The effectiveness of nutrient variation to hydroponic *Caisim* (*Brassica juncea* L.) growth

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**Abstract.** One type of vegetable that is popular among the Indonesian is mustard greens (*Brassica juncea* L.), which is also known as *Caisim* because it is often processed into various dishes and contains various ingredients and vitamins which are good for health. The last few years *Caisim* production has decreased, one of the causes is the constraints in the cultivation process, especially in the use of fertilizers due to the relatively long-term use of inorganic fertilizers. To improve the cultivation of *Caisim* without looking at the soil conditions, we can use a hydroponic system. However, hydroponics need more cost because the AB MIX nutrition is still relatively expensive, so it needs an alternative nutrient as a substitute for AB MIX which has the same ability. AB Mix is a mixture of fertilizer A and fertilizer B. Fertilizer A contains potassium while fertilizer B contains sulfate and phosphate. An alternative nutrient as a substitute for AB MIX which has the same ability, such as liquid fertilizer based on local microorganisms (LMO) which has properties that are easily absorbed by plants so that the use of organic nutrients can be used as a source of substitute nutrition, which is more economically affordable and has a very good influence on *Caisim* and is expected to increase production in *Caisim* cultivation. This study used a Completely Randomized Design with a single factor experimental design consisting of 4 treatments, namely a combination of AB MIX solution and various kinds of LMO-based organic nutrients as follows: A = LMO A 5 ml + AB MIX 5 mL/L of water; B = LMO B 5 mL + AB MIX 5 mL/L water; C = LMO A 5 mL + MOL B 5 mL/Liter water; D = AB MIX 10 mL/L water. The variables observed were plant height, number of leaves, and biomass of *Caisim*. The results showed that the variation of AB MIX nutrition and liquid organic fertilizer based on LMO effectively increased the growth of *Caisim* plants. The highest average plant height was given by *Caisim* with AB MIX nutrition, which is 69.2 cm. The highest average number of leaves was obtained by *Caisim* which was grown with a combination of LMO A and LMO B nutrients, which was 27.8. The largest average wet weight was given by *Caisim* with AB MIX nutrition, which is 32.3 g. According to the three parameters, the use of ab mix nutrients is 10 mL / L water and a combination of LMO A 5 mL + LMO B 5 mL / L water is the most effective combination of nutrients for hydroponic *Caisim* growth.

1. **Introduction**

Vegetables are important for a healthy diet. Eating vegetables can prevent various diseases [1]. Along with population growth, Indonesia is coping with food and nutrition security concerning household hunger and malnutrition. The production of vegetable crops in Indonesia has grown both for domestic consumption and in exports to some extents [2]. One type of vegetable that is quite popular among the Indonesian is mustard greens (*Brassica juncea* L.). The mustard plant (*Brassica juncea* L.) is a type of plant leaf vegetables that has high economic value, including in the *Cruciferae* family, which is also known as *Caisim* because it is often processed into various dishes and contains a variety of ingredients and vitamins that are good for health [3]. Based on data from the Central Statistics Agency in 2015, Mustard Greens production in Indonesia from 2011 to 2013 increased from 580,969 tons to 635,728 tons, but from 2014 to 2015 has decreased from 602,468 to 580.51 tons. This data shows that there were fluctuating production, even the reduction has lasted these three years [4].
The cause of the reduction in *Caisim* production is in its cultivation, one of which is the use of fertilizer. The use of inorganic fertilizer in a relatively long period of time has a bad impact on soil conditions, which in turn will further decrease mustard greens production. Based on these problems, it is necessary to improve and increase the production of *Caisim*. One solution to improve the cultivation of *Caisim* without checking the soil condition is by the hydroponic system either with or without a greenhouse. Cultivation with hydroponics has its own problem, that in order to get AB MIX nutrition, it needs expensive costs, so it needs a substitute for AB MIX which has the same ability. Organic nutrients such as liquid fertilizer based on local microorganisms (LMO) have features that are easily absorbed by plants that use organic nutrients which can be used as a cheaper and efficient source of nutrition for *Caisim*, and will increase production in *Caisim* cultivation. Using liquid fertilizer that is used on local microorganisms (LMO) is an alternative to support the needs of macro and micronutrients. Those Liquid fertilizer have a positive impact on increasing N and P content that are essential for plant growth [5]. Based on the description above, this study was conducted to determine the effectiveness of variations in organic nutrient based on Local Microorganisms (LMO) with inorganic nutrition AB Mixed on the growth of *Caisim* (*Brassica juncea* L.).

