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Mustard (*Brassica Juncea* L.) Growth Hydroponically Using AB-Mix and Liquid Organic Fertilizer Tea Pulp

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ABSTRACT

Mustard greens are vegetables that have a high potential to be cultivated and contain nutrients. Hydroponics is an alternative to the cultivation of mustard plants. AB Mix and liquid organic fertilizer are nutrients to increase plant productivity. In addition, the content of tea pulp can help plant growth. This study was conducted to determine the effect of AB Mix concentration and tea pulp liquid organic fertilizer on mustard growth hydroponically. The study used a Complete Randomized Design in an experimental setting with four different AB Mix nutrient combinations treatments and tea pulp liquid organic fertilizer in the form of V0 (control), V1, V2, and V3. Each treatment is repeated four times. The results showed that the concentration of AB Mix and liquid organic fertilizer tea pulp affected the growth of mustard plant height, number of leaves, and wet weight of mustard plants. The greatest treatment on V2 has a plant height of 14 cm, lots of leaves 7 strands, and a wet weight of 5.8 g.

1. INTRODUCTION

Mustard plants are vegetables that the people of Indonesia favor. Mustard greens have a high nutritional content, so the community uses them as a side dish. Mustard greens are vegetables that have a high potential to be cultivated, besides that mustard greens are also vegetables that are easy to grow in the lowlands or highlands according to research (Lestari, 2017). The contents contained in mustard greens have many uses for the health of the body. According to research (Alifah, 2019), mustard greens contain lots of vitamins A, B, C, E, and K, besides that the content in mustard greens there are carbohydrates, proteins, fats, and other contents in the form of calcium, potassium, manganese, folate, iron, phosphorus, magnesium are also found in mustard vegetables which are helpful as a balance to the health of the body.

Using data analysis from the Central Statistics Agency as a basis (2022), the total value of mustard crop production in Indonesia in 2018 reached 635,982 tons. In 2019 it reached 652,723 tons. In 2020, the total harvest reached 667,473 tons. In 2021, the total production reached 727,467 tons. To meet consumer needs in a sustainable manner, mustard cultivation can be carried out that has good quality and quantity in the crops. According to (Siregar, 2017), cultivation with hydroponic techniques can be an alternative to produce high-quality mustard vegetable products continuously.

One effort to balance the process of growth and development of plants grown hydroponically requires providing proper nutrition, with the provision of little nutrition can cause delays, and the growth and development of mustard plants might be negatively impacted by an excessive nitrogen supply, which will lower yields. However, according to (Fauziah, 2022), mustard greens can grow

and develop optimally with the fulfillment of essential nutrients according to the needs of mustard plants.

AB Mix nutrition is a standard nutrient usually used in addition to nutrients in hydroponics. The use of nutrient solution AB mix requires relatively expensive costs. So alternative technology is needed to develop hydroponic technology to make it easier for people to cultivate planting hydroponically. According to research (Marginingsih, 2018), one way to produce optimal crops for plant growth is to use liquid organic fertilizer as a substitute for AB Mix nutrients. In addition to using AB Mix, liquid organic fertilizer is also very necessary for hydroponic vegetable cultivation to reduce the use of inorganic fertilizers. AB Mix nutrients can be combined with liquid organic fertilizer with the main component of tea pulp to reduce production costs.

Organic fertilizer is fertilizer derived from organic matter such as animal manure, household waste, plants, and sawdust. Making this organic fertilizer by utilizing organic waste can produce environmentally friendly organic fertilizer. Solid organic fertilizers and liquid organic fertilizers are the two categories of organic fertilizers. Organic fertilizers that are liquid rather than solid are more efficient to employ. This type of organic fertilizer known as liquid organic fertilizer has a liquid form and is easily soluble in the soil. According to (Pantang, 2021), liquid organic fertilizer has the advantages that it is easy to make and does not require a long time, can improve the structure of soil particles, and is easy to apply. According to research (Marginingsih, 2018), the usage of liquid organic fertilizer in hydroponics is best combined with AB Mix nutrients so that nutrients complement one another since it can have a perfect influence on plant development and productivity. Therefore, liquid organic fertilizer is used as a substitute in AB Mix nutrition with a liquid organic fertilizer in order to fulfill the nutritional requirements of plants.

