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The Effect of Planting Media and Liquid Organic Fertilizer Interval on the Growth and Yield of Chili Peppers

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ABSTRACT

This study aims to determine the effect of planting media and the interval of application of liquid organic fertilizer of banana stems on the growth and yield of chili pepper plants (Capsicum frutescens L.). The study was conducted in the greenhouse of the Faculty of Agriculture, UTP Surakarta from December 2024 to February 2025 using a factorial complete randomized block design (RAKL) with two factors: planting media (soil, soil + manure, soil + manure + rice husks) and the interval of application of liquid organic fertilizer (without liquid organic fertilizer, once every 5 days, once every 10 days, once every 15 days). The results showed that the planting media of soil + manure + rice husks (M2) had a very significant effect on plant height, fresh weight, dry weight, number of fruits, and harvested fruit weight, with the highest results in plant height (74.729 cm), fresh weight (76.688 g), and harvested fruit weight (576.75 g). The 15-day liquid organic fertilizer application interval (P3) also showed a significant effect on plant growth and yield, with the highest plant height (67.336 cm) and the highest harvest fruit weight (524.56 g). The conclusion of this study is that the use of a mixture of soil, manure, and rice husks as a planting medium and a 15-day POC application interval is the best combination to increase the growth and yield of chili pepper. This study also shows that banana stem liquid organic fertilizer can be an alternative environmentally friendly and sustainable organic fertilizer.

Keywords: Chili, Fertilizer, Interval, Media, Stem

1. INTRODUCTION

Chili pepper (*Capsicum frutescens L.*) comes from the American continent and is suitable for growing in tropical areas, especially around the equator. This plant can be cultivated in lowlands with an altitude of 0-500 meters above sea level, and can still grow up to 1000 meters above sea level, although at altitudes above that its productivity decreases (Zahara et al., 2021). The nutritional content of 5g of chili pepper includes calories, fat, carbohydrates, fiber, protein, vitamins A, B6, C, K, manganese, potassium, and riboflavin. C contains compounds capsicin, capsantin, carotenoids, and essential alkaloids (Lagiman & Supriyanta, 2021). Chili pepper is a commodity with high demand value, it was recorded that in 2023 market demand reached 602,689

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tons (Suhita et al., 2024). If this high demand is not followed by optimal productivity, the supply of chilies in the market will be disrupted.

The existence of problems in cultivating chili pepper in the field is one of the obstacles that are often encountered (Silvia et al., 2016). Problems in cultivating chili pepper can be overcome with proper and environmentally friendly cultivation techniques. One way to increase soil fertility is by using organic materials such as rice straw, sawdust, cocopeat, fern roots, burnt rice husks, and other media (Muliati & Ete, 2017). Use of liquid organic fertilizer has the benefit of increasing soil fertility, so that the nutrients in the soil can be optimally utilized by plants and increase the productivity of cabbage plants (Umar et al., 2020). Fertilizer plays a role in supporting and strengthening the photosynthesis process, increasing the strength and endurance of plants, making plants more resistant to drought, stimulating the growth of production branches, helping to absorb nitrogen from the air, dissolving phosphorus in the soil, and speeding up harvest time (Samantaray et al., 2024). Apart from using fertilizer, plant stems can also be used as an alternative source of nutrients for plants (Saragih et al., 2023)

Banana stems can be used in agriculture as a material for making liquid organic fertilizer that is effective in supporting plant growth. This manufacturing process involves fermentation in a closed container with the addition of water and decomposing microorganisms. The fermentation process will produce liquid fertilizer that is rich in nutrients and microbes that are useful for increasing soil fertility and plant health. Liquid organic fertilizer from banana stems not only provides direct nutrition to plants, but can also improve soil structure, increase soil microorganism activity, and reduce dependence on chemical fertilizers, making it more environmentally friendly and sustainable. The use of banana stems as organic fertilizer can reduce dependence on chemical fertilizers, increase agricultural yields sustainably, and reduce negative impacts on the environment. Banana stem extract contains phosphorus elements of around 0.2-0.5%, which are useful for adding nutrients to support plant growth and production. Therefore, banana stems can be used as liquid organic fertilizer (Gultom et al., 2021). The benefits of this research are to increase the benefits of banana stem waste and change it into a form of liquid organic fertilizer that can play a role in increasing the growth and yield of chili pepper. This study aims to determine the effect of planting media and the use of liquid organic fertilizer on the growth and yield of chili plants.

