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Utilization of Water Spinach Harvest Waste as Liquid Organic Fertilizer and Compost on the Growth and Yield of Large Chili Plants *(Capsicum Annuum L.)*

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Abstract: The aim of the research was to determine the effect of giving concentrations of liquid organic fertilizer and doses of compost from water spinach harvest waste on the growth and yield of large chili plants *(Capsicum annuum L.)*. The results of the research showed that the administration of various concentrations of LOF and doses of compost from kale harvest waste had a significant effect on the height of large chili plants *(Capsicum annuum L.)* at 84 DAP, and had no significant effect on the number of leaves at 84 DAP, flowering age, number of flowers and the number of large chili plants *(Capsicum annuum L.)*. The combination of 5 ml/l LOF and no compost (P1K0) treatment resulted in the highest average plant height at 84 DAP (38.33 cm), and the highest average number of plant leaves (56.00). The combination of treatment with a LOF concentration of 5 ml/l and the addition of 250 g compost per plant (P1K1) resulted in the fastest average flowering age (18.67 DAP). The combination of treatment with a LOF concentration of 10 ml/l and the addition of 250 g compost per plant (P2K1) produced the highest average number of flowers (10.33 pieces) and also produced the highest average number of fruit (2.33 pieces).

Keywords: Compost; Harvest Waste; Large Chili Plants; Liquid Organic Fertilizer; Water Spinach

Introduction

Large chili *(Capsicum annuum L.)* is a type of vegetable that is quite important in Indonesia (Aljaninansya et al., 2022), both as a commodity consumed domestically and as an export commodity. Large chilies have quite high economic value apart from their nutritional value (Izzah et al., 2023). Indonesian people are among the biggest fans of large chilies in the world, so large chilies have become an important product in Indonesian food. According to data from the Central Statistics Agency (BPS) for 2022, production of large fresh chilies with stalks in 2014 was 1.075 million tons (Syahputra et al., 2022). Compared to 2013, there was an increase in production of 61.73 thousand tons (6.09 percent). This increase was caused by an increase in productivity of 0.19 tons per hectare (2.33 percent) and an increase in harvested area of 4.62 thousand hectares (3.73 percent) compared to 2013.

The use of chemical fertilizers to increase chili production can have an impact on the environment (Gou et al., 2020; Putra et al., 2020). Until now, the average farmer fertilizes large chili plants using inorganic fertilizer (Adirianto et al., 2022). Continuous use of artificial chemical fertilizers without being accompanied by the provision of organic materials can cause the land to become barren and productivity decrease as well as pest problems (Rukmana, 2008). Decreased productivity can be overcome by providing organic fertilizer. The use of organic fertilizer can improve and maintain soil quality. The organic fertilizer used can be in the form of liquid organic fertilizer (LOF) and compost (Rozen et al.,

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2023). By providing liquid organic fertilizer and compost, it is hoped that it will be able to increase productivity in large chili plants (Silalahi & Tyasmoro, 2020).

Using liquid organic fertilizer is more effective and efficient in its use (Karim et al., 2019; Phibunwatthanawong & Riddech, 2019). Liquid fertilizer is more easily absorbed by plants because the elements in it have been decomposed (Hastuti, 2021; Irawan et al., 2021). The use of liquid fertilizer is easier to work and use, in one application of liquid organic fertilizer three kinds of processes are carried out at once, namely fertilizing plants, watering plants and treating plants. Meanwhile, compost is a solid organic fertilizer (Chen et al., 2020). Composting is one way of processing rubbish or organic waste into fertilizer (Ayilara et al., 2020), and utilizing rubbish or organic waste in the form of compost can be one of our solutions/efforts as members of society in dealing with and reducing piles of rubbish, which ultimately has an impact on reducing soil pollution.