Based on research (Ulfa, 2021), In agriculture, organic fertilizer from tea pulp can be used because there are various kinds of minerals and nitrogen that are easily absorbed by plants. In addition, tea pulp is also useful as a provider of nutrients during the decomposition process. In addition to nitrogen (N), it also includes the minerals zinc (Zn), selenium (Se), molybdenum (Mo), germanium (Ge), and magnesium (Mg). Minerals included in tea are a crucial component that plants require, thus if they aren't present, growth would be impeded or inadequate (Gultom, 2013).

There are several contents in tea pulp that can help plant growth, namely Organic Carbon, Copper (Cu) 20%, Magnesium (Mg) 10%, and Calcium (Ca) 13%. Tea grounds also contain antioxidant elements to help prevent free radicals in plant cells (Widyantika, 2018). Tea pulp also has a fairly high protein content of 27.42%, the content of other substances in tea pulp, including caffeine 2.5 - 5.5%, theobromine 0.07 - 0.17%, and theophylline of 0.002 - 0.013%, tannin 1.35%, and crude fiber content of 23.01%. All of these ingredients are needed by plants to grow more optimally (Rinaldi, 2021). Tea pulp as a manufacturer of liquid organic fertilizer, can utilize waste from daily household consumption. The benefits of tea pulp for plants include boosting root, stem, and leaf growth, as well as improving soil fertility.

According to this description, research was conducted on employing liquid organic fertilizer made from tea pulp and ab mix to study the growth of mustard (Brassica juncea L.) hydroponically.

2. MATERIALS AND METHODS

This research was carried out at the Green House, Faculty of Teacher Training and Education, University of Muhammadiyah Surakarta. The study runs from February 2023 to May 2023. The tools used are buckets, rockwool, flannel cloth, basins, knives, scales, trays, blenders, sieves, bars, scissors, jars, stirrers, net pots, plastic containers, and stationery. The materials used are mustard plant seeds brand red arrow stamp, tea dregs, AB Mix, water, EM4, brown sugar, and labels.

The study method employed is an experimental research approach with a Completely Randomized Design, consisting of 4 treatments and 4 repeats. This research design uses one factorial with a combination of AB Mix nutrients and tea pulp liquid organic fertilizer, namely V0 = AB Mix 20 ml + liquid organic fertilizer 0 ml, V1 = AB Mix 15 ml + liquid organic fertilizer 35 ml, V2 = AB Mix 10 ml + liquid organic fertilizer 40 ml, V3 = AB Mix 5 ml + liquid organic fertilizer 45 ml.

The research procedure is to seed mustard seeds that have been soaked into rockwool; make liquid organic fertilizer from tea grounds; transfer seeds after 14 days of age into the Wick system hydroponic installation; prepare a solution of liquid organic fertilizer and AB Mix according to treatment as hydroponic nutrients; changing the nutrient solution once a week; measure height growth, and the number of leaves on mustard plants once a week; took data at the end of the observation (28 HST) and weighed the wet weight of the mustard plant. Observational measures, such as plant height, the number of leaves, and wet weight, are used as data on mustard growth characteristics.

Plant height parameters can be measured using the bar as a measuring tool. Plant height is measured using units (cm). The measured part starts from the base of the plant stem that appears on the surface of the medium to the plant's very tip. The parameter of the number of leaves is calculated manually for strands on each plant. Counted leaves are all leaves that have opened perfectly. Wet weight parameters how to take the results by weighing plants using digital scales after harvesting.

3. RESULTS AND DISCUSSION

3.1. Results

Increased plant height, leaf count, and wet weight are indicators of growth in mustard plants. In research that has been conducted on mustard plants using a mixture of liquid organic fertilizer tea pulp and AB Mix as the treatment given to the plant, it was found that the results observed in the study were in the form of plant growth parameters which included plant height, many leaves, and weight of wet mustard plants. Table 1 shows the average of each parameter.

