**Contributions of Central Research Institute for Agriculture**
Vol. 20, No. 4, October 2026, pp. 293~298
ISSN: 2962-9217, DOI: 10.59651/cceria.v20i4.487
Published by: Central Research Institute for Agriculture (CeRIA)


# Effect of liquid organic fertilizer based on cocoa peel waste on white eggplant production (Solanum) melongena L.) in The Village Niko'otano Dao Gunungsitoli Alo'oa District

**Kevin Ondoi Kenari Harefa, Helmin Parida Zebua, Dian Agung Sanora Laia, Putra Hidayat Telaumbanua**
Agrotechnology Program, Faculty of Science and Technology, Nias University, Nias, Indonesia

**Article Info**

***Article history:***

Received : Aug 27, 2026
Revised : Sept 29, 2026
Accepted : Oct 19, 2026

***Keywords:***

Cocoa Husk;
Growth;
Liquid Organic Fertilizer;
Production;
White Eggplant.

**ABSTRACT**

This study aims to determine the effect of liquid organic fertiliser (LOF) made from cocoa husk waste on the yield of white aubergine (Solanum melongena L.), and to evaluate the plants' response. This study aimed to test various doses of organic cocoa powder and identify the dose that yielded the best results. The study was conducted in the village of Niko'otano Dao, Gunungsitoli Alo'oa Sub-district, Gunungsitoli City, using a quantitative field experiment with a non-factorial randomised block design (RBD). The study comprised four treatments: P0 (0 mL/L of water), P1 (100 mL/L of water), P2 (200 mL/L of water) and P3 (300 mL/L of water), each with three replicates. The cocoa powder was produced from cocoa husk waste through a fermentation process and subsequently tested in the laboratory. The parameters observed included plant height, number of fruits, and fruit weight. The data were analysed using analysis of variance (ANOVA) and followed by a 5% DMRT test to determine significant effects. The results showed that fertilisation with cocoa husk waste-based LOF had a positive effect on the growth and yield of white aubergines. Treatment P3 yielded the best results, with an average total of 4.33 fruits per plant and a fruit weight of 215.67 g per plant. Thus, the cocoa husk waste-based LOF at a dose of 300 ml/L of water was the most effective treatment for enhancing the growth and yield of white aubergines under the conditions of this study.

*This is an open-access article under the CC BY-NC license.*

***Corresponding Author:***

Kevin Ondoi Kenari Harefa
Faculty of Science and Technology, Universitas Nias
Jalan Yos Sudarso 118 E/S Gunungsitoli +6285261401772
Email: kenariharefa3@gmail.com

## 1. INTRODUCTION

Research on the use of liquid organic fertilizer (LOF) on white eggplant plants has been widely conducted using various organic materials. Panjaitan et al. 2023 used a combination of liquid LOF and solid organic fertilizer on superior eggplant plants, Andika (2021) used a combination of liquid organic fertilizer cocoa husk on white eggplant variety Kania F1. The potential of cocoa husk as an organic fertilizer material has been reported to have a high potassium and organic material content. The concentrations tested in previous studies differ from the concentrations used in previous studies in this study, namely P0 = 0, P1 = 100, P2 = 200 and P3 = 300 ml/l of water.

White eggplant (Solanum melongena L.) is a horticultural crop cultivated as a vegetable and has both economic and nutritional value. White eggplant belongs to the species S. melongena and is distinguished primarily by its fruit color. This plant has a relatively short production cycle, so managing its growth and meeting nutritional needs are important aspects of its cultivation (Yulianti, 2020; Khosadila et al., 2025).

Plant growth and production are significantly influenced by nutrient availability. Continuous use of inorganic fertilizers without proper management can lead to problems with soil quality and environmental balance. One approach is the application of liquid organic fertilizer (LOF), as organic matter can serve as a nutrient source while supporting soil biological activity (Evizal & R., 2021; Candra, 2025).

