables of various groups, from the upper-middle and lower-middle classes (Triadiawarman & Rudi, 2019). Mustard greens can be consumed with leaves and stem to be processed into various dishes (Dewi, 2019). This vegetable, which has another name caisim, is rich in nutrition and contains vitamins and minerals so its marketing continues to increase to meet the nutritional needs of the Indonesian people (Fauziah et al., 2022). This research investigates the impact of different concentrations of liquid organic fertilizer on the growth of mustard plants. The study aims to determine the optimal concentration that promotes the growth and development of mustard plants. By varying the concentration levels and observing the plant's response, the researchers aim to provide valuable insights into the effective application of liquid organic fertilizers in

mustard cultivation (Ansar, 2022; Javed, 2020). The findings from this study will contribute to the understanding of sustainable agricultural practices and provide farmers with practical recommendations for enhancing mustard plant growth using organic fertilizers.

Mustard plant growth can be measured from plant height, number of leaves, leaf width, the weight when harvested. To support and increase growth, it can be assisted by applying fertilizer because fertilizer contains nutrients that are good for plants (Fontana, 2021; Haryanta, 2023; Janah, 2023; Pokhrel, 2019). This nutrient element is one of the important factors in plant growth and development (Agustin & Wahyuningrum, 2019).

So far there are 2 types of fertilizers namely organic fertilizers and inorganic/chemical fertilizers. Factory-made chemical fertilizers are often used as the main choice of farmers to help grow their plants because they are considered easy, practical, and have a fast effect (Hakim & Eko, 2021). In addition to the positive impacts

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that are considered good for farmers, chemical fertilizers have negative impacts if used in large doses and for a long time. Soil or land that is often given inorganic fertilizers will cause a decrease in the population of soil microorganisms (Triadiawarman & Rudi, 2019). Continuous use of inorganic fertilizers will lead to worse soil conditions and reduced productivity (Mooy et al., 2019).

Several studies state the importance of reducing the reduction of chemical fertilizers and switching to organic fertilizers to maintain soil fertility and increase soil natural matter (Mahmood et al., 2019). Organic fertilizers can be used as a medium for improving soil content and better-maintaining soil quality compared to chemical fertilizers (Friska & Nasution, 2020). One type of organic fertilizer is a liquid organic fertilizer which can increase the production of agricultural commodities, especially for horticultural crops. The content of macro and micro elements in it includes N, P, K, Mn, S, Fe, Ca, Cu, Mg, and other essential organic materials (Zahroh et al., 2018). The content of macro and micronutrients contained in liquid organic fertilizer support plant growth, so currently it is widely developed and used in agriculture. Plants will more easily and efficiently absorb growth (Rosadi & Catharina, 2022; Rusdiyana et al., 2022) and development nutrients from liquid organic fertilizer (Phibunwatthanawong & Riddech, 2019).

Liquid organic fertilizers can be used to minimize environmental pollution, especially soil by chemical fertilizers (Muthu, 2023). Thus, this POC can be used as one of the best alternatives to switching from using chemical fertilizers to plants (Wasilah et al., 2019). The advantages of using POC include increasing crop yields with good quality, not reducing soil quality but improving it, and also making plants more resistant to pests/diseases that have been tested accurately (Nasirudin et al., 2023; Pramuhadi et al., 2023; Saptorini et al., 2021; Singh, 2022).

When compared to solid fertilizers, liquid organic fertilizers are more able to stimulate the soil to produce nutrients and nutrients needed by plants (Candra et al., 2023; Hendarto & Banjarnahor, 2021; Widiastuti & Latifah, 2017). In the process, POC is more easily absorbed by plants because liquid can flow through small gaps in the soil, so the process is faster when compared to the use of solid fertilizers whose absorption takes a longer time (Nguyen et al., 2018). Mustard plants that are cultivated using liquid organic fertilizers are expected to contribute to soil fertility and improve physical and chemical properties (Budiasih, 2018). POC is also considered to be able to make mustard greens crunchier, mustard tastes sharper, and does not have side effects on the health of people who consume it. Currently, organic mustard cultivation (using organic fertilizer) can increase the selling price on the market, the

price of vegetables (mustard) with an organic label is more expensive than vegetables (mustard) that are given inorganic fertilizers (Rahmayanti et al., 2019).

Today, people are increasingly aware of the importance of consuming more environmentally friendly agricultural products. This causes an increase in demand for food, especially organic vegetables to carry out a healthy lifestyle that is widely campaigned for. The community is trying to obtain food that is more natural, high in nutrition, and does not cause environmental damage (Marian & Tuhuteru, 2019). Therefore, it is necessary to have research to increase the production of mustard greens organically. One of them is by using liquid organic fertilizer (Nugroho et al., 2019).

