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The effect of applying fertilizer of moringa leaf (*Moringa oleifera*) extract and rice washing water to the growth of pakcoy plant (*Brassica rapa L. spp. Chinensis (L.)*)

P N Sari¹, M Auliya¹, U Farihah¹ and N E A Nasution¹

¹Department of Biology Education, Education and Teacher Training Faculty,
State Islamic Institute of Jember, Indonesia

E-mail: pipitnurmita93@gmail.com

Abstract. The hydroponic system is increasingly popular in Indonesia. In 2014, 597,674 tons of pakcoy were harvested from hydroponic products. However, the hydroponic system uses mix AB fertilizer which is relatively expensive. Moringa leaf and rice washing water have high mineral and vitamin content. There are cytokinin in moringa leaves which are useful for growth so that they can be used as organic liquid fertilizer. This study aims to determine the response of pakcoy growth to the provision of organic liquid fertilizer made from moringa leaves and rice washing water which is relatively cheap. Organic liquid fertilizer is made through the process of moringa leaf fermentation and rice washing water. The treatment given is in the form of 40% AB mix and 60% fermented organic liquid fertilizer. This treatment showed the results in the form of increased leaf size, number of leaves, stem diameter and weight per sample. The addition of organic liquid fertilizer to Pakcoy resulted in an increase in leaf width and length, number of leaves and weight per sample.

1. Introduction

Hydroponics comes from the Greek language and consists of two words, namely "Hydro" means water. Hydroponics is a method of plant cultivation that uses water as a growing medium. In hydroponics, water becomes a planting medium that is assisted by a machine to supply nutrients to cultivated plants. Plants will receive nutrients through water that passes through the roots. In line with technological developments, hydroponics are grouped into four types based on the irrigation system. The first is the Wick system, the second is floating system, the third is the NFT (Nutrinet Film Technique) system and the last is the Aeroponic system [1]. Hydroponic system cultivation focuses on how to provide water and nutrients in accordance with plant needs, plant age, and environmental conditions. Fertilizers or nutrients are dissolved in water, then circulated to the roots of plants periodically or continuously depending on the type of hydroponic system used.

One of the hydroponic irrigation systems used is the Aeroponic system. This system has advantages in the form of relatively inexpensive manufacturing costs compared to other hydroponic systems. Besides, making it is also easy and can be done by anyone. However, farmers must be



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intensive in caring for planted plants, because the aerobic system is prone to water shortages. This is because the model of a closed aerobic system. Water is in a place that cannot be observed if the box where the plants are planted is not removed [2].

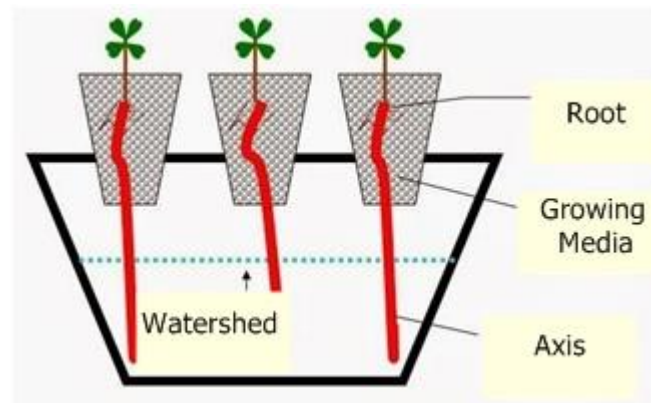


Figure 1. Aeroponic System

Plants that can be cultivated with a hydroponic system include vegetables, fruits and other foodstuffs. One of the vegetables that has a high prospect is Pakcoy (*Brassica rapa var. Chinensis*). Pakcoy (*Brassica rapa var. Chinensis*) is one of a group of mustard greens. This plant has morphological characteristics such as it has stemmed leaves, the shape of leaves is oval with dark green and shiny color, it does not form a head plant, and grow upright or half horizontal. Pakcoy (*Brassica rapa var. Chinensis*) has a short harvest life that ranges from 30-45 days. More than the age of harvest, pakcoy (*Brassica rapa var. Chinensis*) will experience a decrease in growth so that the quality will decrease as well. With a relatively short harvest period, it actually provides a good prospect for Indonesian farmers, besides the large market demand for organic pakcoy (*Brassica rapa var. Chinensis*) which is considered as healthier and cleaner vegetables and controlled by its nutritional content than pakcoy (*Brassica rapa var. Chinensis*) which planted in a conventional manner [3].