2. **Methods**

This research was an experimental study in which organic nutrient based on local microorganism was given to observe the *Caisim* (*Brassica juncea* L.) growth using NFT model hydroponic installations. While the ingredients used were nutrition AB MIX, LMO of Tape (fermented cassava), LMO of the rind, rock wool, water, flannel cloth, label paper, *Caisim* seeds (*Brassica juncea* L.). The tape LMO and rind LMO were deposited for 2 weeks before using. The study was arranged in a Completely Randomized Design with a Single Factor experimental design consisting of 4 treatments, namely a combination of AB MIX solution and various kinds of organic nutrients, as follows: A = LMO A 5 mL + AB MIX 5 mL/L of water; B = LMO B 5 mL + AB MIX 5 mL/L water; C = LMO A 5 mL + LMO B 5 mL/L water; D = AB MIX 10 mL/L water.

2.1 **Production of liquid organic fertilizer based on local microorganism**

Tape LMO is made by weighing 100 g of cassava, then put into a plastic bottle with a volume of 1500 mL. Fill the water in the bottle that has been filled with cassava tape earlier, it does not have to be full. Then put 5 tablespoons of sugar, mix and then stir and shake until the sugar water dissolves. The bottle is left open for 4 or 5 days. Furthermore, after 5 days of incubation, if the smell of alcohol appears, the LMO is ready and can be used as fertilizer.

2.2 **Plant seed watering**

Before starting planting with a hydroponic system, the first thing to do is to seed. The seeds used are *Caisim* seeds (*Brassica juncea* L.). The seeding using Rockwool (a type of sponge) as a seeding medium. Seeds are in seedlings for ± 14 days until the first 4 leaves appear.

2.3 **Seedlings planting into installation and given treatment**

The 4-leaf *Caisim* sprouts are transferred to the net pot, then the seeds are ready to be put into the NFT system hydroponic installation that has been made previously. Nutrition is made according to treatment. Substitution of water and nutrition is done every three days, or when the nutrients in the body have shrunk.

2.4 **Maintenance**

Maintenance is done every 2 days, observing the continuity of the work of the hydroponic installation system, replacing water and nutrients, and keeping the seeds away from pests.
2.5 **Observation variables**
Observations of the results carried out after the seventh day after the planting (DAP) process. Plant height, measured from the base of the stem to the tip of the longest leaf when the plant is on their 7th DAP, 14th DAP, 21st DAP, 28th DAP. The number of leaves is the leaves that are formed perfectly calculated when the plant is on their 7th DAP, 14th DAP, 21st DAP, 28th DAP. Wet weight, *Caisim* wet weight was measured in the fourth week (28th DAP).

2.6 **Observation**
Plant height is measured every week by measuring it from the top surface of the media to the tips of leaf buds. The number of leaves is calculated as leaves grow perfectly, done once a week starting from the first week after planting until harvest. The activity was carried out for one month, namely 7th DAP, 14th DAP, 21st DAP, and harvested in the fourth week (28th DAP).

3. **Results**
The research began with the manufacture of LMO-based organic fertilizer. LMO is made from fruit rind waste and tape (fermented cassava). After 14 days of the incubation period, organic fertilizer is ready to be applied. Mustard greens seedlings which have 4 leaves are placed at the net pot and then put into a hydroponic installation. Each installation consists of 4 pipes (representing 2 treatments), each has 6 holes where the seeds are placed. Seedlings were observed by their height, the number of leaves every week until the fourth week, while the wet weight was measured once at harvest in the 4th week (28th DAP).

Based on observations that have been made for 4 weeks (28 Days) about the effectiveness of nutritional variations on the growth of hydroponic *Caisim* (*Brassica juncea* L.) observation obtained were in the form of plant height, the number of leaves, and wet weight as follows.

**Table 1. The Average of the Growth of *Caisim* (*Brassica juncea* L.) Hydroponic**

| Treatments       | The Average of the Growth of *Caisim* (*Brassica juncea* L.) Hydroponic After 4 Weeks |
|------------------|---------------------------------------------------------------------------------------|
|                  | Plant Height (cm) | Number of Leaves | Gross Weight (g) |
| A (LMO A + AB MIX) | 54.5              | 23.2             | 21.7              |
| B (LMO B + AB MIX) | 54.0              | 23.7             | 21.5              |
| C (LMO A + LMO B)  | 67.8              | 27.8             | 30.3              |
| D (AB MIX)         | 69.2              | 27.2             | 32.3              |

