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Analysis of Plant Growth and Pest Incidence of Pakchoy Plants (*Brassica rapa* L.) Using the Wick System Hydroponics Through the Utilization of Catfish Waste

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ABSTRACT
This study aimed to determine the effect of catfish wastewater as a source of nutrients in the hydroponic wick system cultivation model on the growth of pak choy mustard plants, which include: plant height, number of leaves, leaf area, pest and disease attacks, and plant yields. The method used in this study is a quantitative method with a Non-Factorial Randomized Block Design. This method used 6 treatments, namely (P0) 800 ml of water, (P1) 800 ml of water + AB Mix nutrients (A 5 ml + B 5 ml), (P2) 600 ml of water + 200 ml of catfish wastewater, (P3) 400 ml of water + 400 ml of catfish wastewater, (P4) 200 ml of water + 600 ml of catfish wastewater, (P5) 800 ml of catfish wastewater and repeated 3 times. The results showed that the treatment of 800 ml of catfish wastewater (P5) increased plant height, number of leaves, leaf area and weight of pakcoy plants in hydroponic wick system compared to the treatment of 800 ml of water (P0). Meanwhile, the attack of whitefly pests on pakchoy plants was found to be higher in all treatments of catfish wastewater as a source of nutrients in hydroponic wick system compared to the treatment of 800 ml of water + AB Mix nutrients (P1).

***Keywords**: Pakchoy, Hydroponic wick system, Pest and disease attacks, Catfish wastewater*

INTRODUCTION
Pakcoy plant (*Brassica rapa* L.) is one of the favorite vegetables in Indonesia. Pakcoy is an annual vegetable with oval, soft, hairless leaves and pakcoy is one of the vegetables whose leaves and stems can be used for daily consumption. This plant is widely used by the community, especially traders, for various types of food preparations (Andriyani, 2019). Pakcoy has a lot of nutritional content, making pakcoy a nutritious vegetable. Pakcoy plants are vegetables that are rich in vitamins A, B, C, E and K, these vitamins are vitamins needed by the human body, pakcoy also contains chemical compounds that can inhibit or reduce the risk of cancer (Waryat and Handyani, 2020).

The large use of pakchoi increases the demand for pakchoi plants, which needs to be balanced by an increase in the area of harvested land. However, in reality there has been a decrease in the area of harvested land, one of the causes of which is the increasingly rapid population growth so that there is a lot of land conversion, where agricultural land is now being converted into residential areas and industrial areas (Andriyani, 2019). Hydroponics is a cultivation technique that is considered suitable for overcoming the problem of the lack of productive agricultural land. Romalasari and Sobari (2019) stated that hydroponics is a technique for growing plants that uses water as a planting medium. This environment has a different control system to regulate nutrients and oxygen.

Hydroponics is a method of growing vegetables without soil that emphasizes the addition of nutrients for plant growth (Suarsana et al., 2019). Growth is maximized with the right nutrient concentration. An important factor that determines the success of hydroponic planting is the nutrient solution. If nutrients are not sufficient, it can slow down plant growth and development and even cause plant death (Syah et al., 2021). The second factor that has been of great concern until now is the presence of plant pests in pakchoi plantation which can directly reduce the selling value of pak choi (Nurawalia, 2022).

The wick system is one of the hydroponic methods that uses a wick or connector between nutrients and the planting medium, in this case the wick functions to absorb water. The best wick is flannel which is suitable for the wick system. This system is the simplest and most straightforward system. (Narulita, et

al. 2019).

One thing that must be considered in the wick hydroponic system is the nutrient solution. The nutrient solution is an important factor in the growth process and quality of the hydroponic crop. Liquid waste from catfish ponds can be an alternative source of nutrients for the wick hydroponic system because it contains organic matter needed by plants. The addition of nutrients to organic matter from catfish waste has good potential for use in vegetable cultivation (Angelika, 2019).

