The growth response of purple eggplant plants to BCK compost fertilizer and coconut water compost fertilizier

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Abstract. In an effort to increase the productivity of purple eggplant (*Solanum melongena* L.), BCK compost and old coconut water compost can be used because continuous use of inorganic fertilizers can reduce soil fertility and lower plant productivity. The study aims to determine the response of BCK compost fertilizer, coconut water compost fertilizer, and their combination on the growth of purple eggplant plants, as well as the increase in soil nutrients after organic fertilizer application. Using a completely randomized design (CRD), the research included compost production, preparation of planting media with 200 g and 300 g fertilizer applications, seed planting, plant maintenance, and harvesting, with observations on various growth parameters and analysis using ANOVA along with nitrogen, phosphorus, and potassium testing. The research showed that all three organic fertilizers improved the growth of purple eggplant plants, with significant results in most parameters except wet weight. Therefore, the use of BCK compost, old coconut water compost, or a combination of both is recommended to enhance plant growth and increase soil nutrients.

1 Introduction

Continuous use of inorganic fertilizers can reduce soil quality and fertility by decreasing soil microorganism activity and causing salt accumulation that limits root absorption. One effective strategy to improve land productivity is the application of compost, which is produced from decomposed organic materials such as leaves, straw, and animal manure. Compost and other organic fertilizers provide high organic matter and complete nutrients, including essential macro- and microelements needed for plant growth[1].

Organic fertilizer plays a crucial role in improving soil fertility to support optimal purple eggplant growth. BCK compost contains various beneficial microbes, such as Rhizobium sp, P-solubilizing bacteria, K-solubilizing bacteria, Rhodobacter sp, Bacillus sp, Streptomyces sp, and Trichoderma sp. which can increase the population of beneficial microorganisms in the soil. Apart from BCK compost fertilizer, coconut water compost fertilizer offers significant added value because mature coconut water contains essential

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minerals, natural hormones such as auxin and cytokinin, as well as sugar and protein that support plant growth. Findings from[2] and [3] show that compost enriched with mature coconut water can accelerate fermentation, increase soil nutrient content, and improve plant resistance to environmental stress. This study also introduces an innovation combining BCK compost fertilizer with mature coconut water compost fertilizer to achieve nutritional synergy from their different nutrient compositions.

This study used purple eggplant (*Solanum melongena* L.) as the test plant because it is highly responsive to organic fertilizers, allowing clear and measurable observation of growth and yield changes, and its growth is often limited by suboptimal soil quality. Since no previous research has examined the effects of BCK compost fertilizer, mature coconut water compost fertilizer, or their combination on purple eggplant cultivation, this study aims to determine how these treatments influence plant growth and soil nutrient improvement. Understanding the plant's response to the two types of fertilizers is expected to provide effective data that support increased soil fertility, improved plant growth, and sustainable purple eggplant production.

2 Methods

2.1 Making compost

BCK compost fertilizer consists of cow manure, dolomite, organic waste, and additional microbes including *Rhizobium sp.*, P-solubilizing bacteria, K-solubilizing bacteria, *Rhodobacter sp.*, *Bacillus sp.*, *Streptomyces sp.*, and *Trichoderma sp.*. The old coconut water compost was prepared using 10 kg of cow manure cleaned of inorganic waste, layered on a tarpaulin with dry leaves, and then mixed with a solution of 5 L coconut water, 125 ml EM4, and 250 ml molasses that had been left covered for 4 hours before application. The mixture was then stirred until homogeneous and fermented for 20 days in a covered condition with stirring every four days.

2.2 Making planting media

The purple eggplant planting medium used is topsoil, sand, burnt rice husks, and the addition of compost to increase the nutrients in the soil that will be absorbed by the plant. Treatment :M1D1 (200 gr BCK Compressed Fertilizer); M1D2 (300 gr BCK Compressed Fertilizer); M2D1 (200 gr old coconut water compost); M2D2 (300 gr old coconut water compost); M3D1 (200 gr combined fertilizer); M3D2 (200 gr combined fertilizer); Control (C) (No fertilizer added).

