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Effects of Variations in the Application of Cocoa Pod Shell Compost and Mexican Lilac Liquid Organic Fertilizer on the Growth and Production of Yellow Bell Pepper Plants in Lowland

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Abstract

A research study aimed at evaluating the efficacy and determining the optimal dosage of cocoa pod shell compost fertilizer for enhancing the growth and production of yellow pepper plants in the lowland was conducted. This research was carried out at Experimental Field II, Faculty of Agriculture, Cokraminoto University, Palopo, located on Jalan Lamaranginang, Batu Pasi Village, North Wara District, Palopo City, from July to October 2023. The experimental design employed was Randomized Block Design, encompassing six treatments with four replications. The level treatments used were designed as follows: P0 (no treatment), P1 (135 gr cocoa husk compost and 100 ml/L of liquid organic fertilizer of mexican lilac), P2 (185 gr cocoa husk compost and 150 ml/L of liquid organic fertilizer of mexican lilac), P3 (235 gr cocoa husk compost and 150 ml/L of liquid organic fertilizer of mexican lilac + 200 ml/L of liquid organic fertilizer (gamal), P4 (cocoa pod husk compost 285 gr and liquid organic fertilizer of mexican lilac 250 ml/L, P5 (cocoa pod husk compost 335 gr and liquid organic fertilizer of mexican lilac 300 ml/L). The parameters observed included plant height, flowering age, number of flowers, number of fruit, fruit weight and fruit diameter. Upon conducting research and data analysis, it was revealed that the P3 treatment exerted a highly significant effect on the parameters of fruit weight (449.78 grams). Conversely, P3 demonstrated no significant impact on the parameters of the number of fruits (4.00), fruit diameter (135.20 cm), plant height (39.38 cm), number of flowers (7.88 florets) and flowering age (34.63 HST). In light of these findings, it is recommended to consider an increase in the dosage of cocoa pod husk compost and liquid organic fertilizer (Mexican lilac) to optimize the growth and production of yellow bell pepper plants in subsequent research endeavors

Keywords: yellow pepper, organic fertilizer, cocoa pod shell, mexican lilac

A. Introduction

The bell pepper plant (*Capsicum annuum* var. Grossum) belongs to the eggplant tribe and thrives at altitudes ranging from 700 to 1500 meters above sea level. Originating from Latin American countries such as Mexico, Peru, and Bolivia, the bell pepper plant holds significant market potential in Indonesia's horticultural sector. Currently, West Java stands as the primary supplier of bell peppers in Indonesia, as reported by the Central Bureau of Statistics (BPS, 2019). Beyond its sweet taste, bell peppers are nutritionally rich, containing proteins, carbohydrates, fats, various essential vitamins, and valuable plant secondary metabolite compounds. Noteworthy research has been conducted on paprika plants, as evidenced by studies conducted by Aviantara and Sarjana (2018) and Supriatna and Azzahra (2021). However, it is pertinent to note that the cultivation of yellow bell pepper plants in lowland areas has not been extensively explored.

Cocoa (*Theobroma cacao*) is one of the leading commodities in Luwu Raya. The annual cocoa bean yield in South Sulawesi Province is reported to range from 700 to 800 kg per year (Kabar News, December 2018). The aftermath of cocoa bean harvesting results in cocoa pods, which, if left unattended, can lead to waste accumulation and the potential for disease, emitting unpleasant odors in the cocoa plantation vicinity. Addressing this challenge has become a focal point for researchers aiming to mitigate and manage cocoa pod shell waste. Several studies have explored the valorization of cocoa shell agricultural waste in various domains, including its utilization as animal feed (Min, Bockki, Jongbin Lim, Sanghoon Ko, Kwang-Geun Lee, Sung Ho Lee and Suyoung Lee, 2011; Redgwell, R., V. Trovato, S. Merinat, D. Curti, S. Hediger, A. Manez, 2003; Ayinde, O. E., Adeyina, A.A., Adesoye, O., 2010; Magistrelli, D. Zanchi, R., Malagutti, L., Galazssi, F., Canzi, E., Rosi, F., 2016; Okiyama D. C. G., Sandra L. B. N., & Christianne E. C. R., 2017) and as a heavy metal adsorbent (Saucier C., Adebayo, M. A., Lima E. C., Cataluna R., Thue, P. S., Prola, L. D., Puchana-Rosero, M. J., Machado, F. M., Pavan, F. A., & Dotto, G. L., 2015). The composition of cocoa pod material comprises environmentally friendly components, such as protein, fat, dietary fiber, soluble saccharides, polyphenols, and other valuable constituents (Okiyama et al., 2017).