Table 1. Ror average plant height, many leaves, wet weight of mustard plants

Treatment	Average Parameters		
	Plant Height (cm)	Many Leaf (strand)	Wet Weight (g)
V0	13.9	4.0	5.5
V1	12.4*	3.7*	4.8*
V2	14.0**	7.0**	5.8**
V3	13.4	4.2	5.0

Note: * : lowest
**: best

According to Table 1's average mustard plant findings, the best mustard plant height was discovered in the V2 treatment, where it was 14 cm on average, while the worst treatment was V1, where it was 12.4 cm on average. The best treatment in the parameters of many leaves is V2, which has an average of 7 strands of leaves, while the worst treatment is V1, which has an average of 3.7 strands of leaves. The wet weight parameter shows that V2 has the best treatment with an average wet weight of 5.8 g, and V1 has the worst treatment with an average wet weight of 4.8 g.

Plant height (cm)

According to the analysis showed that the combination of liquid organic fertilizer tea pulp and AB Mix nutrients may increase the height of mustard plants. Figure 1 shows the yield of the average height growth of mustard plants (4 MST- 1 MST).

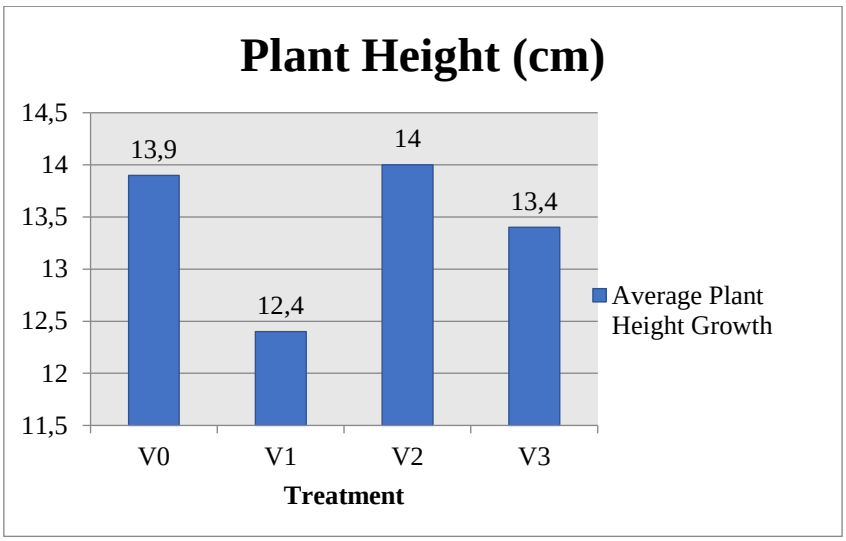

Figure 1. Average Plant Height Growth (cm)

The highest average growth of mustard plants is found in V2 treatment with an average plant height of 14 cm. In the V2 treatment using a combination of nutrients AB Mix 10 ml coupled with liquid organic fertilizer tea pulp 40 ml and produce the best plant height, it shows that the AB Mix and liquid organic fertilizer tea pulp combination's nutrition may satisfy the nutrient requirements of mustard plants. In accordance with the statement (Marginingsih, 2018) that the substitution of liquid organic fertilizer in the nutrients in AB Mix can result in this good growth because the nutrients in AB Mix contain enough macro- and micronutrients to support plant growth during physiological and metabolic processes.

In increasing height, plants need nutrients contained in them such as nitrogen. Nitrogen serves to stimulate budding and increase plant height. In addition, nitrogen accelerates the growth of the entire plant, particularly the stems and leaves, when it is present in appropriate amounts. Research (Alsyah, 2018) states that fertilization is needed to increase plant height and to meet the needs of plant nitrogen nutrients, besides that there are also microelements that function to increase plant height. According to (Adikasari, 2012), tea pulp contains nitrogen minerals that play a role in spurring stem growth and helping root growth.