*LMO: Local Micro Organism  
AB MIX: the types of hydroponic nutrient

From the observational data, it can be seen that variations in nutrition affect the height of *Caisim* plants, it can be seen from the average height of different *Caisim* plants. The results can be seen that the treatments A (AB mix + LMO A) and B (AB mix + LMO B) give almost the same results, namely 54.5 cm and 54.0 cm. Whereas the provision of LMO nutrition alone in treatment C (LMO A + LMO B) gives an average height of 67.8 cm and the average height of the largest plants obtained in treatment D (AB Mix), which is 69.2 cm. While the parameter results for the number of leaves, the average number of leaves in 4 treatments gave different results. The treatments A (AB mix + LMO A) and B (AB mix + LMO B) gave almost the same results, namely 23.2 and 23.7. While giving only the AB Mix nutrition in treatment D gives an average number of leaves 27.8 and the largest average number of leaves obtained in treatment C (LMO A and LMO B), which is 27.2. The results of measurements of plant wet weight can be seen, that there is an effect of different nutritional benefits on the *Caisim* wet weight. Treatment A and B showed almost the same results, namely 21.7 g (treatment A) and 21.5 g (Treatment B).

Whereas the giving of nutrition in the form of LMO alone (Treatment C) gave a greater wet weight result compared to the previous treatment (A and B), which was 30.3 g. The highest wet weight was produced by *Caisim* who were treated with AB Mix only, which was 32.3 g. The results of the analysis
of variance both also gave a significant effect, marked by the value (F <0.05) for each parameter, namely the number of plant leaves and its Wet Weight.

4. Discussions
The results showed that the increase in the concentration of organic fertilizer Tape Local Microorganisms did not show an increase in wet weight, the number of leaves, and plant height. The concentration of LMO fertilizer that has a real effect is the combination of LMO fertilizer with a concentration of 10 ml / L water or treatment C. While the combination of LMO fertilizer with AB MIX (Treatment A and B) does not show a better effect than treatment C and D.

Where it is known that there is a relationship that is directly proportional between the wet weight of plants, the number of leaves, and plant height. The more leaves the wet weight of the plant is also greater as well as the height of the plant, the higher the plant's wet weight is also greater. Local microorganisms (MOL) is a fermented liquid that uses locally accessible resources. MOL contains bacteria of organic matter, plant growth stimulants, pest control agents, and nutrients needed by plants [6]. The local microorganism is the result of own production of natural materials around us (local) which means fertilizer solutions of local microorganisms has the potential to remodel organic matter so that local microorganisms can be used both as decomposers [7].

The combination of organic fertilizer (LMO) and inorganic fertilizer (AB MIX) which is not accompanied by an increase in the wet weight of the plant, allegedly because of this combination of fertilizers results in a large number of deposits resulting from the activity of microorganisms contained in the fertilizer so that the growth of mustard greens becomes inhibited. In another study, it was explained that the presence of microorganism activities that produce residues so that sediment occurs and causes obstruction of water flow and nutrients in the planting media [8].

The low wet weight of mustard plants as a result of the high dose of fertilizer used is also thought to be caused by very high electronic conductivity (EC) making it difficult for plants to absorb nutrients. Electronic conductivity (EC) is a measure of the ability of a solution to conduct electrical current. An electric current in solution is delivered by ions contained in it. The amount of ions in solution is affected by the solids dissolved in it. The greater the number of dissolved solids in the solution, the more likely the number of ions in the solution will also be greater, so that the EC value is also greater [9].

Application of organic fertilizer into the soil can improve soil structure making the soil looser so that the root system can develop better and the absorption process of nutrients runs more optimally [10]. The effect of the use of nutrients in the soil is not only received by plants but will also be received by microbes that have previously been in the soil so that they support each other in the process of plant growth [11]. Microbes disintegrate organic compounds so they can be reabsorbed by plants as nutrients [12]. Cultivation of agricultural land using organic fertilizer appropriately is believed to significantly increase agricultural output, especially vegetables [13].

Different nutrients providing is effective for increasing the growth of *Caisim* (*Brassica juncea* L.). The highest average plant height was given by *Caisim* with AB MIX nutrition, which is 69.2 cm. The highest average number of leaves was obtained by *Caisim* which was grown with a combination of LMO A and LMO B nutrients, which was 27.8. The largest average wet weight was given by *Caisim* with AB MIX nutrition, which is 32.3 g.

5. Conclusion
Based on the data analysis and discussion can be concluded that the variation of AB MIX nutrition and liquid organic fertilizer based on LMO effectively increased the growth of *Caisim* plants. The highest average plant height was given by *Caisim* with AB MIX nutrition, which is 69.2 cm. The highest average number of leaves was obtained by *Caisim* which was grown with a combination of LMO A and LMO B nutrients, which was 27.8. The largest average wet weight was given by *Caisim* with AB MIX nutrition, which is 32.3 g. The use of AB MIX nutrient is 10 mL / L water and a combination of LMO A 5 mL + LMO B 5 mL / L water is the most effective combination of nutrients for hydroponic *Caisim* growth.
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