Effectiveness of Liquid Organic Fertilizer from Banana Peel on the Growth of Pepper Plants (*Capsicum annuum*)

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Abstract- The use of organic fertilizers as an alternative to chemical fertilizers is one way to reduce the use of chemical fertilizers which have negative effects when used for a long time. This study aims to determine the effect of liquid organic fertilizer on the growth of pepper plants. This study used a completely randomized design (CRD), which consisted of 6 treatments with 4 replications, namely control P0 (0 ml), P1 (100 ml), P2 (200 ml), P3 (300 ml), P4 (400 ml), P5 (500 ml). The variables observed in this study were plant height, number of leaves, dry weight, and fresh weight. The results of the study showed that the application of liquid organic fertilizer from banana peels affected plant height, number of leaves, fresh weight and dry weight of pepper plant. P5 treatment (500 ml) is the best concentration for increasing the growth of pepper plants.

Index Terms- Banana peel, Liquid organic fertilizer, Pepper plants, Fermentation.

I. INTRODUCTION

Human population increases continue to occur every year, according to data from the United Nations Department of Economic and Social Affairs (2022) in 2022 the world's population is estimated to reach 8 billion people. An increase in the human population will be followed by an increase in human needs such as shelter and food. The increase in food demand as a result of an increase in population has led to demands to increase the productivity of the agricultural sector. Various methods are used to increase agricultural productivity, one of which is using chemicals as fertilizers or pest control (Kumar *et al.* 2022).

The use of chemical fertilizers can increase crop productivity, according to Yousaf *et al.* (2017) the application of NPK, NP, NK, and PK chemical fertilizers increased the productivity of rice (19% -41%) and repeseed (615-67%). The results of research by Lin *et al.* (2022) also showed an increase in the productivity of soybean and corn plants after the application of chemical fertilizers. Similar results were also found in cotton plants which experienced an increase in vegetative character and productivity after being treated with chemical fertilizers (Ecvheri and Yilmaz, 2018). The use of chemical fertilizers can increase the productivity of agricultural crops, but long-term use has a negative impact. The use of chemical fertilizers for a long time can cause environmental pollution, interfere with human health, and reduce soil quality (Trujillo-Tapia and Ramirez-Fuentes, 2016; Rai and Shukla, 2020; Kumar *et al.* 2022). The use of chemical fertilizers for a long time can affect microbes that play a role in the process of bioremediation of organic elements, increasing soil pH which interferes with plant growth (Mkonda and He, 2017).

The use of organic fertilizers is an alternative that can be used as a substitute for chemical fertilizers. The use of organic fertilizers in agriculture can reduce the amount of use of chemical fertilizers. Organic fertilizers not only contain the nutrients needed by plants but also contain microorganisms that help fertilize the soil (Ajmal *et al.* 2018). The use of organic fertilizers can increase the absorption of nutrients by plants, increase plant growth and productivity and increase the level of plant resistance to environmental stress and pathogens (Daniel *et al.* 2022). Biofertilizers can be made from natural ingredients such as unused fruit and vegetable scraps. The purpose of this study was to determine the effectiveness of liquid organic fertilizer from fermented banana skin waste on the growth of pepper plants.

II. METHODS

This research was conducted at the Botanical Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, and Integrated Field Laboratory, Faculty of Agriculture, University of Lampung. In this study, a completely randomized design (CRD) was used with 6 treatments (ie P0 = (control), P1 = 100 ml; P2 = 200 ml; P3 = 300 ml; P4 = 400 ml; P5 = 500 ml.) repeated as many times as 4 times.

Manufacture of Liquid Organic Fertilizer and Planting Media Preparation

10 kg of banana peels were cut into small pieces and blended until smooth then put in a plastic drum, added 10 liters of coconut water and 1 kg of brown sugar and stirred, covered with plastic and punched with a hose connected to a water bottle to protect pressure. waiting for 30 days for the fermentation process.

Making the planting medium is done by mixing the soil and manure with a ratio (2:1), then sieved to obtain a medium with a loose structure. The media is then sterilized using hot steam by placing the soil in a drum filled with water below, then steaming for 3-4 hours, after which the soil is allowed to cool and put in a 3 kg polybag.