(a) (b)

Figure 2. Mustard plant height (a) highest, (b) lowest

The lowest average mustard plant growth was found in the V1 treatment, with an average plant height of 12.4 cm. In this V1 treatment using a combination of AB Mix 15 ml with liquid organic fertilizer tea pulp 35 ml. The V1 treatment produces less than optimal plant height growth. This

can be because the V1 treatment has a nutrient content that is not able to meet the needs of mustard plants. This fits the definition of the statement (Marginingsih, 2018) that nutrient concentrations that are unable to meet the needs of plants in carrying out physiological processes cause slow growth and development processes. And also, according to a statement (Hidayanti, 2019) which states that the provision of nutrients can increase plant growth if the amount is given according to plant needs. If it is too excessive, it will cause growth to be stunted.

Amount of Leaves

According to the analysis showed that the combination of liquid organic fertilizer tea pulp and AB Mix nutrients may increase the number of mustard plant leaves. Figure 3 shows the average outcome of the mustard plant's number of leaves (4 MST minus 1 MST).

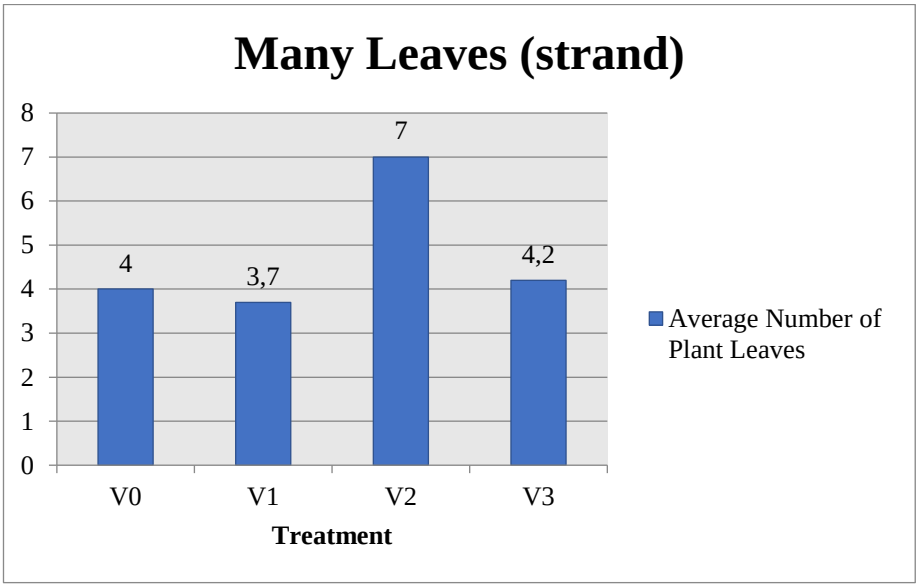

Figure 3. Average Number of Plant Leaves

Based on Figure 3, the conclusions of the study of the average number of leaves on mustard plants indicate that V2 has the best average, with an average of 7 strands of leaves. Considering what has been discovered as a result, it can be seen that the provision of appropriate nutrition will provide optimal results for plant growth and development. Since there are more leaves because of nitrogen, photosynthesis can proceed more quickly, hastening the development of leaf organs. According to (Munifatul, 2014), the amount of nitrogen and phosphorus that is present in the medium and is accessible to plants has a significant impact on how quickly plants can develop leaves. One of the factors in increasing the number of leaves is the absorption of nutrients, especially N. Nitrogen is a macronutrient that of its functions as a constituent of chlorophyll. If the leaves lack chlorophyll, it will slow down the growth of the leaves. Based (Nuryanti, 2022) explained that the use of macro N nutrients is to function as a constituent of chlorophyll, besides that macro N nutrients are also needed by plants in large quantities.

(a) (b)

Figure 4. Many leaves of mustard plants (a) highest, (b) lowest

The average number of leaves in V1 has 3.7 strands, which is the lowest growth output of many leaves. The number of leaves was counted, and the results demonstrate that as the plant grows taller, the number of leaves also grows. In accordance with the statement (Marginingsih, 2018), According to the average number of leaves produced by mustard greens in relation to their average height, it can be concluded that the higher the plant, the more leaves that will be produced. The increasing number of leaves will cause a lot of light absorption as well so that the photosynthesis process can take place properly. As the amount of photosynthesis produced increases, the leaf width is greater, and the wet weight is high.

