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Comparing the Utilization of Cocopeat and Topsoil Planting Media with Cow Manure Fertilizer on Chili Peppers' (*Capsicum frutescens*) Growth

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Abstract

Chili pepper (*Capsicum frutescens*) is one of the important horticultural commodities in Indonesia, widely cultivated due to its spicy flavor and high economic value. This study aims to compare the effectiveness of various planting media and fertilizers in promoting the environmentally friendly growth of chili pepper plants. The study employed a Factorial Randomized Block Design (RAK) with treatments including: Control (without cow manure), 2 kg of cocopeat and 1 ounce of cow manure, 2 kg of cocopeat and 1.5 ounces of cow manure, 2 kg of cocopeat and 2 ounces of cow manure, 2 kg of soil and 1 ounce of cow manure, 2 kg of soil and 1.5 ounces of cow manure, and 2 kg of soil and 2 ounces of cow manure. Data analysis was conducted using ANOVA and BNT post-hoc tests. The results showed that the planting media did not significantly affect plant height or the number of leaves, though variations in values were observed across treatments. In cocopeat media, the treatment of 2 kg of cocopeat and 1.5 ounces of cow manure resulted in the highest plant height at week 4, measuring 30.03 cm, followed by 2 kg of cocopeat and 1 ounce of cow manure (29.23 cm), 2 kg of cocopeat and 2 ounces of cow manure (29.20 cm), and the control treatment (28.46 cm). The highest number of leaves was also found in the 2 kg of cocopeat and 1.5 ounces of cow manure treatment, with 16.66 leaves, although in the second week, the control treatment recorded only 6.33 leaves. In soil media, the 2 kg of soil and 2 ounces of cow manure treatment produced 17.66 leaves, with variations in the second week noted between the cow manure treatments and the control group.

Keywords: Chili Plants, Cocopeat, Cow Manure, Planting Media, Topsoil

1. Introduction

Cayenne pepper (Capsicum frutescens) is one of the most widely cultivated and consumed varieties of chili pepper in Indonesia, renowned for its distinctive spicy flavor. This plant holds significant economic value and is an important commodity in horticulture. It is commonly used as a kitchen spice, preservative, and in the processed food industry. Furthermore, cayenne pepper plants are relatively easy to cultivate in both limited and arid environments, making them well-suited for various agricultural conditions in Indonesia. (Sukasana et al., 2024) .However, common challenges faced in its cultivation include imbalances in soil nutrients, inadequate soil structure, and low biological activity within the soil, all of which can impede optimal plant growth.

The growth of cayenne pepper is significantly influenced by the quality of the growing medium, nutrient availability, and environmental conditions, including temperature and humidity. However, cultivating cayenne pepper often presents several challenges. One major issue is low soil fertility, which can stunt plant growth and reduce yields. Additionally, cayenne pepper is vulnerable to pests and diseases that can severely damage the plants. The excessive use of chemical fertilizers often leads to problems such as environmental pollution and long-term soil degradation. Therefore, effective management of the growing medium and fertilization practices is essential to support optimal cayenne pepper growth and sustainably enhance productivity. (Banu, 2020) .

The use of appropriate planting media plays a crucial role in supporting the growth of cayenne pepper plants. Cocopeat, as an organic planting medium, can retain water

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and provide good aeration for plant roots, thereby enhancing nutrient absorption and promoting plant growth (Siregar, 2020). Furthermore, cow dung, as an organic fertilizer, also plays a crucial role in providing the nutrients plants naturally need, as well as improving the structure and fertility of the planting medium (Farid, 2020). However, several problems often arise when using cocopeat and cow dung as a planting medium. Cocopeat that has not been adequately processed can contain salts and other substances that can inhibit plant growth. Furthermore, cocopeat naturally has a low nutrient content, so it must be supplemented with additional fertilization to prevent plant nutrient deficiencies (Ramli et al., 2023). On the other hand, under-ripe or incompletely composted cow dung can cause unpleasant odors, attract pests, and contain pathogens that can damage plants. Therefore, the management and selection of planting media materials and fertilizers must be carried out correctly in order to provide maximum positive effects on the growth of cayenne peppers.