Cocoa husk waste is an organic material with the potential to be used as a raw material for organic fertilizer. This material is available as a byproduct of cocoa processing and still contains usable nutrients after processing. Taha and Rahayu (2024) reported the potential use of cocoa husk waste as an organic fertilizer, while Mwafulirwa et al. (2024) showed that cocoa husk-based organic materials can affect soil nutrient availability. Utilizing this waste also aligns with efforts to reduce organic waste and increase the use of local resources.

Research on liquid organic fertilizer (LOF) in eggplant plants shows that liquid organic fertilizer can affect growth parameters and crop yields. Panjaitan et al. (2023) reported the effect of LOF on eggplant growth and production. Other studies cited in this thesis also show that the use of organic materials derived from agricultural waste has the potential to increase horticultural crop yields (Akhir et al., 2025; Nurdiani et al., 2025). However, plant response to LOF is still influenced by raw materials, production processes, concentration, plant varieties, and environmental conditions.

Therefore, this study was conducted to test cocoa husk waste as a Liquid Organic Fertilizer (LOF) for white eggplant plants. The main objective was to observe the effect of the LOF on growth and yield, and to determine the optimal dosage for the highest yield.

## 2. METHOD

### 2.1 Research Location and Time

This research was conducted in Niko'otano Dao Village, Gunungsitoli Alo'oa District, Gunungsitoli City. Field research was conducted as part of a series of activities including preparation, production of LOF, planting, treatment application, maintenance, observation, and monitoring. harvest, and data processing from March to July 2026.

### 2.2 Research Design and Maintenance

This study used a non-factorial Randomized Block Design (RBD) with a single factor, namely the concentration of cocoa husk waste LOF. There were four treatment levels, namely P0 = 0 mL LOF/L water, P1 = 100 mL LOF/L water, P2 = 200 mL LOF/L water, and P3 = 300 mL LOF/L water with three groups as replications, resulting in 12 experimental units. The division of groups was based on land slope conditions to standardize environmental factors. Randomization of treatments in each group was carried out by simple randomization through drawing. Each experimental unit consisted of five plants (one plant per plot), and three plants were designated in the middle as sample plants for observation to avoid edge effects. The observation value per experimental unit was obtained from the arithmetic mean of the three sample plants before being analyzed statistically.

This study used a non-factorial Randomized Block Design (RBD) with one factor, namely the concentration of cocoa husk waste LOF. It consisted of 4 treatments, namely P0 = 0 mL/L, P1 = 100 mL/L, P2 = 200 mL/L, and P3 = 300 mL/L with 3 replications as a group, so there were 12 bed plots. Each bed plot contained 9 plants, where 5 plants in the middle were designated as sample plants.

Randomization of treatments within each group was carried out by simple randomization by drawing lo ts. Observation data were taken from the 5 sample plants and the average value per plot was calculated using the arithmetic mean formula of the five sample plants before statistical analysis. Observations were carried out from the age of 15 HST to 74 HST. The application of cocoa husk waste LOF was carried out by the direct pouring method to the soil around the roots. The volume given was 200 mL per plant or 1,800 mL per bed plot at each application. The volume was uniform across all treatments, including P0, which received only plain water at the same volume of 200 mL per plant. Applications were made every seven days, starting at 7 days after planting and ending at 70 days after planting. No manure or other chemical fertilizers were applied during cultivation; the only fertilizer used was cocoa husk waste organic fertilizer (LOF) according to the treatment dosage.

The plants used were Kania F1 white eggplants. Each plot consisted of nine plants, resulting in a total population of 108 plants. examples of plants chosen from each plot in Zig-zag pattern, with a total of 60 sample plants.