Efforts have been undertaken to diminish cocoa pod shell waste through its conversion into compost. According to Kasim, A., Yatim, H., and Maharia, D. (2021), cocoa pod husk compost exerts a noteworthy influence on the vegetative phase of peanut plants. This compost is characterized by nutrient content including 1.81% nitrogen (N), 26.61% organic carbon (C), 0.31% phosphorus pentoxide (P2O5), 6.08% potassium oxide (K2O), 1% calcium oxide (CaO), and 1.37% magnesium oxide (MgO). Furthermore, it is asserted that this compost has the potential to enhance the physical, biological, and chemical attributes of soil (Bahari, 2019).

Gamal leaves (*Gliricidia sepium*), belonging to the Leguminoseae family, are recognized for their substantial nitrogen content (Oviyanti, 2016). The transformation of gamal leaves into liquid organic fertilizer has been shown to have a beneficial impact on the growth and yield of flower cabbage and sweet corn plants (Novriani, 2016 and Jeanne. M. P, Jemmy. N, Paula. C. H. S, Dianne. S.T, 2020).

This research focuses on the cultivation of organic-based yellow bell pepper plants in lowland areas. It involves the utilization of cocoa pod compost and liquid organic fertilizer derived from gamal leaves.

B. Methodology

This research was carried out at the Experimental Garden of Campus II, Cokroaminoto University Palopo, located on Lamaranginang Street in Batupasi Village, North Wara District, Palopo City. The study was conducted from July to October 2023.

Various materials were employed in this research, comprising F1 Yellow Star variety yellow bell pepper plants, cocoa fruit peel compost, gamal leaf POC (liquid organic fertilizer derived from gamal leaves), and water. The tools utilized during the study included hoes, shovels, machetes, stakes, meters, ropes, labels, cameras, buckets, hoses, scales, vectors, treatment labels, research boards, and stationery.

The methodology employed in this study adhered to a group randomized design, encompassing six distinct treatments, each replicated four times. The treatments included cocoa pod husk compost (KBK) and gamal leaf POC (DG). The specific variations applied to each treatment are elucidated as follows:

P0 = No treatment (control)
P1 = KBK 135 g + DG 100 ml/L
P2 = KBK 185 g + DG 150 ml/L
P3 = KBK 235 gr + DG 200 ml/L
P4 = KBK 285 gr + DG 250 ml/L
P5 = KBK 335 gr + DG 300 ml/L

The parameters subject to observation were categorized into vegetative phase parameters, specifically plant height (cm), and generative phase parameters, which encompassed flowering age (hst), the count of flowers (florets), the count of fruits (fruit), and the weight of fruits (grams). After the collection of observational data, an analysis of variance (ANOVA) was employed for statistical analysis. In instances where a significant effect was detected, post hoc analysis was conducted using the Bonferroni-Dunn procedure (BNJ) at the 5% significance level.

C. Result and Discussion

Based on the results of observations and data analysis, it is discerned that yellow bell pepper plants exhibit the capability to thrive and yield produce in lowland regions situated at an altitude of 5 meters above sea level. In the context of this study, emphasis was directed towards the parameters of the generative phase, as opposed to the vegetative phase. This deliberate focus was driven by the primary objective of addressing the pivotal challenge in this investigation, which revolves around achieving successful yellow bell pepper plant production through the utilization of organic fertilizers in lowland environments. The sole vegetative phase parameter subjected to observation was plant height, and the corresponding results are elucidated in Figure 1.

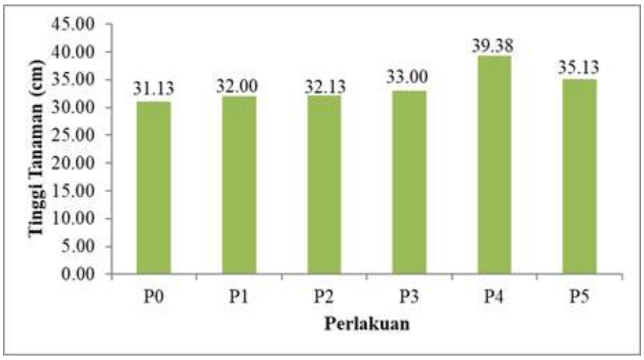

Figure 1. Average Height of Yellow Bell Pepper Plants (cm) for Each Treatment Variation

According to the findings depicted in Figure 1, the P4 treatment yields the most favorable outcomes for the height of bell pepper plants. However, upon scrutiny of the analytical results, it is evident that the administered treatments did not exert a statistically significant influence on the height of yellow bell pepper plants. Despite this, the processed data presented in Figure 1 prompts researchers to hypothesize that the P4 treatment represents an optimal dosage for yellow bell pepper plants cultivated in lowland conditions. This speculation is further substantiated by the observed height fluctuations in P1-P3 and a subsequent decline at P5. Moreover, there is a suspicion that the absorption of nitrogen (N) by yellow bell pepper plants at the P4 treatment level is optimal. It is noteworthy that, despite the favorable outcomes, the height of yellow bell pepper plants in this study remains inferior to that reported in the study conducted by Tulung & Demmassabu (2011).