To meet the nutritional needs of aquaculture plants, the hydroponic system uses fertilizers that have been dissolved in water to meet the nutritional needs of plants. Fertilizers commonly used are nutrient mix AB. Fertilizer A contains macronutrients, such as Nitrogen (N), Phosphate (P), Potassium (K), Calcium (Ca), Magnesium (Mg), and Sulfur (S), while B fertilizer contains micronutrients, such as Iron (Fe), Manganese (Mn), Zinc (Zn), Cuprum / copper (Cu), Boron (B) and Molybdenum (Mo). The mixture of the two fertilizers will later be added to the flow of water in hydroponics. However, the price for 1 liter of mixed AB nutrient fertilizer is relatively expensive for small-scale farmers. This causes many farmers who are reluctant to use hydroponics [4].

In the same planting area, the number of hydroponic crops is greater than the conventional yield. It is very unfortunate if the farmers do not take advantage of it. By doing hydroponic, farmers should be able to harvest quickly and with a decent amount. Therefore we need a new breakthrough in the form of hydroponic fertilizer that has good quality but at an affordable price for farmers.

Hydroponic fertilizers can be made from several types of plants and household waste. Because a lot of plants in Indonesia that contain lots of vitamins and minerals that can be used as ingredients for fertilizer. One of them is Moringa leaf (*Moringa oleifera*). Moringa (*Moringa oleifera*) is a tropical plant. Even its distribution spread across Indonesia, it does not get much attention from people which indicated by the minimum utilization of Moringa (*Moringa oleifera*). Moringa leaf (*Moringa oleifera*) are usually consumed as a daily human vegetable and also animal feed. Whereas Moringa leaf

(*Moringa oliefera*) plant has many benefits as it is nicknamed with "The Miracle Tree". In per 100 grams of fresh Moringa (*Moringa oliefera*) oil contain 70.0 mg phosphorus, 2.3 mg minerals and sulfur 137.0 mg which can be used as plant growth nutrients. And Moringa leaf (*Moringa oliefera*) extract can be used to accelerate plant growth because it contains zeatin, cytokinin, ascorbate, phenolic and minerals such as Ca, K and Fe which can trigger plant growth [5].

To meet the needs of vitamins in plants, organic fertilizer is also added with rice washing water waste. Many household wastes are disposed of because there are still many people who do not know their beneficial contents. Waste water washing rice contains 0.043% vitamin B1, phosphorus 16.306%, nitrogen 0.015%, potassium 0.02%, calcium 2.944%, magnesium 14.252%, sulfur 0.027%, and 0.0427% iron which can be used as plant growth nutrients [6].

Both of the above materials are easily to obtain, farmers should find no difficulties to make their own hydroponic fertilizers. In addition to the benefits in economical side, this utilization able to maximize the potential of existing natural resources. Based on the background of the research, the researcher conducted a literature study that aimed to find out the response of pakcoy (*Brassica rapa var. Chinensis*) growth to the hydroponic system with the treatment of Moringa leaf (*Moringa oliefera*) organic liquid fertilizer and rice wash water with a ratio of 60% organic water fertilizer and 40% nutrient mix AB.

2. Method

The method used is the literature review method. Literature review is the activity of finding information from various sources, such as journals, articles, theses, etc. to obtain the desired information [7]. Data mining was carried out to find out the reasons why the community still did not use the hydroponic system on their agricultural land. Data mining results in information that fertilizer prices are relatively expensive for farmers, so farmers cannot implement a hydroponic system. The problem is then examined and found a solution to make organic liquid fertilizer with basic ingredients that are easy to find and inexpensive for farmers. The basic ingredients used are moringa leaf (*Moringa oliefera*) and rice washing water waste. These two basic ingredients contain vitamins and minerals that are needed in the growth and development of pakcoy (*Brassica rapa var. Chinensis*).