Mustard farmers should also pay attention to the right dosage to obtain maximum yields (Saragih et al., 2019). The concentration of POC that will be given to mustard plants must be considered to give good results. The frequency of giving POC must be determined regularly so that the mustard plants thrive and provide maximum results (Hakim & Eko, 2021). According to research conducted by (Suradi et al., 2022), a compound POC concentration of 10% is stated as the most optimal dose for the growth and production of mustard plants. This is in line with research conducted by Andriani, 2020 which also states that a 10% concentration of liquid organic fertilizer from *Gracilaria gigas* can increase plant growth and production yields.

Another similar study, Nugroho et al. (2019), the results of his research showed that the administration of Biofarm® POC with a concentration of 3 ml/L gave the highest results in mustard plants. Hakim and Eko, (2021) research say a concentration of 75% POC gives optimum effect and results on the variable number of leaves and wet weight. This shows that the concentration of each type of POC to get maximum results in mustard plants is different. So, it is necessary to carry out further research on different types and brands of POC, one of which is a premium liquid organic fertilizer specially formulated for leaf vegetables with the trademark Infarm.

Method

The tools and materials used in this study were mustard seeds (Ayuta produced by CV. Agro Golden Seed), soil tester instruments, polybags measuring 12x25 cm, tile shards, soil, compost, HSP Astiva, water, POC Infarm, and trowels. The research was carried out in the period 16 October 2022 - 20 November 2022, in the garden next to the researcher's house.

This experiment was carried out using a completely randomized design (CRD) or RAL consisting of 6 treatments and 5 replications so that there were 30

experimental units. The 6 treatments are P (0) control variable with a concentration of 0%, namely 0 ml POC/1000 ml of water, P (1) with a concentration of 2%, namely 2 ml POC/1000 ml of water, P (2) with a concentration of 4%, namely 4 ml POC/1000 ml water, P (3) with 6% concentration, namely 6 ml POC/1000 ml water, P (4) with 8% concentration, namely 8 ml POC/1000 ml water, and P (5) with 10% concentration, namely 10 ml POC/1000 ml water.

Mustard seeds are planted in polybags with a soil and compost ratio of 2:1 and given HSP Astiva to maintain soil nutrient balance. Then each experimental unit was measured for soil pH, humidity, temperature, and light intensity before planting the seeds. Each polybag was given 3 mustard seeds which were planted at a depth of 0.5 cm from the soil surface. Plants are given a mixture of fertilizer and water as much as 200 ml with a frequency of 1 time a day. Plant height measurements were carried out every 7 days starting 7 days after planting using a ruler. Mustard plants are measured from the base of the stem that appears above the ground to the highest leaf. As for the number of leaves that are counted, that is with the criteria for leaves that are perfectly open.

The measured data were analyzed using the method of variance (5% F test) Analysis of Variances and a real honest difference test (LSD) were performed to determine the effect between treatments with a 5% confidence level. The results of the analysis are then interpreted and described in detail and clearly.

Here is the implementation scheme for this research: (1) Determination of Research Objectives: The aim of the research is to determine the effect of concentration variation in the application of liquid

organic fertilizer on the growth of mustard plants. (2) Research Design: The research uses a completely randomized design (CRD). There are six different treatments, representing variations in the concentration of liquid organic fertilizer. There are five replications for each treatment, resulting in a total of 30 experimental units. (3) Research Preparation: Prepare uniform and healthy mustard plant seedlings. Prepare the liquid organic fertilizer solution with the predetermined concentration variations. Prepare the planting area suitable for mustard plants. (4) Research Implementation: Plant the mustard seedlings in each experimental unit according to the designated treatments. Apply the liquid organic fertilizer with the appropriate concentration for each treatment. Monitor and measure the growth of the mustard plants periodically, including plant height, leaf count, and resistance to leaf pests. Record and carefully document the observation data. (5) Data Analysis: The collected data will be analyzed using appropriate statistical methods, such as ANOVA. Interpret the results of the data analysis to determine the effect of concentration variation in the liquid organic fertilizer on the growth of mustard plants. (6) Conclusion: Draw conclusions based on the results of the data analysis to address the research objectives. Present the research findings clearly and concisely.

Result and Discussion

Research and observation of the height growth of mustard plants for 5 weeks in each treatment can be observed through the graph in Figure 1.