Cocopeat is an organic material derived from coconut fiber powder that is processed into a light and porous planting medium. This planting medium has a high capacity to retain water and air, thus greatly supporting plant root growth. Cocopeat is also recognized as environmentally friendly because it is a recyclable agricultural waste product that can partially replace the use of soil or other planting media materials. Due to its neutral nature and rich fiber content, cocopeat is widely used in various types of horticultural crops, including chili plants, to enhance the quality of the planting medium while reducing the risk of erosion and soil pollution (Kurniawan et al., 2017). Although cocopeat has many advantages, its use in plant cultivation also faces several challenges. One major obstacle is the relatively low nutritional content of cocopeat, so it needs to be combined with organic or inorganic fertilizers for optimal plant growth. Furthermore, cocopeat that has not been adequately processed can contain salts or other chemicals that can be detrimental to plants. Excessive use of cocopeat without adjusting the nutrients can also cause an imbalance in water content and aeration in the planting medium, which ultimately affects root health and plant productivity. Therefore, a proper understanding and management are crucial for the optimal utilization of cocopeat in agriculture (Harahap, 2022). According to Alfian & Zaedan Fitri (2022), a positive interaction was observed between rice husk charcoal and cocopeat, which had an impact on the vegetative and generative growth of pumpkin, as well as high productivity.

Cow manure is a type of organic fertilizer widely used in agriculture due to its comprehensive nutritional content, including nitrogen (N), phosphorus (P), and potassium (K), as well as beneficial microorganisms that improve soil structure and fertility. In addition to increasing soil nutrient levels, cow manure can also enhance soil biological activity, thereby supporting natural and sustainable plant growth (Agustine, 2023). The use of this fertilizer is considered environmentally friendly and can help reduce dependence on chemical fertilizers, which can pollute the environment and disrupt the balance of the soil ecosystem. However, the use of cow manure also presents several problems that require attention. One of the main obstacles is its high water content and suboptimal maturity, which can cause rotting or attract pests and plant diseases when applied directly to the soil. Furthermore, if not appropriately managed, cow manure can contain pathogens and weed seeds that can potentially disrupt plant growth. An incomplete composting process can also produce unpleasant odors and environmental pollution (Nasution & Tammin, 2022). Therefore, the processing and use of cow manure must be carried out carefully and appropriately to maximize its benefits without causing adverse impacts. According to Pratama (2024), cow dung fertilizer proves effective on various plants. This research has novelty because it was conducted on swamp land, focusing on determining the optimal dose for cayenne pepper growth.

Based on these issues, this research will be conducted to determine the effect of using cocopeat and cow manure as a growing medium on the growth of cayenne pepper plants. This study aims to determine the optimal ratio of growing medium and fertilizer for promoting cayenne pepper growth, thereby providing an environmentally friendly cultivation solution and achieving optimal yields.

2. Material and Methods

2.1. Place and Time of Research

This research will be conducted in Malim Village, Kotapinang District, South Labuhanbatu Regency. The research will be conducted from January to March 2025, located at coordinates 1°53′54″ N and 100°05′21″ E, with an altitude of approximately 100 meters above sea level.

2.2. Tools and materials

The tools used in this research include hoes for digging and preparing the soil, as well as polybags for planting cayenne peppers. Machetes are used to cut plants or other materials needed during the research. Stationery is used to record field data, while mobile phones function for visual documentation and taking pictures of plants during the research process. Laptops are used to compile reports and thesis proposals, as well as analyze data obtained from the research. The materials used include seeds of cayenne pepper plants of the Cakra Putih variety, which is the main object of research; cow dung as an organic fertilizer; polybags as an alternative planting medium; and cocopeat as a planting medium that replaces soil, offering good water retention capacity and being environmentally friendly.

2.3. Research Experiment Design

The experimental design of this research employed a Factorial Randomized Block Design (FRBD) to test two

treatment factors, as follows. The first factor is the cocopeat planting medium and the provision of cow dung fertilizer with four treatments, for the dosage and adjusted to previous researchers, namely: Without Cow Dung Fertilizer Treatment (Control), 2 Kg of Cocopeat and 1 Ounce of Cow Dung Fertilizer, 2 Kg of Cocopeat and 1.5 Ounces of Cow Dung Fertilizer, 2 Kg of Cocopeat and 2 Ounces of Cow Dung Fertilizer.

