Bioscientist: Jurnal Ilmiah Biologi
https://e-journal.undikma.ac.id/index.php/bioscientist

September 2026 Vol. 14, No. 3
e-ISSN: 2654-4571
pp. 1203-1213

Effect of Coconut Husk Liquid Organic Fertilizer on the Vegetative Growth of Bird's Eye Chili (*Capsicum frutescens*)

[1]Afwan Riyadi, [2*] Lestari M.P. Alibasyah, [3]Vita Indri Febriani, [4]Lilies, [5]Gamar B.N. Shamdas, [6]Raya Agni

[1,2,3,4,5,6]Department of Biology Education, Faculty of Teacher Training and Education, Universitas Tadulako, Palu, Indonesia.

*Corresponding Author e-mail: lestari.alibasyah1964@gmail.com

Received: May 2026; Revised: June 2026; Accepted: August 2026; Published: September 2026

Abstract: This study aimed to evaluate the effectiveness of liquid organic fertilizer (LOF) derived from coconut husk on the vegetative growth of bird's eye chili (*Capsicum frutescens*) using a completely randomized design (CRD). The experiment consisted of five treatment levels with four replications, resulting in a total of 20 experimental units. The treatments included P0 (control), P1 (10%), P2 (15%), P3 (20%), and P4 (25%), each applied at a volume of 250 mL per application on 14, 28, and 42 days after planting. Plant height and the number of leaves were measured at 21, 35, and 49 days after planting. The data were analyzed using normality and homogeneity tests, analysis of variance (ANOVA), and the least significant difference (LSD/BNT) post hoc test. The results demonstrated a highly significant effect of coconut husk-based LOF application, with p-values of 0.002 for plant height and <0.001 for the number of leaves. Among the tested treatments, the 15% LOF concentration (P2) exhibited the most optimal effect in promoting the vegetative growth of bird's eye chili.

Keywords: Bird's eye chili; liquid organic fertilizer; coconut husk; vegetative growth

How to Cite: Riyadi, A., Alibasyah, L. M., Febriani, V. I., Lilies, Shamdas, G. B., & Agni, R. (2026). Effect of Coconut Husk Liquid Organic Fertilizer on the Vegetative Growth of Bird's Eye Chili (*Capsicum frutescens*). *Bioscientist: Jurnal Ilmiah Biologi*, *14*(3), 1203–1213. https://doi.org/10.33394/bioscientist.v14i3.20852

https://doi.org/10.33394/bioscientist.v14i3.20852

INTRODUCTION

Cayenne pepper (*Capsicum frutescens* L.) is one of the economically important horticultural commodities due to its high market demand, diverse applications, and contribution to farmers' income. In Indonesia, cayenne pepper is not only consumed as a daily culinary ingredient but also plays an important role in supporting the food supply chain. The continuous increase in consumer demand has strengthened the strategic position of cayenne pepper in the agricultural sector. Moreover, fluctuations in cayenne pepper production frequently influence market prices and contribute to fluctuations in food inflation (Zahara et al., 2021). The commodity also has considerable development potential because its demand remains relatively stable throughout the year (Syahril et al., 2022). Therefore, improving cayenne pepper productivity through sustainable cultivation practices is essential to ensure stable production and economic benefits for farmers.

Plant productivity is strongly determined by the availability of sufficient nutrients during growth and development. Conventional agricultural systems commonly rely on inorganic fertilizers because they provide nutrients rapidly and can directly enhance crop productivity. However, excessive and continuous application of chemical fertilizers may negatively affect soil properties, reduce soil microbial diversity, contribute to nutrient imbalance, and increase production costs (Savci, 2012; Tilman et al., 2002). Consequently, the development of environmentally sustainable nutrient management strategies based on organic resources has become increasingly important. Organic fertilizers, including liquid organic fertilizers (LOFs), represent a potential alternative because they can supply essential nutrients while improving soil biological activity and maintaining long-term soil fertility (Surtono et al., 2023; Muktamar et al., 2020).

Among various agricultural wastes, coconut husk represents an abundant but underutilized organic resource in Indonesia. Coconut production generates substantial amounts of husk waste, which is frequently discarded, accumulated, or openly burned, causing environmental problems. Approximately 35% of coconut fruit weight consists of husk material, which contains organic compounds and mineral elements potentially beneficial for plant growth. The nutrient composition of coconut husk provides opportunities for its conversion into liquid organic fertilizer through fermentation processes. The resulting fertilizer may contain essential macro- and micronutrients that contribute to plant physiological processes, particularly during vegetative growth stages (Faizi et al., 2020; Bulkaini et al., 2022). Previous studies have demonstrated that coconut husk-based organic fertilizers can improve plant growth and productivity in several horticultural crops, including eggplant (*Solanum melongena* L.) (Ramli, 2023).