Wet Weight

According to the analysis showed that the AB Mix nutrients and liquid organic fertilizer tea pulp could have an impact on the wet weight of mustard plants. The results of the average wet weight of mustard plants (4 MST- 1 MST) are shown in (Figure 5)

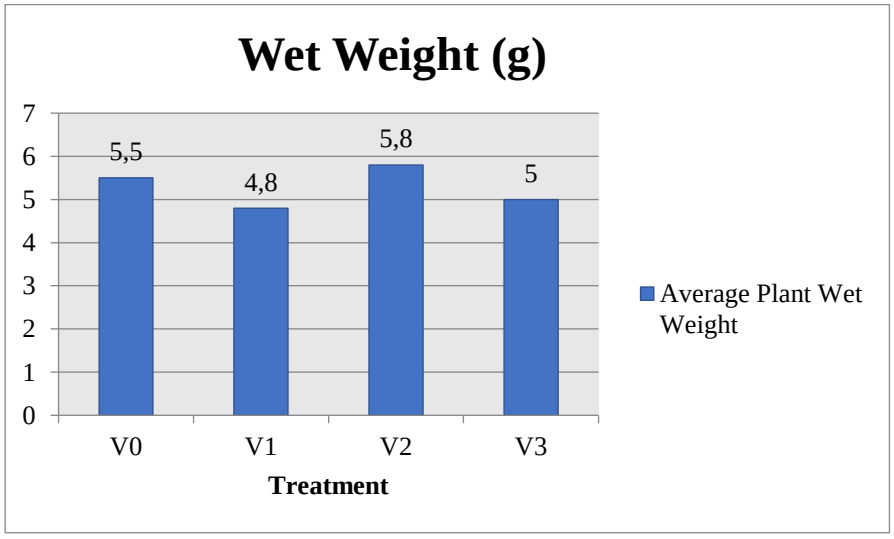

Figure 5. Average Plant Wet Weight (g)

(a) (b)

Figure 6. The wet weight of mustard plants (a) highest, (b) lowest

Wet weight in mustard plants is obtained by weighing mustard plants when the plants are harvested and the roots have been cleaned. Wet weight is used as a clue that characterizes plant growth. Based on Figure 5, the analysis's conclusions of the average number of leaves of mustard plants that have the best average are found in V2, have an average wet weight of plants of 5.8 g. Wet weight in plants can be influenced by the level of effectiveness of plants in absorbing nutrients and water. The number of leaves owned can affect the plant's wet weight, the more the number of leaves, the greater the plant's wet weight. This is in accordance with (Triadiawarman, 2019), the plant's fresh weight will rise in direct proportion to the plant's height and leaf count. In contrast, when a plant's growth is restricted, its fresh weight will be low. In comparison, the lowest plant wet weight is found at V1 because it has an average wet weight of 4.8 g. The variation in mustard plant wet weight in each treatment is caused by the ability of plants to absorb water. If a plant can take water as much as it needs to, its moist weight will rise.

Based on the results of this study, implications can be put forward that can provide information to the community, especially mustard plant cultivators, that AB Mix and tea pulp used as liquid organic fertilizer can be helpful as a combination of nutrients for mustard plants. In addition, it is expected to provide benefits in terms of using cultivation techniques and solution nutrition to increase crop production. In education, this research can be used as input for teachers and prospective teachers as input in the teaching and learning process in grade 12 Biology subjects in Biotechnology.

4. CONCLUSIONS

According to the result and discussion, AB Mix combined with liquid organic fertilizer tea pulp has a significant impact on mustard plant growth in terms of plant height, number of leaves, and wet weight. The V2 treatment uses 10 ml of AB Mix and 40 ml of liquid organic fertilizer, which is the optimum combination of AB Mix and liquid organic fertilizer, while the V1 treatment uses 15 ml of AB Mix and 35 ml of liquid organic fertilizer, which is the lowest combination. The provision of AB Mix nutrition and appropriate liquid organic fertilizer can boost the growth of mustard plants by providing the nutrients that plants need. In this study using liquid organic fertilizer tea pulp, it is necessary to test the content of further fertilizer, including NPK test to see if this fertilizer is by the Indonesian National Standard (SNI).

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