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GROWTH AND YIELD RESPONSE OF PAKCOY (BRASICCA RAPA L.) PLANTS TO THE APPLICATION OF LIQUID ORGANIC FERTILIZER FROM CATFISH CULTIVATION WASTEWATER (POCALE) AND CHICKEN MANURE ON INCEPTISOL SOIL

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Abstract

This study aimed to determine the effect of liquid organic fertilizer from catfish farming wastewater (POCale) and chicken manure on the growth and yield of bok choy (Brassica rapa L.) on Inceptisol soil. The study used a Factorial Randomized Block Design with two factors, namely the dose of POCale (0, 100, 200, and 300 ml/L/plot) and the dose of chicken manure (0, 0.5, 1.0, and 1.5 kg/plot). The parameters observed included plant height, number of leaves, fresh weight per sample, fresh weight per plot, and net weight per plot. The results showed that POCale administration did not significantly affect all parameters of bok choy growth and yield, although the highest dose (300 ml/L/plot) gave the best quantitative value. In contrast, the application of chicken manure had a very significant effect on increasing plant height, number of leaves, and fresh weight of bok choy plants, with a dose of 1.5 kg/plot producing the best performance. The interaction between POCale and chicken manure did not have a significant effect, but the combination of the two at the highest dose yielded the best results numerically. This study concluded that chicken manure was more effective in increasing bok choy growth and yield on Inceptisol soils compared to liquid organic fertilizer from catfish farming waste.

Keywords :*Pakcoy, POCale, Chicken Poultry Fertilizer, and Inceptisol*

INTRODUCTION

Pakcoy (Brassica rapa L.) is a popular horticultural crop widely consumed by Indonesians. It belongs to the Brassicaceae family, along with other mustard greens such as mustard greens and white mustard greens. Of the three, pakcoy is more widely cultivated due to its broad leaves and stems, greener color, and high nutritional content, including protein, fat, calcium, phosphorus, iron, and various vitamins (A, B, C, E, and K), which are beneficial for health (Eko, 2007). Pakchoy is known as a heat-resistant and flexible plant, capable of growing in all climates, from lowlands to highlands (100–1,000 meters above sea level). It also has a fast harvest time, around 30–45 days after planting, with a potential production of 20–25 tons per hectare (Wahyudi, 2010). Market demand for pakchoy continues to increase, but has not yet been fully met by national production, making it a promising business opportunity in the agricultural sector. Pak choy originates from China and has been cultivated since the 5th century in South China and Central China, as well as Taiwan. Today, this plant has spread to various other Asian countries, such as Japan, Malaysia, the Philippines, Thailand, and Indonesia (Anonymous, 2012). Furthermore, Indonesia's growing population has also driven demand for fresh vegetables, including pak choy. According to data from the Ministry of Agriculture (2015), Indonesian vegetable exports increased by 33.5% in 2015 compared to the previous year. To sustainably increase bok choy production, the use of organic fertilizers is an environmentally friendly solution. Commonly used organic materials include agricultural

waste, manure, green manure, livestock waste, and compost (Lingga & Marsono, 2006). One potential material is wastewater from catfish farming, known as POCale (Organic Liquid Catfish Fertilizer). This liquid waste contains macronutrients such as nitrogen (N) and phosphorus (P), which can enhance plant growth. High catfish production, such as in Riau Province, which reached 19,798.07 tons in 2018 (a 20% increase from 2016), also has an impact on increasing the amount of waste that can be used as fertilizer (KKP, 2018). In addition, chicken manure is also a good source of nutrients, containing approximately 1% nitrogen, 0.8% phosphorus (P_2O_5), and 0.4% potassium (K_2O) (Mayadewi, 2007). However, this fertilizer has a relatively high C/N ratio (>28) when fresh, and is only effective after a decomposition process that reduces the C/N ratio to approximately 10–20 (Surya & Suyono, 2013). Inceptisols are young soils with an acidic pH (4.5–6.5), clay texture, crumbly structure, and loose consistency. Although this soil's fertility is relatively low, its productivity can be increased with proper management and agricultural technology (Sudirja, 2007).