### 2.3 Preparation And Analysis from People of color

LOF was prepared using 10 kg of cocoa skin, 200 ml of EM4, 1.5 ml of brown sugar, and 15 L from clean water. That cocoa husk is cut into the small parts; That chocolate sugar is dissolved in water and then mixed with EM4. The chopped ingredients are placed in a fermentation container, and a mixture of water, brown sugar, and EM4 is added. The container is tightly closed and placed in a shaded area for 14 days. Fermentation is carried out anaerobically (in a tightly closed container) at room temperature (27–30°C) in a shaded area for 14 days. The container opened periodically for release fermentation gas. After fermentation is Once completed, the solution is filtered, homogenized, packaged, and analyzed in the laboratory.

**Table 1.** Analysis Results from Nutrition Contents in the LOF cocoa waste skin

| Parameter | Unit | Test Results |
|---|---|---|
| Nitrogen (N) | % | 0.44 |
| $P_2O_5$ | % | 34.87 |
| $K_2O$ | % | 0.07 |
| Organic C | % | 0.75 |

The results of laboratory analysis are used as supporting data to explain the characteristics of LOF applied to plants.

### 2.4 Implementation and Observation

That field is cleaned And plowing to A depth from around 20–30 cm, Then divided into the 2 M The experimental plot measures 2 m. White eggplant seedlings are approximately 21–30 days old after sowing. or have 3–5 CORRECT leaves is embedded in the That field. That plant distance used 60 cm × 70 cm White eggplant fruit was harvested once, namely when the plant was 75 Days After Planting (DAP) when the fruit had met the criteria for harvest maturity. The criteria for maturity were indicated by a shiny white fruit color and maximum fruit size. Harvesting was done by cutting the fruit stalk using scissors. Observations of harvest results were recorded per plant sample. The parameters observed were the number of fruits per sample and the weight of the fruit per sample obtained from one harvest. Thus, the data on the number of fruits presented in this study are the results of a single harvest per sample, not the cumulative total of several harvests. Data Analysis

Data were analyzed using analysis of variance (ANOVA) at a 5% significance level. Prior to ANOVA, data were tested for normality using the Shapiro-Wilk test and for homogeneity using Levene's test. If the ANOVA showed a significant effect, the analysis was continued with DMRT at a 5% significance level to determine differences between treatments.

## 3. RESULTS AND DISCUSSION

### 3.1 Characteristics of LOF Cocoa Skin

Laboratory analysis results showed that the LOF used contained 0.44% N, 34.87 ppm $P_2O_5$, 0.07% $K_2O$ , and 0.75% organic C. The presence of N, P, and K provides a basis for explaining plant responses to LOF treatment. Nitrogen is associated with the formation of vegetative tissue, while phosphorus and potassium play a role in metabolic processes and the development of generative organs. In this study, LOF is not only seen as a source of nutrition but also as a by-product of cocoa shell processing that can be reused in the cultivation system.

These results align with the discussion by Taha and Rahayu (2024) regarding the potential of cocoa husks as an organic fertilizer. Mwafulirwa et al. (2024) also showed that cocoa husk-based organic materials can affect soil nutrient availability. The fermentation process is a crucial step in LOC production because organic materials must decompose before they can be used as a source of plant nutrients.

### 3.2 Plant Tall

Plant height is one of the main vegetative growth parameters that reflects the plant's response to nutrient supply. Growth in plant height Kania F1 white eggplant variation at 15, 29, 43, 53, 67, and 74 days after planting (DAS) with the application of LOF made from cocoa husk waste. shown in Table 2.