This research uses waste from the kale harvest as a basic ingredient for making Liquid Organic Fertilizer (LOF) and compost. Vegetable farmers often ignore waste or leftover crops from their crops on land which can still be reused into more useful materials, namely as organic fertilizer (Murdaningsih et al., 2020). For example, in kale plants, the roots, stems and leaves left over from the harvest are left on the edge of the field so that they become organic waste. Therefore, the author wants to research the effect of LOF and compost from kale harvest waste on the growth and yield of large chili plants. The aim of this research is to determine the effect of providing concentrations of liquid organic fertilizer and doses of compost from water spinach harvest waste on the growth and yield of large chili plants *(Capsicum annuum L.)*.

Method

The research was carried out at the Green House located in Pagutan Timur Village, Mataram District, Mataram City, West Nusa Tenggara. Taking place from February 2023 to June 2023. The research carried out was experimental quantitative research. The research method is validation or testing, namely testing the influence of one or more variables on other variables. This research consists of independent variables and dependent variables. The design used in this research was two factorial completely randomized design (CRD) (Wahyudi et al., 2021) as follows:

The first factor (I) is the concentration of Liquid Organic Fertilizer (LOF):
P0 = 0 mL/L (without LOF)
P1 = 5 mL/L
P2 = 10 mL/L
P3 = 15 mL/L
The second factor (II) is the compost dose:
K0 = 0 (no compost)
K1 = 250 g per plant
K2 = 500 g per plant
So that 12 treatment combinations were obtained, namely:
P0K0 P1K0 P2K0 P3K0
P0K1 P1K1 P2K1 P3K1
P0K2 P1K2 P2K2 P3K2

Each treatment was repeated three times so that there were thirty-six experimental units. The data collection method is carried out by direct observation and measurement using measuring instruments. The results were recorded using a writing instrument. The parameters observed included plant height, number of leaves, number of flowers, and number of fruit. Data analysis uses analysis of variance (ANOVA) and if the results of variance are significantly different (F count > F table 5%) then to compare the two treatment averages a further test is carried out using the Duncan test (Setiawan, 2019). Data processing and analysis using SPSS software.

Result and Discussion

Plant height

The results of the test of variance (ANOVA) for plant height at 84 days after planting (DAP) showed that treatment with various concentrations of liquid organic fertilizer (LOF) and doses of compost from kale harvest waste had a significant effect on the height of large chili plants *(Capsicum annuum L.)* age 84 DAP.

Table 1. Duncan Test Results Average Plant Height (cm) of Large Chili *(Capsicum annuum L.)* Age 84 DAP in Various LOF and Compost Treatments

Treatments	Average plant height
P0K0	36.67cd
P0K1	33.00abcd
P0K2	26.17a
P1K0	38.33d
P1K1	29.17abc
P1K2	31.23abcd
P2K0	35.50bcd
P2K1	34.50abcd
P2K2	27.17ab
P3K0	36.67bcd
P3K1	32.17abcd
P3K2	26.33a

Note: The same letters are not significantly different based on the Duncan Test at a confidence level of 5.00%

The results of Duncan's test are presented in Table 1 which shows that the combination of 5 ml/l LOF treatment and no compost (P1K0) produced the highest average height of large chili *(Capsicum annuum L.)* plants (38.33 cm) at 84 DAP and was significantly different from combination of treatments P0K2, P1K1, P2K2, and P3K2. And not significantly different from the treatment combinations P0K0, P0K1, P1K2, P2K0, P2K1, P3K0, and P3K1.

Number of Leaves

The results of the variance test (ANOVA) on the number of leaves at 84 days after planting (DAP) showed that the treatment of various concentrations of liquid organic fertilizer (LOF) and the dose of compost from the waste from the kale harvest did not have a significant effect on the number of leaves of large chili plants (Capsicum annuum L) age 84 DAP as seen in Figure 1.