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2. RESEARCH METHOD

Research Site

Research was conducted in the greenhouse of the Faculty of Agriculture, UTP Surakarta from December 2024 to February 2025.

Research Design

The research was designed using a factorial Complete Randomized Block Design (RAKL) consisting of 2 factors. The first factor, planting media (M) consists of 3 levels M0, M1, M2 (Soil, Soil + manure, Soil + manure + rice husks. The second factor, Liquid Organic Fertilizer Interval (P) consists of 4 levels P0, P1, P2, P3 (Without Liquid Organic Fertilizer, Liquid Organic Fertilizer once every 5 days, Liquid Organic Fertilizer once every 10 days, Liquid Organic Fertilizer once every 15 days. Each treatment combination was repeated 3 times.

Making Organic Liquid Fertilizer from Banana Stems

Banana stems are chopped into small pieces (5kg), put into a sack, soaked in water containing 10 L of rice washing water, 200 g of brown sugar and 200 mL of EM4, the bucket is closed and left for 7-14 days. The bucket lid is opened and closed to release gas, the use of liquid organic fertilizer is diluted (1 Liquid organic fertilizer: 15 L of water). Given to plants with the treatment (P0: Without liquid organic fertilizer, P1: Application of liquid organic fertilizer once every 5 days, P2: Application of liquid organic fertilizer once every 10 days, P3: Application of liquid organic fertilizer once every 15 days).

Preparation of planting media and planting

Plastic polybags measuring 35x35 (cm) filled with treated media (M0: Soil Media, M1: Soil Media + Manure (1:1), M3: Soil Media + Manure + Husk (1:1:1) each polybag contains 15kg. Seedlings that have been sown at 14 days old are ready to be planted in polybags and given liquid organic fertilizer according to the treatment.

Observation

The 2-week-old plants were observed for plant height and number of leaves, then after flowering the number of flowers formed was observed, after 60-70 days the harvest was carried out once a week until 8 days were finished, then observations were made (Plant height, fresh weight, dry weight, number of disease attacks, number of fruit, fruit weight).

Data Analysis

Data obtained were analyzed by SAS aplication Analysis of Variance (ANOVA) or analysis of variance. If there is a significant difference, a further test (Duncan Multiple Range Test) DMRT is carried out at the 5% level.

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3. RESULTS AND DISCUSSION

Liquid organic fertilizer from natural ingredients such as banana stems can provide significant benefits (Basri et al., 2023) in increasing soil fertility and supporting sustainable plant growth. In addition, the right planting media and appropriate fertilization interval settings are very important in maximizing the potential of plant yields. Based on the results of research conducted in the field, the following data were obtained.

Table 1. Effect of Planting Media Treatment and Liquid Organic Fertilizer Interval on Plant Height, Fresh Weight, and Dry Weight

Treatment	Plant Heigh (cm)	Fresh Weight (g)	Dry Weight (g)
Planting Media (M)			
Control (M0)	47,561c	48,155c	27,376c
Soil + Manure (M1)	62,783b	67,178b	34,625b
Soil + Manure + Husk (M2)	74,729a	76,688a	44,579a
Liquid Organic Fertilizer Interval (P)			
Control (P0)	55,292d	62,786b	31,492b
Applying Liquid Organic Fertilizer every 5 days (P1)	60,042c	62,458b	35,713a
Applying liquid organic fertilizer once every 10 days (P2)	64,094b	62,231b	37,143a
Applying liquid organic fertilizer once every 15 days (P3)	67,336a	68,553a	37,758a

(Source: Observation Result, 2024)

Note: Numbers with the same letters do not indicate significant differences. In the 5% DMRT test.