The topsoil soil factor is the soil planting medium and the provision of local cow dung fertilizer with four treatments, for the dosage and adjusted to previous researchers, namely: Without Cow Manure Fertilizer Treatment (Control), 2 kg of soil and 1 ounce of cow dung fertilizer, 2 kg of soil and 1.5 ounces of cow dung fertilizer, 2 kg of soil and 2 ounces of cow dung fertilizer.

2.4. Research Implementation

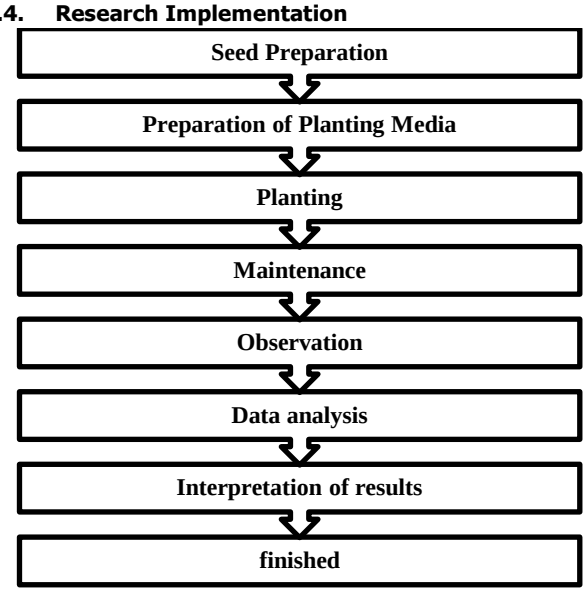

Figure 1. Research flow diagram

2.5. Research Parameters

2.5.1. Plant Height

Plant height will be measured every two weeks after planting to monitor growth and development. Measurements are taken from the base of the plant to the tip of the tallest leaf. This parameter is important for determining how quickly the plants grow under each growing medium and fertilizer dosage. Optimal plant height indicates that the plants are receiving favorable conditions for growth.

2.5.2. Number of Leaves

The number of leaves was counted on each plant during each observation period. Leaves are a crucial indicator of photosynthesis, which has a direct impact on plant development. The more leaves a plant has, the better its photosynthesis process, which can support overall plant growth.

2.6. Data Analysis Techniques

The results of this study were analyzed using ANOVA techniques in the IBM SPSS application to test for significant differences between growing media treatments and fertilizer doses on the growth and yield of cayenne pepper plants. Following the ANOVA analysis, this study continued with the Least Significant Difference (LSD) test using SPSS version 24.

3. Results and Discussion

3.1. Plant height

Based on the results of field research and data analysis, the height of cayenne pepper plants using coconut coir (cocopeat) as planting media is presented in Table 1.

Table 1. High Yield of Chili Pepper Plants Using Cocopeat Planting Media

Treatment	Average Height of Chili Pepper Plants (Cm)			
	1 MST	2 MST	3 MST	4 MST
Control	8.77±0.32a	15.33±0.49a	22.66±0.46a	28.46±0.49a
2 kg of cocopeat and 1 ounce of cow dung fertilizer	9.23±0.32a	16.2±0.29a	23.43±0.24a	29.23±0.23a
2 kg of cocopeat and 1.5 ounces of cow dung fertilizer	9.70±0.37a	17.1±0.60a	24.13±0.47a	30.03±0.49a
2 kg of cocopeat and 2 ounces of cow dung fertilizer	8.43±0.37a	16.53±0.25a	23.1±0.27a	29.2±0.25a

Based on the results of the height measurement of cayenne pepper plants in Table 1, it can be seen that all cocopeat planting media treatments provided a gradual increase in plant height from the first week to the fourth week. In the first week, plant height ranged from 8.43 cm (2 kg of cocopeat and 2 ounces of cow dung fertilizer) to 9.70 cm (2 kg of cocopeat and 1.5 ounces of cow dung fertilizer). Furthermore, in the second week, plant height increased to 15.33 cm (Control) to 17.10 cm (2 kg of cocopeat and 1.5 ounces of cow dung fertilizer). The same increase also occurred in the third week, with a height range between 22.66 cm (Control) and 24.13 cm (2 kg of cocopeat and 1.5 ounces of cow dung fertilizer). In the fourth week, the highest plant height was achieved by the treatment of 2 kg of cocopeat and 1.5 ounces of cow manure with 30.03 cm, followed by 2 kg of cocopeat and 1 ounce of cow manure with 29.23 cm, 2 kg of cocopeat and 2 ounces of cow manure with 29.20 cm, and the control with 28.46 cm. Although the treatment of 2 kg of cocopeat and 1.5 ounces of cow manure showed the highest plant height value in all weeks of observation, the results of statistical tests showed that the difference in plant height between treatments was not significant (all values are marked with the letter "a"), so it can be concluded that the