METHOD

This research was conducted in March - June 2023 at the Fathul Ulum Islamic Boarding School, Puton Village, Diwek District, Jombang Regency, East Java. The tools used in this study were: 1.5 liter plastic bottles, flannel cloth, seedling trays, netpots, rockwool, rulers, stationery, sprayers, cameras, scissors or cutters. The materials used were: Pakchoy seeds, water, catfish wastewater, AB Mix nutrients, toothpicks. This study used a non-factorial Randomized Block Design consisting of 6 treatments repeated 3 times, namely (P0) 800 ml of water, (P1) 800 ml of water + AB Mix nutrients (A 5 ml + B 5 ml), (P2) 600 ml of water + 200 ml of catfish wastewater, (P3) 400 ml of water + 400 ml of catfish wastewater, (P4) 200 ml of water + 600 ml of catfish wastewater, (P5) 800 ml of catfish wastewater and repeated 3 times. The research data were analyzed using analysis of variance (ANOVA). If there is a difference between the treatments carried out, further testing is needed using the Least Significant Difference Test (LSD).

RESULT AND DISCUSSION

The results showed that the P5 treatment increased the height of pakchoi plants at 35 hst observations compared to the P0, P3, and P4 treatments (Table 1). This is inseparable from the high concentration of catfish waste in the P5 treatment so that the nutrients contained in it can be used by pakchoi plants optimally.

Table 1. Plant height (cm) of pakchoi due to treatment at 21, 28 and 35 days after planting.

Treatment	Plant height (cm) at the observation age		
	21 dap	28 dap	35 dap
P0 800 ml Water	11.67	13.67	13.67 a
P1 800 ml Water + AB Mix	13.33	15.33	17.00 c
P2 600 ml water + 200 ml Catfish Wastewater	12.33	14.33	14.67 ab
P3 400 ml water + 400 ml Catfish Wastewater	11.67	14.33	13.67 a
P4 200 ml water + 600 ml Catfish Wastewater	13.67	15.33	14.33 a
P5 800 ml Catfish Wastewater	13.00	15.33	15.83 bc
CC	7.89%	5.77%	4.58%
LSD	ns	ns	1.24

Description: Numbers accompanied by the same letters indicate no significant difference based on the 5% LSD test (p = 0.05); dap = days after planting; ns = not significant.

In the number of leaves parameter, the P5 treatment increased the number of leaves at the observation age of 21 days after planting compared to the P0, P2, and P3 treatments (Table 2). The P1 treatment produced a number of leaves that was not significantly different from the P5 treatment. These results indicate that the provision of catfish waste can meet the nutritional needs of pakchoy plants in the hydroponic wick system. Adequate nutritional needs allow increased plant metabolism which has an impact on active plant cell division. The impact of cell division on plants includes increasing fresh plant weight through increased plant height, leaf area, number of leaves, and root growth (Isherdini et al., 2023).

Table 2. Number of leaves (blades) of pakchoi due to treatment at 21, 28 and 35 days after planting.

Treatment	Number of leaves (blades) at the observation age		
	21 dap	28 dap	35 dap
P0 800 ml Water	6.67 ab	6.33	6.33 a
P1 800 ml Water + AB Mix	7.67 c	7.00	14.67 b
P2 600 ml water + 200 ml Catfish Wastewater	6.67 ab	8.00	5.00 a
P3 400 ml water + 400 ml Catfish Wastewater	6.33 a	7.00	6.00 a
P4 200 ml water + 600 ml Catfish Wastewater	7.33 bc	8.00	6.00 a
P5 800 ml Catfish Wastewater	7.67 c	6.33	4.67 a
CC	7.16%	30.45%	30.12%
LSD	0.92	ns	3.90

Description: Numbers accompanied by the same letters indicate no significant difference based on the 5% LSD test (p = 0.05); dap = days after planting; ns = not significant.

Table 3. Leaves area (cm^2) of pakchoi due to treatment at 21, 28 and 35 days after planting.

Treatment	Leaves area (cm^2) at the observation age		
	21 dap	28 dap	35 dap
P0 800 ml Water	9.06 a	15.24	14.20 a
P1 800 ml Water + AB Mix	16.02 cd	22.64	24.69 d
P2 600 ml water + 200 ml Catfish Wastewater	12.62 b	18.20	15.92 ab
P3 400 ml water + 400 ml Catfish Wastewater	12.74 b	17.97	14.21 a
P4 200 ml water + 600 ml Catfish Wastewater	13.99 bc	21.84	17.74 bc
P5 800 ml Catfish Wastewater	16.38 d	20.93	17.74 bc
CC	12.52%	20.93%	1057%
LSD	3.07	ns	3.34

Description: Numbers accompanied by the same letters indicate no significant difference based on the 5% LSD test (p = 0.05); dap = days after planting; ns = not significant.