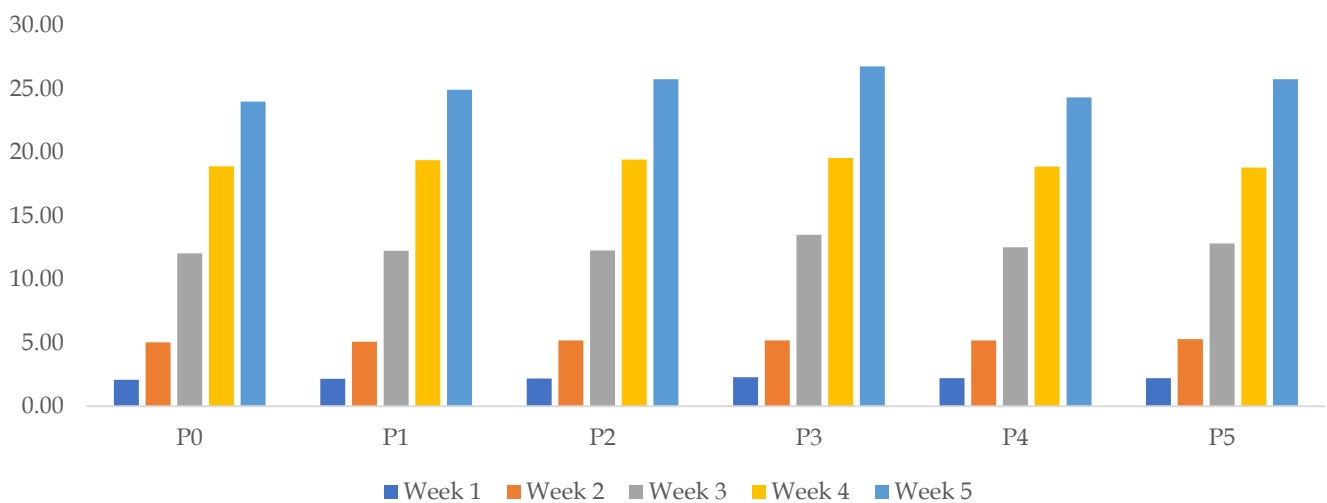


Figure 1. Plant High Average Per Week

From the results in Figure 1, it can be seen that the highest height of the mustard plant in the 5th week of

observation was shown by P3, namely the treatment with 6% fertilizer concentration. Graphs P0 to P3 have

increased, which means that the higher the POC concentration, the higher the mustard plant. But in the P4 and P5 treatments the plant height was lower than in P3, there are two possibilities, namely the maximum concentration to achieve a maximum plant height of 6% or growth in the P4 and P5 treatments were hampered due to external factors. The fertilizer packaging shows

how to use the recommended fertilizer with a concentration of 2%, so there is a possibility of an effect when the dose given is higher. Treatments P4 and P5 at weeks 3-4 found pests in the form of armyworms which could be indicated as growth inhibitors. To analyze further, an Anova test was carried out, namely the F test through analysis of variance with the results in Table 1.

Table 1. Anova F test results for the average plant height

ANOVA TEST RESULT							
Source of Diversity (SD)	Degrees of freedom (Df)	Total Squared (Ts)	Center Square (Cs)	F Count	F Tabel 5%	F Tabel 1%	Notation
Treatment	5	26.83	5.37	14.36	2.62	3.89	**
Error	24	8.97	0.37				
Total	29	35.81					

The ** notation means that there is a significant difference from each treatment to the mustard plant height.

Table 1 shows that the calculated F is greater than the F table of 5% and F table of 1% so that it can be concluded that there are significant differences from the variations in the given POC concentrations. To find out the differences between treatments, a 5% LSD test was carried out with the following results.

Table 2. LSD test results on the average plant height

Treatment	Plant Height Average (cm)				
	Week 1	Week 2	Week 3	Week 4	Week 5
P0	2.08 a	5.04 a	12.04 a	18.92 b	24.00 a
P1	2.16 a	5.08 a	12.26 a	19.38bc	24.94 b
P2	2.18 a	5.18 a	12.28 a	19.44cd	25.78 c
P3	2.28 a	5.20 ab	13.52 d	19.56 d	26.78 d
P4	2.22 a	5.20 ab	12.52 bc	18.88ab	24.34ab
P5	2.20 a	5.28 b	12.82 c	18.80 a	25.76 c

Note: The mean score followed by the same letter means that it is not significantly different and those followed by different letters mean that it is significantly different at the LSD test level of 5%.

Table 2 shows that there was no significant difference in plant height growth in the first week. This could be due to the small age of the plants and the possibility that POC has not been completely absorbed by the plants. In the second week, there was a significant difference in height, namely in treatment 5 (10% POC concentration). Plants with 10% POC treatment became plants with the highest average growth among the others. However, the observations from week 3 to week 5 had different results. The highest growth in plant height was in treatment 3 with a POC concentration of 6%.

In this study, the number of leaves on mustard plants was also used as a parameter in the comparison of mustard growth. Data on the growth of many mustard leaves is presented in the graph in Figure 2. The graph shows the average number of leaves in each treatment for 5 times the observation time.