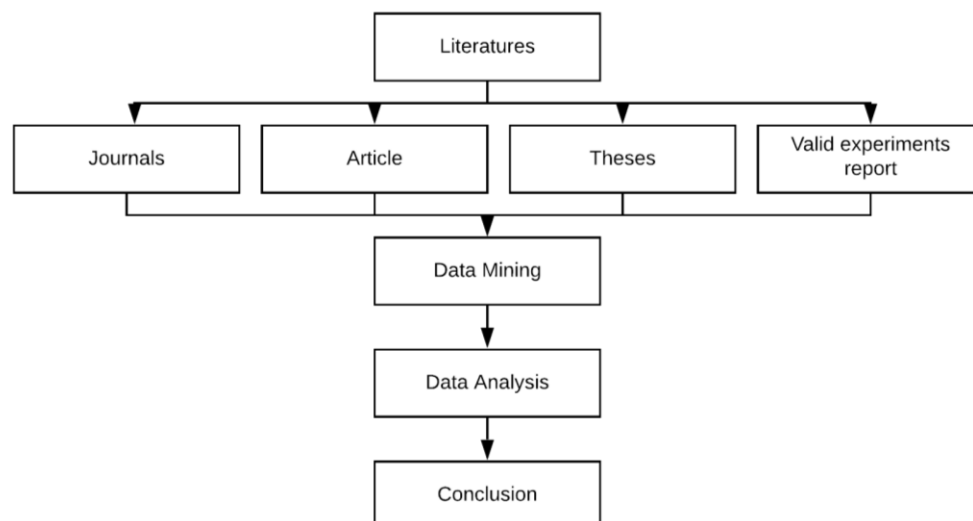


Figure 2: Research Methods Diagram

3. Research and Result

The literature study obtained the data in the form of Moringa leaf (*Moringa oliefera*) content and

water content of used rice washing.

3.1. The content of Moringa Leaves (*Moringa oliefera*)

Moringa (*Moringa oliefera*) contains Calcium (Ca), Iron (Fe), Potassium (K), Zinc (Zn), Protein, Vitamin A, Vitamin B, Vitamin C, Vitamin D, Vitamin E, Vitamin K, Folic Acid, Biotin and Cytokinin. Based on these contents it can be seen that Moringa leaves (*Moringa oliefera*) contain various vitamins and minerals needed by the growth and development of pakcoy (*Brassica rapa var. Chinensis*) [8].

3.2. Content of Rice Washing Water

After knowing the content of Moringa leaves (*Moringa oliefera*), there is a need for additional ingredients to optimize the content of liquid organic fertilizer as like rice washing water. Rice washing water contains many vitamins and minerals such as Vitamin B1, Vitamin B3, Vitamin B6, Iron (Fe), Calcium (Ca), Magnesium (Mg), Nitrogen (N), Phosphorus (P) and Sulfur (S). Based on these constraints it can be seen that the water used for washing rice has the potential to be used as material for making liquid organic fertilizer in the hydroponic system [9].

4. Discussion

Pakcoy (*Brassica rapa var. Chinensis*) is one of the most wanted vegetables by the people. Pakcoy (*Brassica rapa var. Chinensis*) is a type of mustard that contains vitamins and minerals needed by humans. The nutritional content in 100 g pakcoy (*Brassica rapa var. Chinensis*) is 2.39 mg protein, 0.39 mg fat, 4.09 mg carbohydrate, 220 mg calcium, 38 mg phosphorus, 2.9 mg iron and 102 mg vitamin C. The nutritional content of pakcoy (*Brassica rapa var. chinensis*) can be seen in the followingtable.

Table 1. Content of Pakcoy (*Brassica rapa var. Chinensis*)

Number	Composition	Amount
1	Calorie	22,00 k
2	Protein	2,30 mg
3	Fat	0,30 g
4	Carbohydrate	4,00 g
5	Fiber	1,20 mg
6	Calcium (Ca)	220,50 mg
7	Phosphor (P)	38,40 mg
8	Iron (Fe)	2,90 mg
9	Vitamin A	969,00 SI

Number	Composition	Amount
10	Vitamin B1	0,90 mg
11	Vitamin B2	0,10 mg
12	Vitamin B3	0,70 mg
13	Vitamin C	102,00 mg

Based on Table 1 above it can be seen that pakcoy (*Brassica rapa var. Chinensis*) has a lot of nutrients that are good for health.

Vitamin A level in pakcoy (*Brassica rapa var. Chinensis*) is very high in the role of maintaining the health of the cornea of human eyes. The content of vitamin E in pakcoy (*Brassica rapa var. Chinensis*) functions as a major antioxidant in cells, and has a good role in preventing aging. The content of calcium, phosphorus, iron and vitamins owned by the Pakcoy plant (*Brassica rapa var. Chinensis*) functions as an antiviral and antibacterial, it helps prevent cataracts, reduces the risk of congenital defects, reduces the risk of heart disease strokes as it can maintain normal blood pressure and good for curing wound in digestion. The abundant benefits of pakcoy (*Brassica rapa var. Chinensis*) make it as one of the most favorite vegetables for Indonesian people [10].