Plant height is one of the important variables used to measure the physical growth of plants during the cultivation period. In general, plant height is influenced by factors such as the type of planting media, fertilizer application, and environmental conditions. In this study, plant height measurements were carried out to evaluate the response of cayenne pepper plants to the treatment of planting media and the interval of application of liquid organic fertilizer to banana stems. This variable provides an overview of the extent to which the treatment can support the vegetative development of plants and their potential to produce optimal fruit.

Observation results showed that the treatment of planting media had a very significant effect ($p<0.01$) on plant height (Table 1). Plant height in the treatment of planting media Soil + Manure + rice husks (M2) obtained the highest growth of plant height, which was 74.729 cm,

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compared to the height of plants without manure (M0) obtained the lowest plant height, which was 47.561 cm (Table 1). The provision of manure showed good growth, this is because manure can store water optimally (Jailani & Almukarramah, 2022), then the manure is converted into humus. In addition to optimizing plant growth, manure from animal waste can improve the physical and chemical properties of the soil (Putra et al., 2020)

Treatment of liquid organic fertilizer intervals had a significant effect ($p<0.05$) on plant height (Table 1). Plant height in the provision of liquid organic fertilizer once every 15 days (V3) obtained the highest growth in plant height, which was 67.336 cm or much higher, compared to plant height without liquid organic fertilizer (V0) with the lowest plant height, which was 55.292 cm (Table 1). The increasing interval of organic fertilizer administration also showed an increase in yield in plants (Gudadhe Khatri Mahavidyalaya et al., 2023) states that the liquid organic fertilizer content is enriched with bacteria and fungi that can make the soil healthy and beneficial for plants.

Treatment of planting media gave a very significant effect ($p<0.01$) on wet weight (Table 1). The wet weight in the treatment of planting media Soil + Manure + rice husks (M2) obtained the highest growth of wet weight, which was 76.688 g, compared to the wet weight without manure (M0) obtained the lowest wet weight, which was 48.155 g (Table 1). The treatment of liquid organic fertilizer intervals gave a significant effect ($p<0.05$) on wet weight (Table 1). The wet weight in the provision of Liquid organic fertilizer once every 15 days (V3) obtained the highest growth of wet weight, which was 68.553 g or much higher, compared to the wet weight without the provision of liquid organic fertilizer (V0) the lowest wet weight, which was 62.786 g (Table 1). This parameter shows that the liquid fertilizer given is sufficient for the macro and micro elements needed by the plant. (Payumi et al., 2022) States that if the content of micro and macro elements in fertilizer is insufficient, plant metabolism cannot run optimally.

Planting media traetment gave a very significant effect ($p<0.01$) on dry weight (Table 1). Dry weight in the treatment of planting media Soil + Manure + rice husk (M2) obtained the highest growth of dry weight, namely 44.579 g, compared to dry weight without manure (M0) obtained wet dry weight of 27.376 g (Table 1). In line with research (Chotimah et al., 2022) manure application in the media increased the dry weight of *Rorippa indica* L. Hiern up to 2.61 g. Plant dry weight is closely related to nutrients obtained from the soil because these nutrients support various physiological processes that are essential for plant growth. The main nutrients such as nitrogen (N), phosphorus (P), and potassium (K) play a role in protein synthesis, root formation,

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and energy production in plants. With sufficient nutrient availability, plants can photosynthesize efficiently, producing energy and organic matter needed for growth.

Liquid organic fertilizer intervals had a significant effect ($p<0.05$) on dry weight (Table 1). Dry weight when given liquid organic fertilizer once every 15 days (V3) obtained the highest growth in dry weight, which was 37.758 g or much higher, compared to dry weight without giving liquid organic fertilizer (V0) with the lowest dry weight, which was 31.492 g (Table 1). Increasing the interval of giving POC tends to increase the dry weight of chili plants, according to research (Pangaribuan et al., 2019) this increase is due to the absorption of elements running optimally so that there is an increase in the dry weight of the plant.