Table 4. Fresh weight (g) of pakchoi due to treatment at 35 days after planting.

Treatment	Fresh weight (g) of pakchoi
P0 800 ml Water	23.33 a
P1 800 ml Water + AB Mix	39.00 c
P2 600 ml water + 200 ml Catfish Wastewater	25.33 a
P3 400 ml water + 400 ml Catfish Wastewater	20.33 a
P4 200 ml water + 600 ml Catfish Wastewater	27.33 ab
P5 800 ml Catfish Wastewater	34.00 bc
CC	14,70%
LSD	7,55

Description: Numbers accompanied by the same letters indicate no significant difference based on the 5% LSD test (p = 0.05); dap = days after planting; ns = not significant.

The results showed that the P5 treatment increased the leaf area of pakchoi plants at an observation age of 21 hst compared to the P0, P2, P3, and P4 treatments (Table 3). At an observation age of 35 hst, the P4 and P5 treatments increased the leaf area of pakchoi plants compared to the P0 and P3 treatments. In pak choi cultivation activities, leaves are one of the important parameters for determining pakchoi plant production (Rusdiana et al., 2021).

Treatment P5 increased the fresh weight of pakchoi plants compared to treatments P0, P2, and P4. Treatment P5 also produced a fresh weight of pakchoi that was not significantly different compared to treatment P1 with the provision of AB mix, which means that treatment P5 can be a substitute for treatment P1 which is a nutrient for hydroponic pakchoi plants. The availability of sufficient nutrients in plant growth will support the rate of photosynthesis optimally. By increasing the rate of photosynthesis in plants, the process of forming carbohydrates, fats, and proteins will run perfectly, so that maximum plant yields will be obtained. The number of leaves can affect the fresh weight of the pakchoi plant because

when the number of leaves increases, the fresh weight of the plant will also increase, because leaves are a sink for plants (Sarijan et al. 2020).

Figure 1. Whitefly attack on pakcoy leaves

The level of whitefly attack on pakchoi plants is influenced by nutritional treatment. The results showed that the use of catfish wastewater as a source of nutrients for pakchoi in the wick hydroponic system has not been able to reduce the tolerance of whitefly attacks compared to the P1 treatment with the provision of AB mix (Table 5). These pests often attack young shoots and leaves, which can cause abnormal leaves and cause direct damage to plant growth (Figure 1). Cabot et al. (2019) reported that sustainable optimization of plant nutrition can be an effective approach to improving plant health where nutrients are directly involved in plant protection as structural components and metabolic regulators.

Table 5. Whitefly attack intensity (%) due to treatment at 21, 28 and 35 days after planting.

Treatment	Whitefly attack intensity (%) at the observation age		
	21 dap	28 dap	35 dap
P0 800 ml Water	1.00	1.00 b	0.67
P1 800 ml Water + AB Mix	0.33	0.33 a	0.00
P2 600 ml water + 200 ml Catfish Wastewater	0.67	1.00 b	0.67
P3 400 ml water + 400 ml Catfish Wastewater	0.67	1.00 b	0.67
P4 200 ml water + 600 ml Catfish Wastewater	0.67	1.00 b	1.00
P5 800 ml Catfish Wastewater	1.00	1.00 b	1.00
CC	0.00%	26.52%	67.08%
LSD	ns	0.43	ns

Description: Numbers accompanied by the same letters indicate no significant difference based on the 5% LSD test (p = 0.05); dap = days after planting; ns = not significant.

CONCLUSIONS

From the results of the study, it can be concluded that the provision of catfish wastewater can increase plant height, number of leaves, leaf area and fresh weight of pakchoy plants in the wick hydroponic system compared to the control treatment without nutrients (P0). Treatment P5, namely 800 ml of catfish wastewater, resulted in pakchoy plant growth and production that was not significantly different from treatment P1 with the provision of AB mix nutrients. On the other hand, the use of catfish waste as plant nutrients has not been able to suppress whitefly pest attacks on pakchoy plants.

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