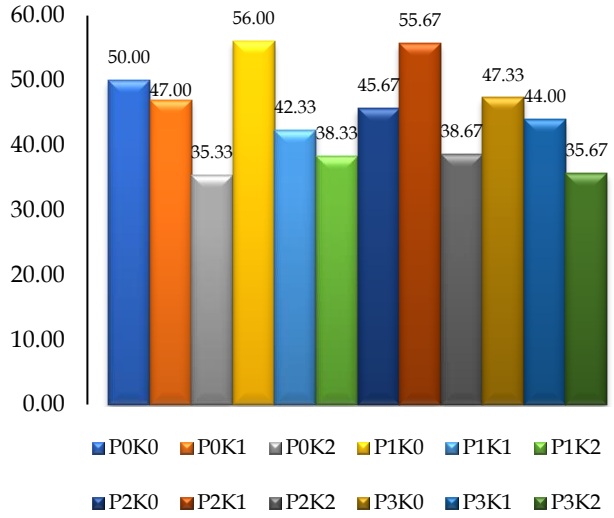

Figure 1. Average Number of Leaves (strands) of Large Chili Plants *(Capsicum annuum L.)* Age 84 SAP in Various LOF and Compost Treatments

Figure 1 shows that the combination of 5 ml/l LOF and no compost (P1K0) treatment produced the highest average number of leaves on large chili plants *(Capsicum annuum L.)* (56.00 pieces) at the age of 84 DAP.

Flowering Age

The results of the test of variance (ANOVA) on flowering age showed that the treatment of various concentrations of liquid organic fertilizer (LOF) and the dose of compost from kale harvest waste had no significant effect on the flowering age of large chili plants *(Capsicum annuum L.)*.

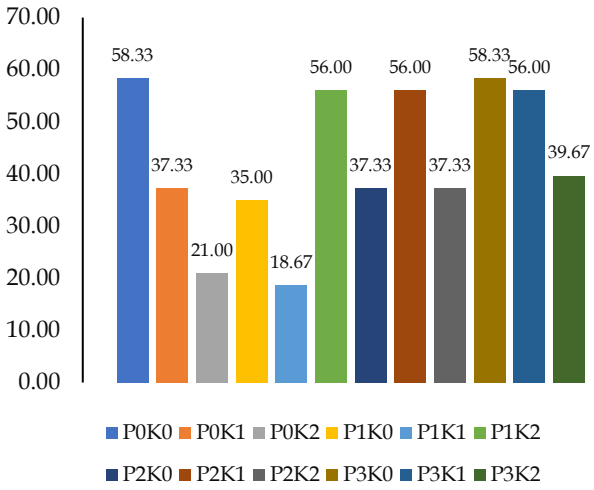

Figure 2. Average Age of Flowering (DAT) of Large Chili Plants *(Capsicum annuum L.)* in Various LOF and Compost Treatments

Figure 2 shows that the combination of 5 ml/l LOF treatment and 250 g compost dose per plant (P1K1) resulted in the fastest average flowering age of large chili plants (Capsicum annuum L.) (18.67 DAT).

Amount of Flower

The results of the variance test (ANOVA) for the number of flowers showed that the treatment of various concentrations of liquid organic fertilizer (LOF) and the dose of compost from kale harvest waste had no significant effect on the number of flowers of large chili plants *(Capsicum annuum L.)*. Figure 3 shows that the combination of 10 ml/l LOF treatment and 250 g compost dose per plant (P2K1) produced the highest average number of flowers on large chili plants *(Capsicum annuum L.)* (10.33).

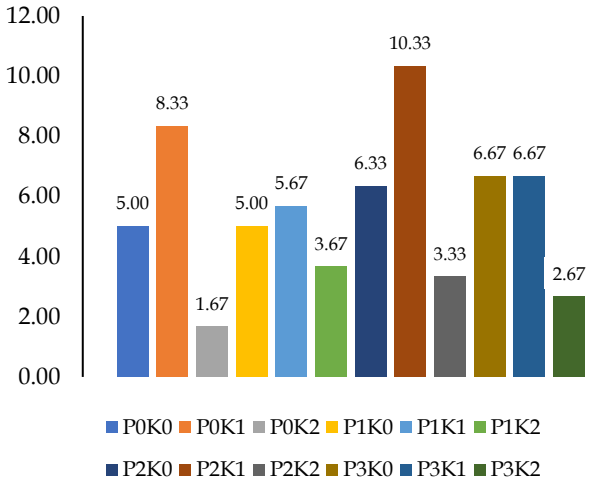

Figure 3. Average Number of Flowers (strands) of Large Chili Plants (Capsicum annuum L.) in various LOF and Compost Treatments

Number of Fruits

The results of the test of variance (ANOVA) for the number of fruit showed that the treatment of various concentrations of liquid organic fertilizer (LOF) and the dose of compost from waste from the kale harvest had no significant effect on the number of fruit from large chili plants *(Capsicum annuum L.)*.