Correlation between plant dry weight and nutrient absorption is very close (Sitorus et al., 2014), because the dry weight of the plant reflects the total amount of organic matter formed as a result of photosynthesis and other metabolic processes. The higher the dry weight of the plant, the more likely it is that the plant has a well-developed root system, which allows for more efficient absorption of nutrients from the soil. Healthy plants with optimal growth are usually able to absorb more nutrients such as nitrogen, phosphorus, potassium, and other microelements that are important for supporting their growth. Increased dry weight often indicates that the plant has absorbed enough nutrients to support the process of forming plant tissues, such as leaves, stems, and roots. Conversely, if nutrient absorption is impaired, the dry weight of the plant tends to be low, which can indicate an imbalance in the availability or absorption of nutrients needed by the plant (ERDAL et al., 2017) stated that the weight of the seeds produced is highly dependent on the weight of the plant. Thus it can be said that there is a positive relationship between the dry weight of the plant and the ability of the plant to absorb the nutrients needed to grow and develop.

Table 2. Effect of Planting Media Treatment and Liquid Organic Fertilizer Interval on Disease, Number of Fruits, and Harvested Fruit Weight

Treatment	Disease	Fruit Quantity (Qty)	Fruit Weight (g)
Planting Media (M)			
Control (M0)	72,0833a	45,5833c	375,42c
Soil + Manure (M1)	57,0833b	60,2500b	497,50b
Soil + Manure+ Husk (M2)	35,0000c	67,0833a	576,75a
Liquid Organic Fertilizer Interval (V)			
Control (V0)	61,667a	54,2222d	425,00c
Applying Liquid Organic Fertilizer every 5 days (P1)	56,111b	57,1111c	478,33b
Applying liquid organic fertilizer once every 10 days (P2)	51,111c	58,2222b	505,00ab
Applying liquid organic fertilizer once every 15 days (P3)	50,000c	61,0000a	524,56a

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(Source: Observation Result, 2024)

Note: Numbers with the same letters do not indicate significant differences. In the 5% DMRT test.

The treatment of planting media gave a very significant effect ($p<0.01$) on Disease (Table 2). Disease in the treatment of planting media without manure (M0) obtained the highest growth of disease, which was 72.0833 compared to the dry weight of the treatment of planting media Soil + Manure + rice husks (M2) obtained the lowest disease, which was 35.0000 (Table 2). This shows that the M2 treatment is the best type of media in this study. Poor quality planting media can cause plant stress, making plants more susceptible to disease attacks. Fertile and well-drained media allows the roots to absorb water and nutrients well (Dwiyani et al., 2024), so that plants are stronger and have better resistance to pathogens. Media that is too dense or too wet can create ideal conditions for the growth of fungi or bacteria that cause diseases, such as root rot.

Liquid organic fertilizer treatment intervals had a significant effect ($p<0.05$) on disease (Table 2). Disease without liquid organic fertilizer obtained the highest growth of disease, namely 61,667 or much higher, compared to the disease of liquid organic fertilizer administration once every 15 days (V3) the lowest disease was 50,000 (Table 2). Increasing the liquid organic fertilizer watering interval also correlated positively with a decrease in the level of disease attacks (Dewa Ayu Bela et al., 2024) reported that increasing fertilizer application can reduce the percentage of fruit that falls..

Type of planting media gave a very significant effect ($p<0.01$) on the number of fruits (Table 2). The number of fruits in the treatment of planting media Soil + Manure + rice husks (M2) obtained the highest growth in the number of fruits, namely 67.0833, compared to the number of fruits without manure (M0) obtained the lowest number of fruits, namely 27.376 (Table 2). Research (Hidayat et al., 2025) also stated something similar, that the use of manure as a medium can increase the number of fruits on eggplant plants. The treatment of giving POC gave a significant effect ($p <0.05$) on the number of fruits (Table 2). The weight of the fruit on the giving of POC once every 15 days (V3) obtained the highest number of fruits, namely 61,000 or much higher than the number of fruits without giving POC (V0) the lowest number of fruits was 54,222 (Table 2). This study shows that the use of banana stems as fertilizer shows good results. Banana stems contain various nutrients that are important for plant growth. One of the main components in banana stems is macro elements such as nitrogen (N), phosphorus (P), and potassium (K) (Dwi Mentari et al., 2022), which is needed by plants for the growth of leaves, roots and flowering.