variation of the cocopeat planting medium used did not have a significant effect on the growth of cayenne pepper plants in this study. This study aligns with Widiarta et al. (2021), which shows that planting media composed of a mixture of fertile soil and cow manure yields the best results in cayenne pepper seed growth. However, the difference between treatments was not statistically significant. This study differs from that of Nasution & Tammin T (2022), which showed that the combination of cocopeat and manure significantly impacted the growth of cayenne pepper plants and the number of leaves. This point was followed by an analysis of plant height data from soil plants, as presented in Table 2.

Table 2. High Yield of Chili Peppers with Soil as a Planting Medium

Treatment	Average Height of Chili Pepper Plants (Cm)			
	1 MST	2 MST	3 MST	4 MST
Control	5.03±0.60a	6.30±0.63a	8.13±0.72a	9.50±0.80a
2 kg of soil and 1 ounce of cow dung fertilizer	6.10±0.55a	7.40±0.55a	9.30±0.51a	10.90±0.64a
2 kg of soil and 1.5 ounces of cow dung fertilizer	7.13±0.66a	8.50±0.64a	10.50±0.76a	12.20±0.75a
2 kg of soil and 2 ounces of cow dung fertilizer	6.90±0.26a	8.10±0.32a	10.00±0.31a	11.60±0.37a

Based on Table 2, the average height of cayenne pepper plants planted in soil media showed an increase from the first week to the fourth week of observation. In the first week, plant height ranged from 5.03 cm (Control) to 7.13 cm (2 kg of soil and 1.5 ounces of cow dung fertilizer). Furthermore, in the second week, plant height increased from 6.30 cm (Control) to 8.50 cm (2 kg of soil and 1.5 ounces of cow dung fertilizer). In the third week, plant height values were between 8.13 cm (Control) and 10.50 cm (2 kg of soil and 1.5 ounces of cow dung fertilizer). In the fourth week, the highest plant height was achieved in the treatment of 2 kg of soil and 1.5 ounces of cow dung fertilizer with 12.20 cm, followed by 2 kg of soil and 2 ounces of cow dung fertilizer at 11.60 cm, 2 kg of soil and 1 ounce of cow dung fertilizer at 10.90 cm, and Control at 9.50 cm. Although there were differences in plant height values between treatments, the results of statistical analysis showed that the difference was not significant (marked with the letter "a"), so it can be concluded that the variation in soil media used did not have a significant effect on the growth of cayenne pepper plants in this study. This study aligns with Widiarta et al. (2021), which shows that although the use of a mixture of fertile soil and cow dung compost as planting media resulted in the best growth of cayenne pepper seeds, the difference between treatments was not statistically significant. This result indicates that the variation in planting media did not have a significant effect on the growth of cayenne pepper plants. This study differs from Yahya et al.'s (2023) study, which showed that the combination of planting medium and mycorrhizal application significantly influenced the growth of cayenne pepper plants. This result contrasts with our study, which showed no significant effect of soil media variations.

3.2. Number of leaves

Based on the results of field research and data analysis, the number of leaves on cayenne pepper plants with coconut coir (cocopeat) planting media is presented in Table 3.

Table 3. Results of the Number of Chili Pepper Leaves Using Cocopeat Planting Media

Treatment	Average Number of Leaves on Chili Pepper Plants (Shells)			
	1 MST	2 MST	3 MST	4 MST
Control	4.33±0.88a	6.33±0.57c	9.33±1.15a	12.33±1.45a
2 kg of cocopeat and 1 ounce of cow dung fertilizer	5.33±0.33a	7.33±0.33bc	10.66±0.66a	14.33±0.66a
2 kg of cocopeat and 1.5 ounces of cow dung fertilizer	6.33±0.88a	8.66±0.33ab	12.66±0.88a	16.66±1.15a
2 kg of cocopeat and 2 ounces of cow dung fertilizer	5.66±0.33a	7.66±0.33a	11.66±0.57a	14.66±0.88a