Research methods

This research was conductedat the Experimental Land of the Faculty of Agriculture, Al Washliyah University, Jl. Sisingamangaraja No. 10, Harjosari I, Medan Amplas District, Medan City, North Sumatra Province with an altitude of ± 25 meters above sea level, with flat topography. This research began in November 2023 and will be completed. The tools and materials used in this research are: hoes, rakes, measuring tools, scales, hand sprayers, knives, buckets, meters, barrels/buckets, stationery, documentation tools for pak choy seeds, liquid organic fertilizer from catfish farming wastewater, chicken manure, and other tools and materials that support the implementation of the research. This study used a Factorial Randomized Block Design (RAK) with two factors, namely: Factor of providing liquid organic fertilizer from catfish cultivation wastewater (L): L0 = Control (Without Liquid Organic Fertilizer from Catfish Cultivation Wastewater), L1 = 100 ml, L2 = 200 ml, L3 = 300 ml and factor of providing organic fertilizer from chicken coop (K): K0 = Control (Without Organic Fertilizer from Chicken Coop), K1 = 0.5 kg, K2 = 1 kg, K3 = 1.5 kg.

This research began with sowing bok choy seeds in 3x5 cm polybags for one week. Liquid organic fertilizer from catfish wastewater (POCale) was made by mixing catfish wastewater, molasses or granulated sugar, and EM4, then letting it sit for one week. The planting medium was prepared in 48 plots measuring 100x100 cm. Before planting, 25 grams of NPK Pelangi (20-10-10) base fertilizer was applied per plot. Chicken manure was sprinkled on the soil surface two weeks before planting and watered daily. POCale was applied one week before planting by dissolving it in water and then watering it into the soil. Seedlings are planted one week after sowing, at a depth of 4–5 cm. Maintenance includes watering twice daily, weeding weekly starting 2 weeks after planting, replanting for plants that are not growing normally, and pest control using manual methods or organic pesticides when necessary. Harvesting takes place 35 days after planting, before the plants flower. Parameters observed in this study included plant height, number of leaves, and fresh weight per sample. Observations were conducted periodically using measuring instruments such as meters and analytical scales.

Research Results and Discussion

Plant Height (cm)

The results of the study showed that the administration of liquid organic fertilizer from wastewater from catfish farming POCale on the height of pakcoy plants had no significant effect and the administration of chicken manure on the height of pakcoy plants had a very significant effect, while the interaction between the administration of liquid organic fertilizer from wastewater from catfish farming POCale and chicken manure on plant height had no significant effect on inceptisol soil.

Table 1. The Response of Liquid Organic Fertilizer from Pocale Catfish Cultivation Wastewater and Chicken Manure to Plant Height (cm) of Pakcoy Brassica rapa L. on Inceptisol Soil.

POCale	Chicken Manure				Average
	K0	K1	K2	K3	
L0	14.93	17.53	17.66	19.18	17.33
L1	16.21	18.28	17.94	18.51	17.73
L2	16.85	18.37	18.35	20.16	18.43
L3	16.46	17.04	19.04	22.52	18.76
Average	16.11c	17.80 bc	18.25b	20.09 a	18.06

Information : Numbers followed by different letters in the same treatment group are significantly different at the 5% level based on the DMRT test.

Table 1 above shows that the application of liquid organic fertilizer from catfish farming wastewater POCale had no significant effect on the height of bok choy plants. The highest height of bok choy plants was in treatment L3 (POCale 300 ml/L/plot), namely 18.76 cm, and the lowest height of bok choy plants was in treatment L0 (control/without POCale), namely 17.33 cm. This is suspected because POCale is unable to affect the height of bok choy plants because the nutrient content of POCale is very low, so it is unable to provide optimal results for the growth of bok choy plants. According to Distan, 2014. Organic fertilizers have a more complete nutritional content, both macro and micro, but the dosage is small (Zulfansyah et al., 2021). Similarly, Tanti, et al., 2019 stated that the nutrient content in organic fertilizers produced from fish waste is fairly complete but the amount is small. And the provision of chicken manure has a very significant effect on the height of pakcoy plants. The highest height of pakcoy plants in the K3 treatment (1.5 kg organic chicken manure/plot) is 20.09 cm which is significantly different from the K2 treatment (1 kg organic chicken manure/plot) which is 18.25 cm which is not significantly different from the K1 treatment (0.5 kg organic chicken manure/plot) which is 17.80 cm which is not significantly different from the K0 treatment (control/without organic chicken manure) which is 16.11 cm which is the lowest parameter.