Observations pertaining to the flowering age (hst) further revealed that plants subjected to the P4 treatment exhibited the most expeditious flowering, surpassing the flowering duration of plants subjected to treatments other than P4. Figure 2 illustrates a comparative analysis of the flowering ages across different treatments administered to each plant.

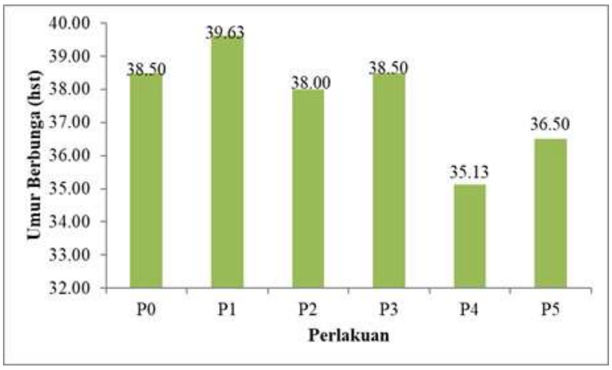

Figure 2. Average Flowering Age (hst) of Bell Pepper Plants for Each Treatment Variation

The data presented in Figure 2 highlights that plants subjected to the P4 treatment exhibit the most rapid flowering. However, akin to the observations in the plant height parameter, the variations in treatment do not yield a statistically significant impact on flowering age. Researchers posit that the treatment combinations may not have achieved an optimal effect on plants, particularly in terms of the flowering age parameter. Consequently, it is conjectured that meticulous adjustment of fertilizer nutrient levels is paramount for optimizing plant performance.

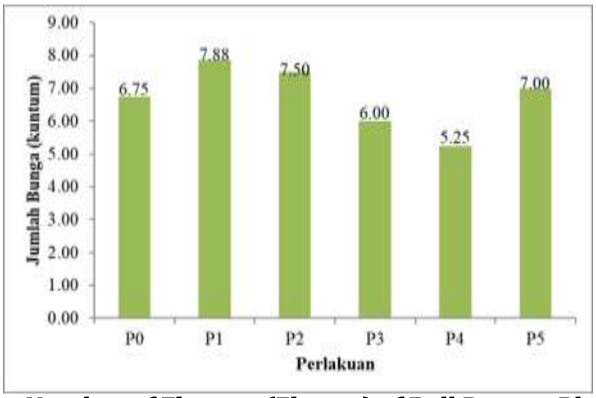

Figure 3. Average Number of Flowers (Florets) of Bell Pepper Plants in Each Treatment

Another generative parameter under scrutiny was the count of flowers (florets), serving as a metric to gauge the plant's ability to absorb nutrients and generate flowers. Figure 3 delineates the data pertaining to the number of flowers corresponding to each treatment. The data concerning the number of flowers underwent variance analysis, leading to the determination that the administered treatment did not impart a substantive effect. This outcome is attributed to adverse weather conditions, wherein rainfall is identified as a contributing factor causing premature shedding of budding flowers. This assertion finds support in the work of Nautiyal Pankaj & Supyal, Varun & Rathore, Arun Singh & Singh, Esha & Chaudhary, Ashutosh & Rayeen, Shifa & Pal, Sagar & Tiwari, Ayushi & Khaniya, Saugat & Deo, Nandani (2022), which affirms that climate-related factors, including fluctuations in wind speed and rainfall, constitute significant contributors to premature flower fall before the onset of fruiting.
The trend of the graph concerning the parameter of the number of flowers diverges from that of the graph representing the number of fruits. As illustrated in Figure 4, it becomes apparent that not all blooming flowers successfully progress to maturation and fruition.