**Table 2.** Average plant tall from white eggplant under many kinds of maintenance on 15 to 74 day after sowing

| Age | P0 | P1 | P2 | P3 |
|---|---|---|---|---|
| 15 HST | 8.75 c | 9.99 B | 11.01 b | 12.45 A |
| 29 HST | 15.31 c | 17.39 b | 6:29 ab | 19.05 A |
| 43 HST | 50.15 c | 53.64 b | 55.27 b | 62.85 A |
| 53 HST | 49,57 c | 54.17 b | 56,87 b | 61,77 A |
| 67 HST | 78,40 c | 83,29 b | 85,21 b | 89.15 A |
| 74 HST | 88,30 c | 92.15 b | 95,35 b | 98,89 A |

Table 2 shows that the average plant height increased with increasing plant age. Throughout the observation period, P3 produced the highest average, while P0 produced the lowest value. At 15 DAP, the P3 plant height reached 12.45 cm compared to 8.75 cm for P0. At 74 DAP, the plant height increased to 98.89 cm for P3, while P0 reached 88.30 cm. The DMRT results show that for most of the observation period, P3 was in a different group from the other treatments, while P1 and P2 were in the same group at a certain age.

The ANOVA results showed that the treatment had a very significant effect on plant height at the analyzed observation time points. At 15 HST, the calculated F value was 22.262 with a significance level of 0.001; at 29 HST, the calculated F value was 22.545 with a significance level of 0.001; at 43 HST, the calculated F value was 26.982 with a significance level of 0.001; at 53 HST, the calculated F value was 20.774 with a significance level of 0.001;.

The increase in plant height in the LOF treatment is believed to be related to the availability of nutrients from the organic matter in cocoa husks. Nitrogen supports the formation of vegetative tissue, while phosphorus and potassium play a role in plant metabolism and development. This finding is consistent with the results of research by Panjaitan et al. (2023), which showed that liquid organic fertilizer can affect eggplant growth. The use of cocoa husks as organic matter is also supported by Mwafulirwa et al. (2024), who reported the effect of cocoa husk-based materials on soil nutrient availability.

### 3.3 Number from Fruits

That amount eggplant is A parameter to observe That generative phase, counted based on on the number of F1 white eggplant fruits formed per planting in each treatment

**Table 3.** Average number from white eggplant fruits

| Treatment | Number from fruits (fruit/plant) | DMRT 5% |
|---|---|---|
| P0 | 2.47 | C |
| P1 | 3.53 | B |
| P2 | 3.40 | B |
| P3 | 4.33 | A |

Fruit number showed different responses among treatments. P3 produced an average of 4.33 fruits per plant, while P0 produced 2.47 fruits. P1 and P2 produced 3.53 and 3.40 fruits, respectively. DMRT results showed that P0 was significantly different from the treatment receiving LOF; P1 and P2 were not significantly different from each other; and P3 was significantly different from the other treatment groups.

Analysis of variance (ANOVA) for the number of fruits shows a calculated F value of 26,780 with a significance level of 0.001. Thus, the LOF treatment had a very significant effect on fruit number. The increase in fruit number in P3 is likely related to better vegetative growth conditions and nutrient availability during the flowering and fruit formation phases. LOF, which contains N, P, and K, can support the development of the crown and physiological processes related to the formation of generative organs.

These results are consistent with those of Panjaitan et al. (2023), who reported that liquid organic fertilizer affected eggplant fruit number and yield. Therefore, the observed fruit number response in this study confirms previous research findings that liquid organic fertilizer can be a factor in increasing eggplant yield components.

### 3.4 Fruit Heavy

Fruit weight is A produce parameter measurable based on on That total weight of F1 variation White eggplant fruit harvested per plot under each treatment

**Table 4.** Average fruit heavy from white eggplant

| Treatment | Fruit heavy (g/plant) | DMRT 5% |
|---|---|---|
| P0 | 114.93 | C |
| P1 | 157.80 | B |
| Page 2 | 181.13 | ab |
| P3 | 215.67 | A |

Fruit weight gain from 114.93 G at P0 to 215.67 g on P3. P1 yield 157.80 G And P2 produces 181.13 G per plant. That DMRT results show that P3 different significantly from P0 And P1, but is not

significantly different from P2. P2 is also not significantly different from P1. Thus, the difference in mean scores between P2 and P3 is not statistically significant enough to be considered a significant difference.