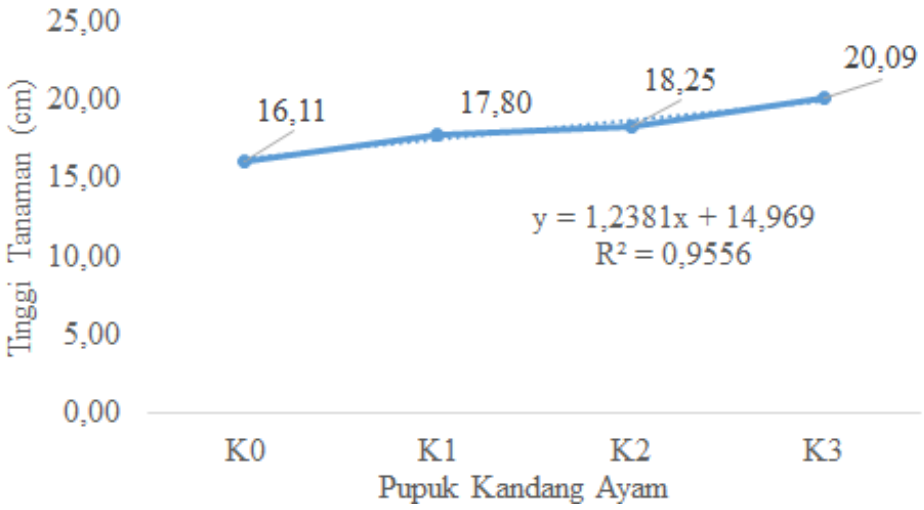

Figure 1. Graph of the Relationship between Chicken Manure Response and Pakcoy Brassica rapa L. Plant Height on Inceptisol Soil.

Based on Figure 1 above, it shows that the effect of chicken manure provides a positive response to the height of pak choy plants. The higher the dose of chicken manure given, the taller the pak choy plants produced. This result is linear with the equation y = 1.2381x + 14.969 with a correlation coefficient of 95.56% which is influenced by chicken manure. This is thought to be because the function of chicken manure can absorb height and water storage capacity which

overall can increase soil fertility so that roots can absorb water and nutrients contained in the soil resulting in an increase in the rate of plant growth (Zulfansyah et al., 2021). This is in line with the research of Kurnia, et al., 2016. Who stated in their research results that plant height increases every week as the plant ages. Meanwhile, the interaction of liquid organic fertilizer from catfish farming wastewater POCale and chicken manure had no significant effect on the height of pak choy plants. The highest pak choy plant height was in the L3K3 treatment (POCale 300 ml/L/plot and chicken manure organic fertilizer 1.5 kg/plot) which was 22.52 cm and the lowest pak choy plant height was in the L0K0 treatment (control/without POCale and control/without chicken manure organic fertilizer) which was 14.93 cm.

Number of leaves (blades)

The number of leaves of pakcoy plants had no significant effect and the provision of chicken manure on the number of leaves of pakcoy plants had a very significant effect, while the interaction between the provision of liquid organic fertilizer from POCale catfish cultivation wastewater and chicken manure on the number of leaves of pakcoy plants had no significant effect on inceptisol soil.

Table 2. The Response of Liquid Organic Fertilizer from Pocale Catfish Cultivation Wastewater and Chicken Manure to the Number of Leaves (Sheets) of Pakcoy Brassica rapa L. Plants on Inceptisol Soil.

POCale	Chicken Manure				Average
	K0	K1	K2	K3	
L0	10.42	11.50	11.67	12.33	11.48
L1	10.67	11.83	12.08	12.50	11.77
L2	11.58	11.67	12.50	13.67	12.35
L3	11.08	11.67	12.42	15.07	12.56
Average	10.94c	11.67bc	12.17b	13.39a	12.04

Information : Numbers followed by different letters in the same treatment group are significantly different at the 5% level based on the DMRT test.

In table 2 above, it can be seen that the provision of liquid organic fertilizer from catfish cultivation wastewater POCale has no significant effect on the number of leaves of pakcoy plants. The highest number of leaves of pakcoy plants was in treatment L3 (POCale 300 ml/L/plot) which is 12.56 pieces and the lowest number of leaves of pakcoy plants was in treatment L0 (control/without POCale) which is 11.48 pieces. This is suspected to be the nitrogen content in the catfish cultivation wastewater given is very low so that POCale does not affect the number of leaves on pakcoy plants and can experience a decrease in nitrogen content due to evaporation and so on, as stated by Adiningsih, 2008. N is an element that is unstable, easily washed out, and evaporates so that its content in the soil is small that can be absorbed by plants.