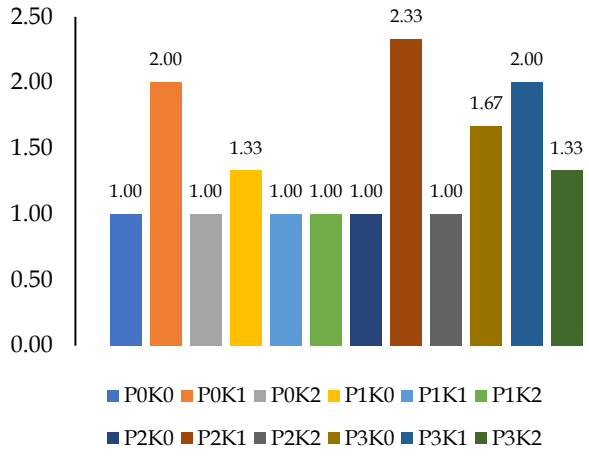

Figure 4. Average number of fruits (fruit) of large chili plants (Capsicum annuum L.) in various LOF and compost treatments

Figure 4 shows that the combination of 10 ml/l LOF treatment and 250 g compost dose per plant (P2K1) produced the highest average number of fruit on large chili plants *(Capsicum annuum L.)* (2.33).

Discussion

Based on Table 1. Duncan Test Results Average Plant Height (cm) of Large Chili *(Capsicum annuum L.)* Age 84 DAP, it can be seen that the combination of treatment with a Liquid Organic Fertilizer (LOF) concentration of 5 ml/l and without compost (P1K0) produces the highest average plant height (38.33 cm) compared to other treatment combinations,

It is shown by other results on the number of leaves aged 84 days after planting (DAP) that the combination of treatment with a concentration of Liquid Organic Fertilizer (LOF) of 5 ml/l and without compost (P1K0) produced the highest average number of plant leaves (56.00 pieces) compared to other treatment combinations. This means that even without using compost, giving LOF from water spinach waste can provide high plant yields and a better number of leaves (Sulistiani et al., 2023). It is suspected that providing the nutrients contained in liquid organic fertilizer at this concentration can meet the nutrient requirements needed by large chili plants and can also be absorbed and utilized properly by the plants. According to (Bindraban et al., 2015), giving the right dosage will facilitate the entry of nutrients into the root tissue so that the transport of nutrients into the plant will be smooth, which will result in good plant growth and development, so that leaf formation is encouraged.

LOF is able to provide the macro and micro nutrients needed by plants so that it can support high growth and large leaf numbers of chili plants and also because the fertilizer is in liquid form, nutrient absorption is faster. According to (Lingga, 2010), another advantage of LOF is that it can be given more evenly and the concentration can be adjusted according to the plant's needs, nutrient absorption is faster and the plant can directly use it because the nutrients in it have been broken down so that the effect can be seen directly on the growth and production of the plant. generated.

Apart from that, waste from the kale harvest is leftover organic material which is easily decomposed and contains good nutrients to be used as raw material for LOF, as stated by Sakib (2021) that wet organic material such as fruit and vegetable waste is a very good raw material for liquid fertilizer good (Esparza et al., 2020; Fadlilla et al., 2023; Ginandjar et al., 2019) because apart from being easily decomposed, this material is also rich in nutrients that plants need. The combination of treatment with a Liquid Organic Fertilizer (LOF) concentration of 5 ml/l and the addition of 250 g compost per plant (P1K1) resulted in the fastest average flowering age (18.67 DAP) compared to other treatment combinations. It can be seen that the low LOF concentration treatment still supports the acceleration of plant flowering time.