ANOVA results show calculations F value from 29,798 with meaning level of 0.001, indicating That That People of color the treatment has very significant influence on fruit weight. That increase in the Fruit weight is believed to be related to nutrient availability, which supports canopy growth and photosynthetic activity, allowing photosynthetic products to be allocated to generative organs. Furthermore, organic matter derived from processed cocoa husks has the potential to improve growing media conditions and nutrient availability.

Panjaitan et al. (2023) reported that LOF can affect eggplant fruit weight. The results of this study showed a consistent pattern, namely that increasing LOF concentration was followed by an increase in average fruit weight, although the difference between treatments P2 and P3 was not statistically significant. This finding suggests that the highest average value is not always shows a significant difference compared to the treatment below.

Overall, the application of LOF is obtained from cocoa husk waste produces a positive response in all observed parameter. P3 produce That highest average values For plant tall, number from fruit, and fruit weight. However, the DMRT results showed that for some parameters, especially fruit weight, P2 was not significantly different from P3. Therefore, the results of this study indicate that 300 ml/L of water produced the highest average. These values were obtained under experimental conditions, but this cannot yet be interpreted as the absolute optimal dose.

The limitations of this study should be considered when interpreting the results. The study was conducted at a single location, using a single variety (Kania F1), four dose levels, and three replications. Consequently, the results primarily reflect the response of this specific variety and the environmental conditions of the study. Further testing across a wider range of locations, varieties, and dose levels is needed to determine the consistency of response and the optimal dose of cocoa hull LOF.

## 4. CONCLUSION

The application of liquid organic fertilizer derived from cocoa husk waste had a very significant effect on the growth and yield of white eggplant under research conditions. P3 (300 ml/L from water) produced That the tallest average plant tall on that final observation, that is the plant height is 98.89 cm, produces 4.33 fruits per plant, and the fruit weight per plant is 215.67 g. Liquid organic fertilizer used containing 0.44% N, 34.87 ppm $P_2O_5$ , 0.07% $K_2O$, And 0.75% organic carbon. Based on On average, P3 produced the highest response; however, for fruit weight, P3 did not differ significantly from P2. Thus, 300 ml/L of water was the treatment with the highest growth and yield response under the conditions of this study, not the optimal dose applicable to all cultivation conditions.

Based on the results of this study, it is recommended for further research to determine the optimal dose of cocoa husk waste LOF with a dose range above 300 ml/L of water, considering that the P3 treatment has not shown any decrease in yield so that the optimum dose has not been achieved. Considering that the nutrient content of the LOF used is still relatively low, namely 0.44% N, 34.87 ppm P2O5, 0.07% K2O and 0.75% C-organic, it is necessary to optimize the fermentation process by adding decomposers and nutrient sources to improve the quality of the LOF. Furthermore, it is necessary to study the combination of cocoa husk LOF with inorganic fertilizers and test its effectiveness on different soil types, planting seasons, and other horticultural commodities. To complete the scientific study, it is also recommended to analyze the long-term effects of LOF application on soil biological properties, soil microorganism populations, as well as an economic feasibility analysis to assess the efficiency and sustainability of its use.

## REFERENCES

Akhir, T., Studi, P., Pertanian, P., Pertanian, J., Pembangunan, P., Gowa, P., Extension, B., Pengembangan, DAN, Pertanian, SDM, & Pertanian, K. (2025). Utilization of Cocoa Fruit Peel Waste (Theobroma cacao L.) as Liquid Organic Fertilizer (POC) to Increase the Growth and Production of Chili Pepper Plants (Capsicum frutescens L.) Cocoa Fruit Skin Waste (Theobroma cacao) L.) as Organic Liquid Fertilizer (POC) to Increasing the Growth and Production of Chili Pepper Plants (Capsicum frutescens L.) .

Andina, AF (2021). The Effect of Various Types of Bokashi and Rice MOL Concentration on That Growth and Yield of White Eggplant (Solanum melongena L.). Gunungsitoli Alo'oa District in Figures in 2024. (2024).