Pepper Planting and Treatment

The pepper seeds are soaked in water for 1 hour, the seeds that have been soaked are then sown in trays filled with soil and manure until they are 21 days old until 3-4 leaves appear. Transfer of seeds to polybags is done carefully by removing the seeds and soil.

Plants that have been transferred to polybags are then given liquid organic fertilizer treatment with different volumes for each treatment. The doses given were 0 ml (control), 100 ml (P1), 200 ml (P2), 300 ml (P3), 400 ml (P4), and 500 ml (P5). Giving liquid organic fertilizer is done 1x a week for 1 month.

Data Collection and Analysis

The phenotypic characters measured were dry weight, fresh weight, number of leaves, and plant height. Measurement of plant height and the number of leaves were measured at weeks 2, 4, and 6 while the dry weight and fresh weight of pepper plants were measured at week 6. The phenotypic data obtained were then analyzed using ANOVA at the α level of 5% and the Least Significant Difference Test at α level of 5% using the SPSS ver 26 application.

III. RESULT AND DISCUSSION

Plant Height

Table 1. Height of Pepper Plant

Treatments	Plant Height (cm)		
	Week 2	Week 4	Week 6
P0(0 ml)	6 ± 0.91[a]	10.25 ± 1.32[a]	16.2 ± 1.03[a]
P1 (100 ml)	11.87 ± 3.63[b]	17.5 ± 6.6[ab]	22.4 ± 8.57[ab]
P2 (200 ml)	14.5 ± 3.78[bc]	21.25 ± 5.69[b]	28.77 ± 8.28[b]
P3 (300 ml)	13.37 ± 2.56[b]	17.25 ± 2.21[ab]	24.37 ± 3.27[ab]
P4 (400 ml)	17.12 ± 2.59[bc]	22.5 ± 3.58[b]	25.5 ± 4.41[ab]
P5 (500 ml)	19 ± 4.88[c]	24 ± 8.43[b]	27.55 ± 6.88[b]

Numbers followed by the same letters are not significantly different on the Duncan test α <5%

The application of liquid organic fertilizer has a significant effect on α <5% on plant height characters. Liquid organic fertilizer treatment was able to produce better plant height than the control treatment. of the five concentrations of liquid fertilizer treatment given, the P5 treatment (500 ml) produced the best plant height compared to the control treatment and other concentration treatments. The results in table 1 also show a positive correlation between plant height and the increase in the concentration of liquid fertilizer used, pepper plants that were given liquid fertilizer with higher concentrations produced better plant height than the control treatment and treatments with lower fertilizer concentrations.

Number of Leaf

Table 2. Number of leaf of Pepper Plant

Treatments	Number of Leaf (cm)		
	Week 2	Week 4	Week 6
P0 (0 ml)	5.5 ± 0.577[a]	7.25 ± 1.258[a]	8.2500 ±1.258 [c]
P1 (100 ml)	8.5 ± 1.291[bc]	10 ± 3.367[ab]	11.5000±2.646[bc]
P2 (200 ml)	8.5 ± 1.732[bc]	12.25 ± 3.096[b]	16.2500±4.272[a]
P3 (300 ml)	8.25 ±1.5 [b]	9.75 ± 1.708[ab]	12.7500±1.893[ab]
P4 (400 ml)	9.5 ± 1.291[bc]	11 ± 2.582[ab]	10.7500±3.202[bc]
P5 (500 ml)	10.75 ± 2.217[c]	13.5 ± 3.416[b]	11.0000±1.414[bc]

Numbers followed by the same letters are not significantly different on the Duncan test α <5%

The character of the number of plant leaves resulting from the application of liquid fertilizer showed significant differences at the level of α <5%. The results of the highest number of leaves were obtained in the P5 treatment (500 ml) compared to the control treatment and other concentrations. The number of leaves of the control pepper plants without the application of liquid organic fertilizer obtained the smallest results compared to the pepper plants which were given liquid organic fertilizer, the concentration of liquid organic fertilizer used also showed a positive correlation with the number of red pepper plant leaves observed.