2.3 Planting, maintenance, and harvest

Planting is carried out when the seedlings are one month old with 4–5 leaves, using labeled polybags to distinguish treatments, and the seedlings are transplanted into 10 cm deep holes with 15 cm spacing before being covered up to the root collar. Plant care includes watering twice daily depending on soil moisture, installing hanging stakes for support, and controlling weeds while occasionally loosening compacted soil around the polybags. Eggplants are ready to harvest when the flesh is not yet firm, the color is shiny, and the size is moderate to ensure optimal quality.

2.4 Measurement

The parameters that will be observed in this study are as follows plant height (cm), number of leaves, fruit weight (gr), plant wet weight (gr), plant dry weight (gr), root length (cm).

2.5 Data Analysis

In this study, statistical analysis was carried out using analysis of variance (ANOVA) which was processed with the help of SPSS software version 25.

2.6 Nutrient Testing

This nutrient test sample used BCK compost fertilizer, coconut water compost fertilizer, and planting media that provided the best effect and was carried out by the Chem-Mix Pratama for total nitrogen, phosphor, and kalium.

3 Results and discussion

3.1 Plant Height

Based on Figure 1a, the highest average plant height at 90 days after planting was observed in the M1D2 treatment, namely BCK fertilizer at a dose of 300 g. The ANOVA results showed that fertilizer type significantly affected plant height ($p = 0.032$), with all fertilizer treatments performing better than the control and BCK fertilizer tending to show the best growth, although not significantly different from old coconut water fertilizer. In contrast, fertilizer dose did not produce a significant effect ($p = 0.294$), indicating that the dose variations used in the study did not influence plant height despite the general role of organic fertilizers in promoting root growth and supporting photosynthesis, which are essential for plant development. These findings align with previous studies suggesting that inappropriate organic fertilizer concentrations can hinder growth and that nutrients such as nitrogen, phosphorus, and potassium in organic fertilizers contribute to increased plant production, flowering, and overall yield [4][5].

3.2 Number of leaves

The growth results for the number of leaves at 90 days after planting, shown in Figure 1b, indicate that the highest average number of leaves occurred in the M2D2 treatment using old coconut water compost at a dose of 300 g, while the control treatment produced the lowest results. ANOVA analysis showed a significant effect of both fertilizer type and fertilizer dose on the number of leaves, where all fertilizer treatments increased leaves number compared to the control, with old coconut water fertilizer performing best. These findings align with previous studies [6][7], which reported that compost made from mature.