This is a good opportunity for farmers to cultivate pakcoy (*Brassica rapa var. Chinensis*). Society today prefers organic plants, because they think organic plants are more hygienic and healthier as organic plants do not use much pesticides and chemicals as well as controlled nutritional content. One of the organic planting systems is hydroponics. However, the nutrients used in the hydroponic system are relatively expensive and hard to afford for farmers with limited financial source. The AB mix nutrients commonly used in hydroponic systems can be reduced by the use of organic liquid fertilizer made from Moringa leaves (*Moringa oliefera*) and rice washing water waste. Moringa leaves (*Moringaoliefera*) contain many minerals and cytokines that are needed in plant growth, as well as waste water washing rice which contains many vitamins and minerals. Both of these ingredients are easy to obtain even without having to buy.

Moringa (*Moringa oliefera*) is an Asian plant that lives in the tropics and spreads throughout Indonesia. So it is not difficult to find Moringa (*Moringa oliefera*). Meanwhile, rice washing water waste can be obtained from households and the food industry sector that uses rice. Rice is a main food for Indonesian people so that almost every day waste water from rice washing will be produced from Indonesian people's house hold kitchen activities. Fertilizer is made by fermentation. The part of Moringa (*Moringa oliefera*) that is used only its leaves, because the largest mineral and cytokinin content is in the leaves. To produce the fertilizer, the Moringa leaves (*Moringa oliefera*) first are cleaned and mashed. Then put it in a storage container. After that, added with rice washing water and add an ingredient to speed up the decomposition process. Starters can be stale rice, sugar or EM4. Comparison of ingredients 4:1 between Moringa leaves (*Moringa oliefera*) and rice washing water waste. For the number of starters given to a small amount. After all the ingredients are placed in the container, the ingredients are stirred until evenly distributed.

Then close the container tightly with plastic cover and let it for two weeks. The container could regularly opened in the morning or evening to be stirred again so that the decomposition can be evenly distributed and the fermented gas can be removed. After two weeks, the mixture will change by its shape, color and aroma. The mixture will turn into brown water. This water can be run as organic water fertilizer on hydroponic plants.

The treatment given is in the form of 60% liquid organic fertilizer and 40% AB mix nutrient in hydroponic plants. This treatment is given as many as three days or according to conditions. If in hot areas plants will absorb water more quickly, the water in the hydroponic tub will quickly run out. The addition of water is also accompanied by the addition of organic liquid fertilizers and nutrient mix AB. The results of this treatment can be seen from several studies that use organic liquid fertilizers with Moringa leaves (*Moringa oleifera*) or rice washing water waste.

According to Kartika in her research stated that making liquid organic fertilizer by adding Moringa leaf (*Moringa oleifera*) extract as much as 40% affected the growth of pakcoy plants (*Brassica rapa var. Chinensis*) which included the number of leaves, plant length, wet weight and dry weight. The application of Moringa (*Moringa oleifera*) liquid organic fertilizer with a concentration of 60% fertilizer 40% water with watering once every three days gave the highest results in the parameters of the number of plant leaves [11].

According to Awan in his research said that waste water washing rice can improve the quality of pakcoy (*Brassica rapa var. Chinensis*). After being treated with the addition of 75% rice washing water waste to hydroponic water, the growth of pakcoy (*Brassica rapa var. Chinensis*) has increased. The size of leaves, stems, and weight per sample increased, which led to an increase in the number of harvests of pakcoy (*Brassica rapa var. Chinensis*) [12].

According to the literature, Moringa leaves (*Moringa oleifera*) and wastewater from rice washing can be used as organic liquid fertilizer in hydroponics. Because the contents of both ingredients are good and needed by plants. The addition of organic liquid fertilizer with the right level can produce the maximum amount of harvest in pakcoy (*Brassica rapa var. Chinensis*). Besides it is good for saving, using organic liquid fertilizers is beneficial as it could be produces independently and easily by obtaining raw materials for their production.

5. Conclusion and Suggestion

Moringa leaves (*Moringa oleifera*) and rice wash water containing minerals and vitamins are needed for pakoy growth. The addition of organic liquid fertilizer to pakcoy (*Brassica rapa var. Chinensis*) resulted in an increase in leaf width and length, number of leaves and weight per sample. Farmers can apply hydroponic systems to their farms by minimizing costs through liquid organic fertilizer which can reduce the use of nutrient mix AB which is relatively expensive.

Acknowledgement

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