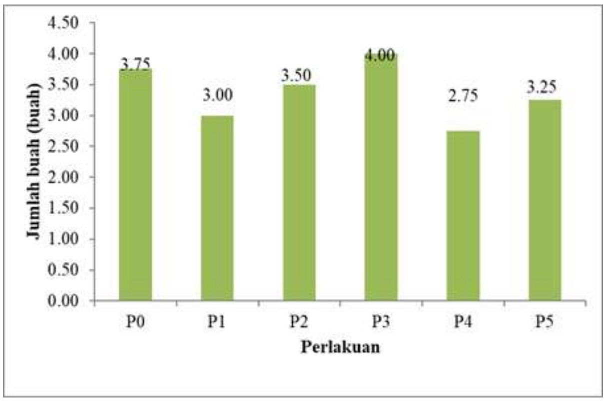

Figure 4. Average Number of Fruits (Fruit) of Yellow Bell Pepper Plants for Each Treatment

The flowers that successfully progressed to maturation and fruition, as depicted in Figure 4, constituted less than half of the total number of flowers that initially bloomed (Figure 3). The primary contributing factor to this discrepancy is identified as fruit fly infestation. According to the outcomes of the variance analysis, the administered treatment does not yield a statistically significant effect on the number of fruits produced by yellow bell pepper plants. It is noteworthy that, despite the challenges posed by fruit fly infestation, the quantity of yellow bell peppers generated in this study surpassed the yield reported in a parallel study conducted by Tulung & Demmassabu in 2011.

The weight of fruits obtained in this study exhibited an average that was double the magnitude reported in a corresponding study by Tulung & Demmassabu in 2011. The outcomes of the variance analysis for fruit weight data underscored that the administered treatments exerted a statistically significant influence on the fruit weight of yellow bell peppers. The trend in the fruit weight of bell pepper plants, corresponding to various treatment variations, is visually represented in Figure 5.

After establishing the substantive effect for fruit weight data, a Bonferroni-Dunn procedure (BNJ) at the 5% significance level was applied for further analysis. The outcomes of this analysis indicate that the provision of treatments imparts a discernible effect on yellow bell pepper plants in comparison to the absence of treatment. However, it is noteworthy that only the P5 treatment exhibited a fruit weight that was significantly distinct from the other four treatment variations. Of particular interest is the observation that the average fruit weight of yellow bell pepper plants subjected to P3 was the highest among all treatments applied. This elevation in fruit weight in P3 is attributed to the absence of fruit fly infestation. It is pertinent to note, however, that despite the favorable conditions contributing to increased fruit weight, the yellow bell pepper fruits produced are categorized as very large (Suwarno, 2006).

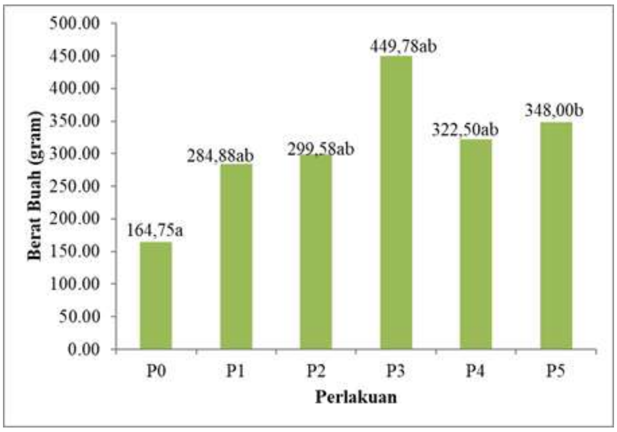

Figure 5. Average fruit weight (g) of bell pepper plants for each treatment

The accumulation of adverse weather conditions, suboptimal plant height, inadequate pest control, and varying treatment doses, both appropriate and suboptimal, are identified as contributing factors to the lack of a significant effect on the observed plant parameters for yellow bell pepper plants. Despite these challenges, the overall objectives of this research, particularly the experimental cultivation of yellow bell pepper plants in lowland conditions, have been realized. Subsequent research endeavors are anticipated to explore the enhancement of the P4 treatment dosage, as applied in this study, to further refine and optimize the cultivation practices for yellow bell pepper plants in lowland environments.

C. Conclusion

Derived from the outcomes of meticulous observations and comprehensive data analysis, it is deduced that the application of cocoa pod compost and liquid organic fertilizer did not impart a statistically significant effect on various parameters, including plant height, flowering age, number of flowers, number of fruits, and fruit diameter of yellow bell pepper plants. Notably, the treatment exhibited a substantial influence exclusively on the parameter of fruit weight, where a significant difference was observed at P5 for this parameter. It is conclusively ascertained that the cultivation of yellow bell pepper plants in lowland conditions is viable.

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