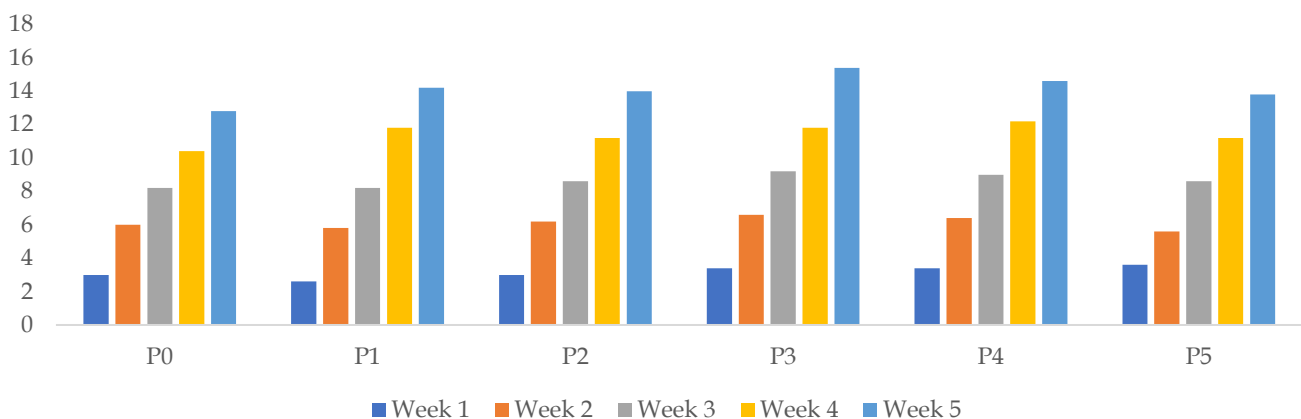


Figure 2. The average number of leaves per week

Figure 2 shows that the growth in the highest number of leaves was in treatment 3, namely with a POC concentration of 6%. While the growth of the lowest

number of leaves was shown by treatment 0 or the control variable which was not given POC treatment.

Table 3. Anova F test results for the average number of leaves

Source of Diversity (SD)	Degrees of freedom (Df)	Total Squared (Ts)	Center Square (Cs)	F Count	F Tabel 5%	F Tabel 1%	Notation
Treatment	5	18.67	3.74	6.05	2.62	3.89	**
Error	24	14.8	0.62				
Total	29	33.47					

The ** notation means that there is a significant difference from each treatment to the mustard plant height.

The results of the ANOVA test show that F count is greater than F table 5% and F table 1%, which means that the data on the average number of leaves in each treatment is significantly different. Therefore, a Least Significant Difference Test (LSD) is needed to further analyze the differences in each treatment. The results of the LSD test on the average number of leaves of mustard plants in each treatment are presented in Table 4.

Table 4. LSD test results on the average number of leaves

Treatment	The Average Number of Leaves				
	Week 1	Week 2	Week 3	Week 4	Week 5
P0	3.0ab	6.0ab	8.2 a	10.4 a	12.8 a
P1	2.6 a	5.8 a	8.2 a	11.8 b	14.2 b
P2	3.0ab	6.2ab	8.6 a	11.2ab	14.0 b
P3	3.4 b	6.6 b	9.2 b	11.8 b	15.4 c
P4	3.4 b	6.4 b	9.0ab	12.2 c	14.6bc
P5	3.6 b	5.6 a	8.6 a	11.2ab	13.8ab

Note: The mean score followed by the same letter means that it is not significantly different and those followed by different letters mean that it is significantly different at the LSD test level of 5%.

The number of leaves on the mustard plant is also influenced by several external factors such as armyworm pests, leaf locusts, and changing weather which can cause fungus on the leaves. This results in several treatments not having a significant difference. The highest average number of leaves in the last week of observation was in treatment 3, namely 15.4 leaves. Just like the average height growth of mustard plants, 6% POC concentration gave maximum results compared to the other five treatments.

Conclusion

Premium Liquid Organic Fertilizer (POC) specially formulated for leaf vegetables under the trademark Infarm is made from 100% organic nutrients. The macro and micro elements contained in it are proven to be able to help increase the growth of leaf vegetable plants which in this study were mustard greens. The maximum increase in plant height and number of leaves was shown by the POC concentration of 6%. To test the ability of this POC more deeply, it is necessary to have further research with the maximum duration of research until the harvest to measure the weight and quality of

the mustard greens. In addition, further research is also needed on other types of green vegetables.

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Author Contribution

The first author conceptualized the research idea and designed the experimental methodology. She also collected and analyzed the data, performed statistical analysis, and interpreted the results. Both authors jointly contributed to the writing of the manuscript, reviewing, and editing it for intellectual content. While the second author supervised the overall research process. He also contributed to the literature review and provided critical feedback during the research process.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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