Based on the data in Table 3, the average number of leaves on cayenne pepper plants grown in cocopeat media showed an increase from the first week to the fourth week. In the first week, the number of leaves ranged from 4.33 (Control) to 6.33 (2 Kg Cocopeat and 1.5 Ounces of Cow Manure) leaves. The increase in the number of leaves continued in the second week with a range of 6.33 (CONTROL) to 8.66 (2 Kg Cocopeat And 1.5 Ounces of Cow Manure), where the 2 Kg Cocopeat And 1.5 Ounces of Cow Manure treatment showed a higher number of leaves than other treatments, indicated by the ab value in the statistical test. In the third and fourth weeks, the number of leaves continued to increase, with the highest value also obtained in the treatment of 2 kg of cocopeat and 1.5 ounces of cow dung fertilizer, namely 12.66 and 16.66 leaves, while other treatments were below it but statistically all treatments had the letter "a" which means not significantly different. This result indicates that although there is a tendency to increase the number of leaves in the treatment of 2 kg of cocopeat and 1.5 ounces of cow dung fertilizer, the variation of cocopeat planting media has not had a significant effect on the number of leaves of cayenne pepper plants in this study. This study aligns with Kusumawati et al. (2016), who found that the composition of the growing medium did not significantly affect the number of leaves in hybrid cayenne pepper plants.

However, the watering interval had a significant impact on the number of leaves per plant. This research differs from that of Nasution and Tammin (2022). The results showed that the combination of cocopeat and manure had a significant effect on the number of leaves in cayenne pepper plants. This treatment increased nutrient availability, supporting vegetative growth. This process was followed by an analysis of the leaf number data for plants grown in soil, presented in Table 4.

Table 4. Results of the Number of Chili Pepper Leaves with Soil Planting Media

Treatment	Average number of leaves on cayenne pepper plants (leaflets)			
	1 MST	2 MST	3 MST	4 MST
Control	4.32±0.88a	5.66±1.15a	7.33±1.45a	9.33±1.73a
2 kg of soil and 1 ounce of cow dung fertilizer	5.66±1.33a	7.65±2.08a	9.66±2.18a	12.33±2.33a
2 kg of soil and 1.5 ounces of cow dung fertilizer	7.33±1.33a	9.66±1.45a	12.33±2.18a	14.66±2.33a
2 kg of soil and 2 ounces of cow dung fertilizer	8.66±0.88a	11.66±1.15a	14.66±1.45a	17.66±1.73a

Based on the data in Table 4, the average number of leaves of cayenne pepper plants grown in soil media increased from the first to the fourth week of observation. In the first week, the number of leaves ranged from 4.32 (Control) to 8.66 (2 kg of soil and 2 ounces of cow dung). Furthermore, in the second week, the number of leaves increased with a range of 5.66 (Control) to 11.66 (2 kg of soil and 2 ounces of cow dung). In the third and fourth weeks, the number of leaves continued to increase, with the highest values observed in the 2 kg of soil and 2 ounces of cow dung treatment, at 14.66 and 17.66 leaves, respectively. Although there were differences in the number of leaves between treatments, the results of statistical tests showed that the difference was not significant (all values have the letter "a"), so it can be concluded that the variation in soil media used did not have a significant effect on the number of leaves of cayenne pepper plants during the observation period. This study aligns with Sari et al. (2023), who found that the combination of beach sand, clay, and manure as a growing medium did not significantly affect the number of leaves in Dewata cayenne pepper plants. This study differs from Adolph (2016), who found that the type of growing medium significantly affected the number of leaves in cayenne pepper plants. A growing medium consisting of soil, coconut fiber, and manure produced a higher number of leaves than other media.

Figure 2. Cocopeat treatment

Figure 3. Treatment of soil planting media

4. Conclusion

The results of the study indicated that, overall, neither cocopeat nor soil as a growing medium had a significant impact on the height of cayenne pepper plants or the number of leaves produced. Although there was a tendency for increased growth values in specific treatments—specifically, 2 kg of cocopeat combined with 1.5 ounces of cow dung fertilizer, and 2 kg of soil combined with 2 ounces of cow dung fertilizer—the statistical analyses revealed that the differences between treatments were not significant. Therefore, the variation in growing media utilized in this study did not significantly affect the growth of cayenne pepper plants.

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