And the provision of chicken manure has a very significant effect on the number of leaves of pakcoy plants. The highest number of leaves of pakcoy plants was in the K3 treatment (1.5 kg organic chicken manure/plot) which was 13.39 strands which was significantly different from the K2 treatment (1 kg organic chicken manure/plot) which was 12.17 strands which was not significantly different from the K1 treatment (0.5 kg organic chicken manure/plot) which was 11.67 strands which was not significantly different from the K0 treatment (control/without organic chicken manure) which was 10.94 strands which was the lowest parameter.

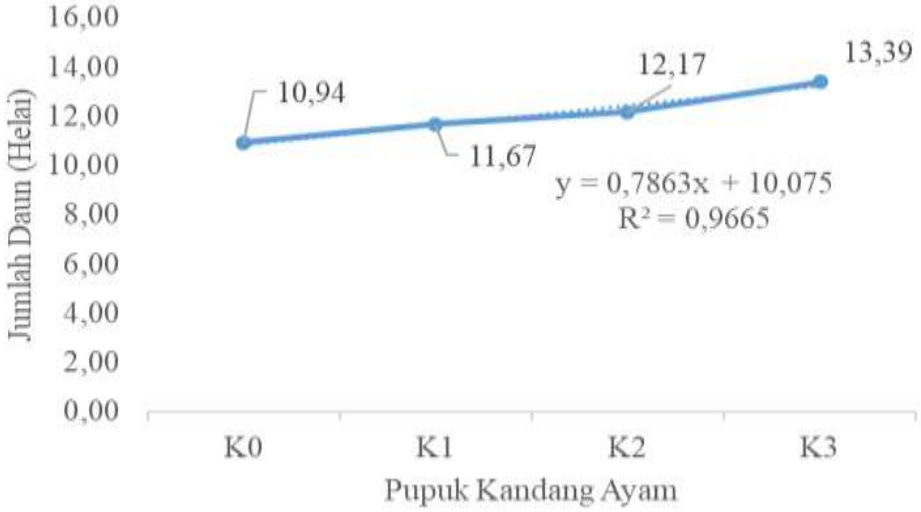

Figure 2. Graph of the Relationship between the Response of Chicken Manure and the Number of Leaves of Pakcoy Brassica rapa L. Plants on Inceptisol Soil.

Based on Figure 2 above, it shows that the effect of chicken manure gives a positive response to the number of leaves of pakcoy plants. The higher the chicken manure given, the more leaves of pakcoy plants produced. This result is linear with the equation y = 0.7863x + 10.075 with a correlation coefficient of 96.65% which is influenced by chicken manure. This is because the content of chicken manure contains high nitrogen, namely N 1% of the weight of the mass of chicken manure listed on the label of the Koyam organic manure brand so that the growth of the number of leaves. Based on research by Kurnia, et al., 2016. Chicken manure contains three times more nitrogen than other manures. So this content increases the growth and development of more plant leaves (Mayly et al., 2022). Meanwhile, the interaction of liquid organic fertilizer from catfish farming wastewater POCale and chicken manure had no significant effect on the number of pakcoy plant leaves. The highest number of pakcoy plant leaves was in the L3K3 treatment (POCale 300 ml/L/plot and chicken manure organic fertilizer 1.5 kg/plot) which was 15.07 leaves and the lowest number of pakcoy plant leaves was in the L0K0 treatment (control/without POCale and control/without chicken manure organic fertilizer) which was 10.42 leaves.

Fresh Weight of Plants Per Sample (g)

The fresh weight per sample of pak choy plants had no significant effect and the provision of chicken manure on the fresh weight per sample of pak choy plants had a very significant effect, while the interaction of the provision of liquid organic fertilizer from POCale catfish cultivation wastewater and chicken manure on the fresh weight per sample of pak choy plants had no significant effect on inceptisol soil.

Table 3. The Response of Liquid Organic Fertilizer from Pocale Catfish Cultivation Wastewater and Chicken Manure to the Fresh Weight Per Sample (g) of Pakcoy Brassica rapa L. Plants on Inceptisol Soil.

POCale	Chicken Manure				Average
	K0	K1	K2	K3	
L0	39.58	47.50	74.17	83.75	61.25
L1	42.08	72.92	77.50	81.67	68.54
L2	56.25	75.42	85.42	88.75	76.46
L3	58.33	69.67	65.83	116.67	77.63
Average	49.06 b	66.38 ab	75.73 a	92.71a	70.97

Information : Numbers followed by different letters in the same treatment group are significantly different at the 5% level based on the DMRT test.