Fresh Weight and Dry Weight

Tabel 3. Fresh weight and dry weight of pepper plant

Treatments	Fresh Weight (gr)	Dry Weight (gr)
P0 (0 ml)	1.47 ± 0.33[a]	0.17 ± 0.05[a]
P1 (100 ml)	3.57 ± 2.2[ab]	0.37 ± 0.24[ab]
P2 (200 ml)	6.32 ± 2.77[b]	0.29 ± 0.22[ab]
P3 (300 ml)	3.35 ± 0.79[ab]	0.45 ± 0.11[ab]
P4 (400 ml)	3.39 ± 2.24[ab]	0.47 ± 0.34[ab]
P5 (500 ml)	4.95 ± 2.46[b]	0.56 ± 0.25[b]

Numbers followed by the same letters are not significantly different on the Duncan test α <5%

The highest dry weight of pepper plants resulting from liquid organic fertilizer treatment was found in treatment P5 (500 ml), the results were significantly different at the 5% level compared to the control treatment P0. The other liquid organic fertilizer concentration treatments showed an increasing trend compared to the control treatment even though it was not statistically significant.

Discussion

In this study, the application of organic liquid fertilizer significantly increased the vegetative character of pepper plants, this result is in line with the results of Nhu *et al.* (2018) which showed that organic fertilizers derived from fruit waste were able to increase the growth of I. aquatica, B. integrifolia and B. rapa chinensis plants. The same results were also shown for Caesalpinia pulcherrima plants which produced better growth than control plants without applying liquid organic fertilizer (Suliasih and S Widawati, 2018). In this study the fermentation process was carried out by mixing banana peels with coconut water and brown sugar for 1 month to grow microorganisms. Sugar and coconut water are useful as a source of sugar needed for the growth of microorganisms during the fermentation process of liquid organic fertilizer so that fermented liquid organic fertilizer is obtained which contains microorganisms in it. The application of liquid organic fertilizer containing microbes such as bacteria can have a positive effect on increasing the vegetative character of plants, Maheswari and Elakkiya (2014) stated that the application of organic liquid fertilizer containing bacteria such as Azospirillum, Rhizobium, and Azotobacter shows a positive effect on the vegetative character of plants. The application of liquid organic fertilizer without or with the bacterial inoculants Azotobacter and Azospirillum and the addition of NPK can increase the percentage of germination, growth and productivity of brijal plants compared to controls (Sherpa *et al.* 2019).

In this study liquid fertilizer was made with banana peels as the main ingredient, this was due to the limited use of banana peels as animal feed. From the results of this study, it is known that banana peels have the potential as a liquid organic fertilizer that can increase the growth of pepper plants. Banana peel is known to have many ingredients such as potassium, calcium, sodium, iron, manganese, bromine, rubidium, strontium, zirconium, protein, lipid, carbohydrate, fiber, copper, ash (Anhwange *et al.* 2009; Hassan and Peh, 2018; Hassan *et al.* 2018). Nutrients such as phosphorus, potassium, potassium, and magnesium are needed by plants. Johnson and Mirza (2020) state that macronutrients and micronutrients are needed by plants for growth and development, and the availability of sufficient nutrients can increase plant productivity.

The use of macronutrients in large quantities can increase plant growth and productivity (Alhasan and Al-Merie, 2021). Tripathi *et al.* (2014) also stated that macronutrients are very important in plant growth and development, their functions vary from forming plant structural units to redox agents. The application of macronutrients generally increases the productivity, growth, and quality of plants. The availability and amount of nutrients such as nitrogen are linearly related to the increase in dry weight, other nutrients such as phosphorus, potassium, and magnesium also affect plant dry weight apart from increasing fertility (Veazie *et al.* 2022). Lack of availability of macronutrients and micronutrients can inhibit plant growth and development (Jeyanny *et al.* 2009). The treatment of liquid organic fertilizers containing microorganisms is also able to increase the levels of nutrients in the soil needed by plants such as nitrogen, phosphate, and potassium (Neneng, 2020). The results of Demir's research (2020) also show that the application of organic fertilizers increases the availability of macronutrients in the soil such as N, P, K, Mg, and Ca.

IV. CONCLUSION

Treatment of liquid organic fertilizer from fermented banana skin waste can increase the growth of pepper plants compared to controls. Increasing the dose of liquid organic fertilizer showed a positive correlation to the increase in the vegetative character of pepper plants.

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