The combination of treatment with a Liquid Organic Fertilizer (LOF) concentration of 10 ml/l and the addition of 250 g compost per plant (P2K1) produced the highest average number of flowers (10.33 pieces) and also produced the highest average number of fruit (2.33 pieces) compared to other treatment combinations. This means that increasing the LOF concentration and adding compost can produce a better number of flowers and fruit (Andaries et al., 2023; Zaccardelli et al., 2018). It is suspected that giving LOF is able to provide the macro and micro nutrients needed by plants so that they can support plant growth and production. Prajnanta (2011) explained that macro elements play an important role in plant growth and development and micro elements play a role in the formation and improvement of yield quality. Likewise, the addition of compost can provide benefits for plants, including organic compost which can improve the structure of clay soil so that it becomes light (Indriani, 2011). With these conditions, it can increase soil porosity so that it can support plant root growth better so that it will also influence the vegetative and generative growth of large chili plants.

The results of the variance test (ANOVA) showed that treatment with various concentrations of liquid

organic fertilizer (LOF) and doses of compost from kale harvest waste had no significant effect on the number of leaves, flowering age, number of flowers and number of fruit of large chili plants *(Capsicum annuum L.)*, this is thought to be influenced by poor plant growth due to environmental factors, namely air humidity which tends to be higher, where chili plants are plants that are susceptible to the effects of high humidity. This is in accordance with what was stated by Ripangi (2012), that chili plants can grow well in areas with moderate air humidity. High air humidity causes plants to tend to be susceptible to pests and diseases. These pests and diseases can interfere with the growth and production of chili plants. This can be seen by the fairly high drop of flowers and fruit, so that liquid organic fertilizer (POC) and compost are applied. Most of them have no effect on the growth and production of large chili plants, and only affect initial growth, namely the height of large chili plants. From the observation results it can be seen that the flowers produced are not able to form maximum fruit. This happens because the plant experiences flower abort during the flowering period. This is due to unfavorable environmental influences so that plants are susceptible to pests and disease.

Conclusion

Providing various concentrations of liquid organic fertilizer (POC) and doses of compost from water spinach harvest waste have a significant effect on the height of large chili plants (Capsicum annuum L.) at 84 DAP, and have no significant effect on the number of leaves at 84 DAP, flowering age, number of flowers and number of fruits of large chili plants (Capsicum annuum L.). The combination of treatment with a liquid organic fertilizer (POC) concentration of 5 ml/l and without compost (P1K0) resulted in the highest average plant height at 84 DAP (38.33 cm), and the highest average number of plant leaves (56.00 pieces) , while the combination of treatment with a liquid organic fertilizer concentration (POC) of 5 ml/l and the addition of 250 g compost per plant (P1K1) produced the fastest average flowering age (18.67 DAT), and the combination of treatment with a liquid organic fertilizer concentration (POC) of 10 ml/l and the addition of 250 g compost per plant (P2K1) produced the highest average number of flowers (10.33 pieces) and also produced the highest average number of fruit (2.33 pieces).

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Place acknowledgments, including information on grants received, before the references, in a separate section, and not as a footnote on the title page

Author Contributions

The author's contribution to research activities is: Nurlailah Mappanganro (Chief Researcher) is tasked with compiling proposals, collecting data, analyzing data, preparing final reports, national seminars, coordinating with the research team during research activities. Baiq Inggar Linggarweni (Member) is tasked with preparing proposals, collecting data, analyzing data, preparing final reports. Nirmawati (Member) is in charge of preparing proposals, collecting data, analyzing data, preparing final reports.

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Conflicts of Interest

The activities of this entire series of research are fully funded by internal funds from Al-Azhar Islamic University where the output of this research is in the form of a Reputable National Journal which is published in the journal Sinta 2 according to the funds and contract of the funder (UNIZAR) to the researcher. The duties of each researcher have been approved by both the chairman, members and students involved in this research. The research results will be submitted at the research monev at a predetermined time and the research output will be submitted to LPPM as the institution tasked with reporting on all research and service activities to the University.

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