Table 3 above shows that the application of liquid organic fertilizer from catfish cultivation wastewater, POCale, had no significant effect on the fresh weight of each pak choy plant sample. The highest fresh weight per pak choy plant sample was in treatment L3 (POCale 300 ml/L/plot), namely 77.63 g, and the lowest fresh weight per pak choy plant sample was in treatment L0 (control/without POCale), namely 61.25 g. This is thought to be because the nutrient content of POCale has a complete nutrient content of macro and micro nutrients (Anggraeni, et al., 2022), but these nutrients are in small amounts so they cannot provide significant results from pak choy plants. And the provision of chicken manure has a very significant effect on the fresh weight per sample of pakcoy plants. The highest fresh weight per sample of pakcoy plants was in the K3 treatment (1.5 kg organic chicken manure/plot) which was 92.71 g which was not significantly different from the K2 treatment (1 kg organic chicken manure/plot) which was 75.73 g which was not significantly different from the K1 treatment (0.5 kg organic chicken manure/plot) which was 66.38 g which was not significantly different from the K0 treatment (control/without organic chicken manure) which was 49.06 g which was the lowest parameter.

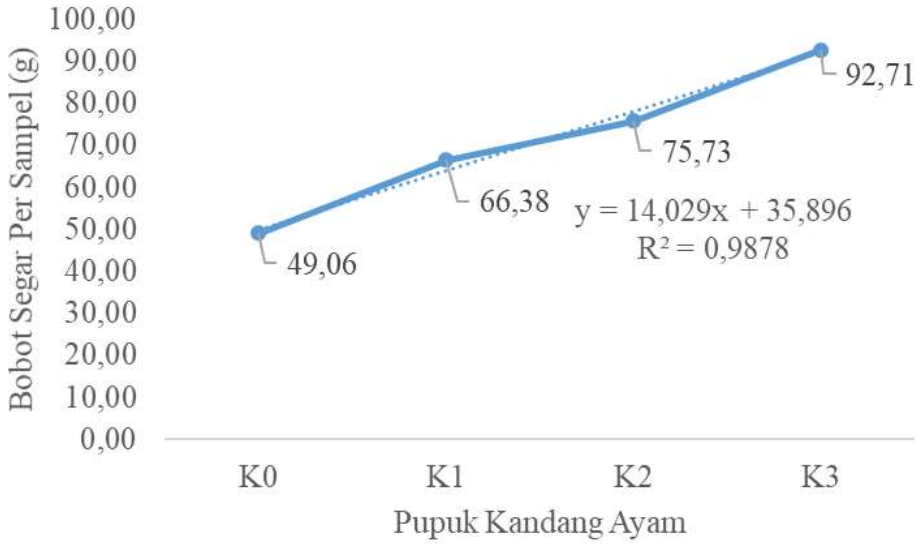

Figure 3. Graph of the Relationship between Chicken Manure Response and Fresh Weight of Pakcoy Brassica rapa L. Plant Samples on Inceptisol Soil.

Based on Figure 3 above, it shows that the effect of chicken manure provides a positive response to the fresh weight per sample of bok choy plants. The higher the chicken manure given, the higher the fresh weight per sample of bok choy plants produced. This result is linear with the equation y = 14.029x + 35.896 with a correlation coefficient of 98.78% which is influenced by chicken manure. This is thought to be because the application of chicken manure provides additional nutrients in the soil, especially nutrients containing nitrogen, phosphorus, and potassium, which are important nutrients needed by bok choy plants so that bok choy plants can grow optimally. This is in line with Bhoki, et al., 2021 who stated that the fresh weight of mustard plants is affected by the application of chicken manure. Meanwhile, the interaction of liquid organic fertilizer from catfish farming wastewater POCale and chicken manure had no significant effect on the fresh weight per sample of pak choy plants. The highest fresh weight per sample of pak choy plants was in the L3K3 treatment (POCale 300 ml/L/plot and chicken manure organic fertilizer 1.5 kg/plot) which was 116.67 g and the lowest fresh weight per sample of pak choy plants was in the L0K0 treatment (control/without POCale and control/without chicken manure organic fertilizer) which was 39.58 g.

Conclusion

The application of liquid organic fertilizer derived from catfish farming wastewater (POCale) did not significantly affect bok choy growth, although the highest dose (300 ml/L/plot) produced the best results. Conversely, chicken manure significantly increased bok choy plant height, leaf number, and weight, with the highest dose (1.5 kg/plot)

being the best. The combination of the two fertilizers did not significantly affect bok choy growth, although the highest dose of both produced the best quantitative results.

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