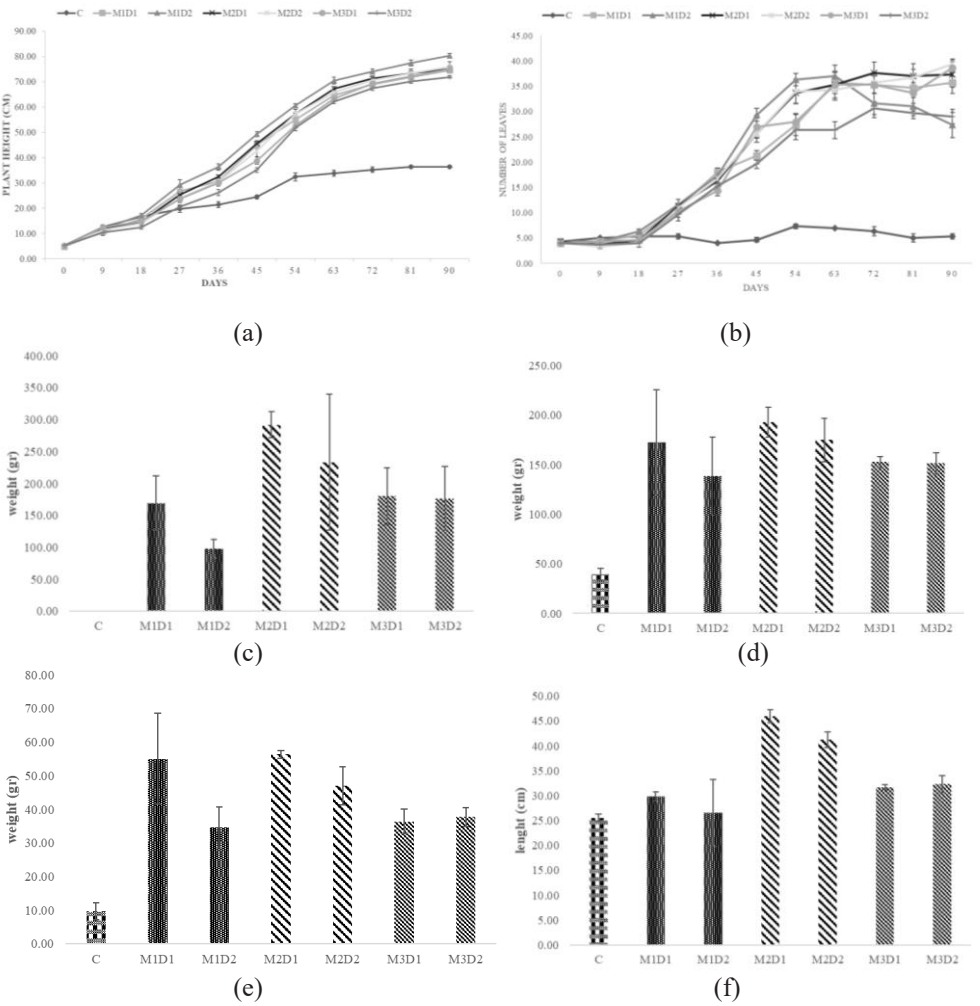

Fig. 1. a. plant height; b. number of leaves; c. fruit weight; d. plant wet weight; e. plant dry weight; f. root lenght

coconut water effectively enhances leaves growth in purple eggplant due to its natural hormone content such as cytokinins, auxins, and gibberellins. Additionally, the essential nutrients in mature coconut water, including potassium, calcium, and magnesium, improve soil fertility and support optimal water and nutrient uptake, thereby promoting leaves development.

3.3 Fruit weight

Based on Figure 1c, the highest average fruit weight at 90 days after planting was achieved by the M2D1 treatment using old coconut water compost at a dose of 200 grams, while the control treatment produced no fruit at all. ANOVA results showed very significant effects of fertilizer type (p-value $0.000 < 0.05$) and fertilizer dose (p-value $0.043 < 0.05$), with fertilizer type contributing the most to variations in fruit weight, and Duncan's test confirming that old coconut water fertilizer performed significantly better than all other treatments. Previous studies also support these findings, as mature coconut water contains natural hormones such as auxin and cytokinin that enhance fruit formation, enlargement, and development by

improving chlorophyll production and photosynthetic efficiency. In addition, the essential nutrients in mature coconut water, including nitrogen, phosphorus, potassium, and various minerals, promote optimal flowering and significantly increase fruit weight in purple eggplant.

3.4 Plant wet weight

Based on Figure 1d, the highest average wet weight of eggplant plants at 90 days after planting was obtained from the M2D1 treatment using old coconut water compost at a dose of 200 g, which aligns with the statement of Hafrayuni et al. (2024) that optimal leaves growth enhances photosynthesis and increases both wet and dry plant weight. ANOVA results showed that neither fertilizer type ($p = 0.202 > 0.05$) nor fertilizer dose ($p = 0.264 > 0.05$) had a statistically significant effect on plant wet weight, likely because plants in the generative phase allocate more energy to fruit development rather than vegetative biomass, as stated by [8]. However, Duncan's test indicated that all fertilizer treatments significantly increased wet weight compared to the control, with old coconut water fertilizer at 200 g and 300 g producing the highest biomass. Overall, all three fertilizer types demonstrated similar effectiveness in increasing plant biomass, with fertilization in general producing nearly four times more wet weight than unfertilized plants.