Artyah, A., Akhir, T., Studi, P., Pertanian, P., Pertanian, J., Pembangunan, P., Gowa, P., Extension, B., Pengembangan, DAN, Pertanian, SDM, & Agriculture, K. (2025). Utilization cocoa (Theobroma) chocolate

Capsicum frutescens (L.) fruit peel waste as liquid organic fertilizer (POC) to increase the growth and production of cayenne pepper (Capsicum frutescens L.).

Candra, IA (2025). Utilization of Bacillus sp. bacteria in the agricultural sector, 7(2), 178–184. https://doi.org/10.31289/jiperta.v7i1.6001

Environmental Journal.

Ernitha Panjaitan, P., Sianturi, PLL, Sidauruk, L., & Manurung, EY (2023). The the effect of liquid organic The effect of solid organic fertilizer and solid organic fertilizer on the growth and yield of eggplant (Solanum melongena L.). Journal of Management and Reasoning Studies, 1(3), 185–199. https://doi.org/10.59031/jkpim.v1i3.210

Harisandi, W. (2021). The effect of bokashi made from cocoa husk waste on growth and crop yield. from tomato plants (Lycopersicum esculentum Mill.). Student Research Journal.

Mangungsong, A., Budidaya, J., Perkebunan, T., Pertanian, P., & Payakumbuh, N. (2019). Utilization of soil microbes in organic fertilizer production and their role in alluvial soil and cocoa seedling growth, 47(3), 318–325.

Mwafulirwa, L., Sizmur, T., Daymond, A., Atuah, L., Quaye, A.K., Coole, S., Robinson, S., Hammond, J., Awudzi, G., Awunyo-Vitor, D., Domfeh, O., & Hadley, P. (2024). Organic matter derived from cocoa pod husks has varying effects on soil fertility, nutrient solubility, and greenhouse gas emissions in cocoa soils. Journal of Cleaner Production, 479. https://doi.org/10.1016/j.jclepro.2024.144065

Nurdiani, R., Ibnusina, F., & Candra, DA (2025). The effect of pineapple peel liquid organic fertilizer concentration and inorganic fertilizer dosage on the growth and yield of pak choi (Brassica rapa L.), 7(2), 121–129.

PGPR application at different concentrations and time intervals, 1(1), 1–14.

Phallus, P., & Marsono. (2008). Fertilizer Use Guidelines. Spreader Self-reliance. Jakarta.

Rifa'i, FN (2023). The Effect of Various Planting Media and Liquid Organic Fertilizer Concentrations on Eggplant Growth and Yield. Thesis, UPN Veteran Yogyakarta.

Sartini, et al. (2012). Cocoa husk waste as a source of pollution and compost potential.

Sulistyono, A., Putri, KA, & S., DP (2023). The effect of type and concentration of liquid organic fertilizer on the growth and production of purple eggplant. Lampung Agricultural Engineering Journal, 12(4), 997–1009.

Taha, L., & Rahayu, S. (2024). Utilization self cocoa beans husk waste Here organic fertilizer, 24(1), 148–156 . Sure, A., Umarie, I., & Suroso, B. (2025). Growth And produce eggplant response (Solanum melongena L.) on

Widia, R., & Haris, M. (2023). The effect of liquid organic fertilizer doses of cocoa husks on the vegetative growth of horticultural plants. Indonesian Journal of Agricultural Sciences.

Yao, KA, et al. (2025). Evaluation of the Effectiveness of Cocoa Husk and Moringa Leaf-Based Organic Fertilizer on N'Drowa Eggplant (Solanum aethiopicum). Journal of Agricultural and Environmental Chemistry.

Yulianti, W. (2020). Utilization of cocoa husk compost to optimize eggplant (Solanum melongena L.) production. Hortuscolere Journal, 1(1), 27–32.