Planting media gave a very significant effect ($p<0.01$) on the weight of the harvested fruit (Table 2). The weight of the harvested fruit in the treatment of planting media Soil + Manure + rice

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husks (M2) obtained the highest growth of the weight of harvested fruit, which was 576.75, compared to the weight of the harvested fruit without manure (M0) obtained lowest weight of harvested fruit, which was 375.42 (Table 2). Combination of planting media using soil, organic fertilizer and rice husks in this study was the best media for growth of chilies as indicated by the fruit weight indicator. (Elsadig et al., 2017) also reported that planting media mixed with organic fertilizer showed almost the same fruit weight results as media treatment with inorganic fertilizer. The use of rice husks as a mixture of planting media is also an effort to restore soil fertility (Managanta et al., 2023).

The treatment of liquid organic fertilizer administration gave a significant effect ($p<0.05$) on the weight of the harvested fruit (Table 2). The weight of the harvested fruit in the administration of liquid organic fertilizer once every 15 days (V3) obtained the highest growth. The weight of the harvested fruit was 524.56 or much higher, compared to the number of fruits without the administration of POC (V0) the lowest weight of the harvested fruit was 425.00 (Table 2). Based on the data obtained (Table 2) it can be seen that the administration of POC at intervals of once every 5 days can actually reduce the weight of the fruit, this is because the provision of too much nutrition can interfere with the physiological processes of the plant and have a negative impact on plant growth (Toor et al., 2020).

Planting media treatment had a very significant effect ($p<0.01$) on plant height, fresh weight, dry weight, disease, and number of fruits. The treatment of liquid organic fertilizer interval had a significant effect ($p<0.05$) on plant height, fresh weight, dry weight, disease, and number of fruits and had no significant effect ($p>0.05$) on harvested fruit weight. The treatment of planting media + manure + rice husk with a liquid organic fertilizer interval of 10 days obtained the highest plant height of 78.333 cm or higher compared to the height of plants without treatment or control obtained the lowest plant height of 34.710 cm. This is in line with research conducted by Mubarok et al (2013) There is a composition of the type of planting media (soil: compost: burnt rice husks) which is higher than other treatments because the composition of this planting media has high porosity so that it is able to store oxygen needed for the respiration process in plant roots which will absorb water and nutrients well so that it can accelerate the growth of plant height.

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Figure 1. Banana stems as liquid organic fertilizer

Figure 2. Brown sugar added as energy source of microorganism

Figure 3. EM4 added to fertilizer solution

Figure 4. Research Demonstration Plot

This study used organic materials in the form of banana stems used as liquid organic fertilizer. Banana stems can be used as raw materials in making liquid organic fertilizer because they are rich in nutrients, such as potassium, phosphorus, and several microelements that are important for plant growth. Figures 1, 2 and 3 show the process of making liquid organic fertilizer, all of which are environmentally friendly materials. Figure 4 is the location of the research demonstration plot. This research provides a reference regarding the interval for applying liquid organic fertilizer from banana stems and the best media combination consisting of soil + manure + husks in chili cultivation. Previous related research only included the dosage of liquid organic fertilizer, not the application interval.

4. CONCLUSIONS

The use of a mixture of soil, manure and rice husks as a planting medium is the optimal medium for chili growth in this study as indicated by the parameters of chili plant growth and

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yield. Interval of giving liquid organic fertilizer once every 15 days showed high results in each observation parameter. Treatment without manure and rice husks, and without giving liquid organic fertilizer showed low growth and yield.

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