3.5 Plant dry weight

Based on Figure 1e, the highest average dry weight of eggplant plants at 90 days after planting was obtained from the M2D1 treatment using old coconut water compost at a dose of 200 g. Dry weight is a crucial parameter because it reflects the actual accumulation of organic compounds produced through photosynthesis and serves as a more accurate indicator of plant productivity than wet weight, which is influenced by water content. ANOVA results showed significant differences in dry weight between fertilizer types ($p = 0.031 < 0.05$) and between fertilizer doses ($p = 0.034 < 0.05$), indicating that both factors significantly affected the buildup of dry biomass. Compared with wet weight, which previously showed no significant differences, dry weight provides a clearer measure of true biomass accumulation, supporting the expectation that fertilizers supplying essential nutrients contribute directly to greater dry matter production.

3.6 Root Leght

Based on Figure 1f, the highest average root length of eggplant plants at 90 days after planting was produced by the M2D1 treatment using coconut water compost at a dose of 200 g. ANOVA results showed a very significant effect of fertilizer type ($p = 0.000 < 0.05$) but no significant effect of fertilizer dose ($p = 0.141 > 0.05$), indicating that fertilizer type strongly influences root development while dose differences within the tested range do not. Duncan's test confirmed that coconut water fertilizer was the most effective in promoting root growth, while combination fertilizer provided a slight improvement and BCK fertilizer showed no significant difference compared to the control. These results align with findings from[9] [10], which explain that mature coconut water contains natural hormones such as auxin and cytokinin that stimulate root cell division, elongation, and overall tissue development, thereby enhancing root length.

3.7 Nutrient Content

The results of the nutrient content analysis conducted by the Yogyakarta Chem-Mix Laboratory are presented in Table 1. The nutrient content tested includes total N, phosphorus, and potassium.

Table 1. Nuitrient Content

Code	Nitrogen (%)	Fosfor (%)	Kalium (%)
M1	0,53	0,54	0,42
M2	0,64	0,5	0,44
M2D2	0,55	0,41	0,43

The analysis of total nitrogen (N) content in the organic fertilizers showed generally low values, which is consistent with findings by Gani et al. (2021) and may result from limited nitrogen in raw materials, absence of additional nitrogen sources, and active microbial decomposition that reduces nitrogen availability. Nitrogen loss may also occur through volatilization as ammonia (NH_3) or nitrogen gas (N_2) in compost piles with open pores, while microorganisms convert nitrogen into nitrate (NO_3^-) and ammonium (NH_4^+), forms readily absorbed by plants. The phosphorus content was also low, aligning with[11], and is likely influenced by the dominance of nitrogen in the raw materials, which drives microbial activity and phosphorus mineralization, as explained by [12]. Despite its low concentration, phosphorus remains essential for cell formation and photosynthate production, supporting plant growth as emphasized by [13]. Potassium levels were similarly low but still within acceptable limits for plant growth, consistent with [14], and this may be due to potassium's high solubility and tendency to leach, even though it plays a vital role in cell division, root development, and overall plant physiology.

4 Conclusion

The study concluded that applying various organic fertilizers—BCK compost, old coconut water compost, and their combination—positively influenced the growth of purple eggplant (Solanum melongena L.), increasing parameters such as plant height, number of leaves, fruit weight, dry plant weight, and root length. Although plant wet weight did not show a significant response, the overall use of organic fertilizers still outperformed the control, while nutrient analysis indicated that the nitrogen, phosphorus, and potassium content of the composts was relatively low but adequate for improving plant productivity and soil quality. The composts also exhibited typical organic fertilizer characteristics, including a soil-like texture, blackish color, and earthy compost odor.

Acknowledgment

The researcher's thanks go to colleagues who have helped and supported this research from beginning to end.

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