The effectiveness of liquid organic fertilizers is highly dependent on their nutrient composition and application concentration. An appropriate fertilizer concentration is required to ensure optimal nutrient availability because insufficient nutrient supply may limit plant growth, whereas excessive application may cause nutrient imbalance and reduce nutrient uptake efficiency (Marschner, 2012). Previous studies have indicated that coconut husk-derived liquid organic fertilizer can positively influence horticultural crop growth; however, most studies have focused on crops other than cayenne pepper or have primarily investigated fertilizer production techniques rather than plant responses (Rozen et al., 2023). Therefore, scientific information regarding the optimal concentration of coconut husk-based liquid organic fertilizer for improving vegetative growth characteristics of cayenne pepper remains limited.

Nutritionally, coconut husk contains several essential nutrients, particularly nitrogen (N), phosphorus (P), and potassium (K), which play important roles in plant metabolism, leaf formation, photosynthesis, and biomass accumulation (Bulkaini et al., 2022). Nitrogen is primarily associated with vegetative growth and chlorophyll synthesis, phosphorus contributes to energy transfer and root development, while potassium regulates water balance, enzyme activation, and physiological processes involved in plant growth (Marschner, 2012). Therefore, the application of coconut husk-based liquid organic fertilizer may provide a sustainable nutrient source to support vegetative development in cayenne pepper. Nevertheless, the specific response of cayenne pepper (*Capsicum frutescens* L.) to different concentrations of coconut husk-based liquid organic fertilizer remains insufficiently explored.

Based on this research gap, this study aimed to evaluate the effect of different concentrations of coconut husk-based liquid organic fertilizer on the vegetative growth performance of cayenne pepper, particularly plant height and leaf number. We hypothesized that the application of coconut husk-based liquid organic fertilizer at an appropriate concentration would significantly enhance vegetative growth compared with untreated plants. The findings of this study are expected to provide scientific information regarding the potential utilization of coconut husk waste as an environmentally friendly nutrient source and to determine an optimal fertilizer concentration for sustainable cayenne pepper cultivation.

METHOD

Experimental Design and Research Site

This study was designed as a quantitative experimental study using a Completely Randomized Design (CRD) as the experimental framework. Five concentrations of coconut husk liquid organic fertilizer (LOF) were evaluated, consisting of P0 (control without LOF), P1 (10% LOF), P2 (15% LOF), P3 (20% LOF), and P4 (25% LOF). Each treatment was replicated four times, resulting in a total of 20 experimental units. For each treatment, 1,000 mL of fertilizer solution was prepared and proportionally distributed among the replicates, with each replicate receiving 250 mL of solution. The experiment was conducted from January to April 2025 in the Greenhouse of the Biology Education Study Program, Universitas Tadulako.

Materials and Equipment

The equipment used in this study included medium-sized fermentation containers, measuring cups, 40 × 40 cm polybags, hoes, sacks, rulers or measuring instruments, writing tools, notebooks, and headphones. The materials consisted of 1 kg of coconut husk, 500 mL of EM4 microbial solution, 500 g of brown sugar (molasses source), 10 L of clean water, bird's eye chili seedlings as planting material, and soil as the growth medium.

Preparation of Coconut Husk Liquid Organic Fertilizer

The coconut husk-based liquid organic fertilizer (LOF) was prepared through a series of systematic fermentation steps. First, 1 kg of coconut husk was cut into small pieces to accelerate the decomposition process. Subsequently, 500 mL of EM4 solution was prepared, and 500 g of brown sugar was dissolved in 1,000 mL of water. All prepared materials were then mixed in a clean fermentation container containing 10 L of clean water. The container was tightly sealed and left to undergo anaerobic fermentation for 14 days. The container lid was opened periodically each day to release accumulated fermentation gases and prevent excessive pressure buildup. After 14 days of fermentation, the coconut husk LOF was ready for application or storage in bottles (Bulkaini et al., 2022).

Analysis of LOF Nutrient Content

Coconut husk-based LOF contains essential macronutrients resulting from the decomposition of organic materials during fermentation using EM4 and molasses. Nitrogen (N) plays an important role in promoting the development of vegetative plant tissues, particularly chlorophyll-containing organs. Phosphorus (P) contributes to root growth and the development of reproductive organs, especially flowers. Meanwhile, potassium (K) is involved in fruit formation, regulation of water and nutrient transport, and improvement of plant tolerance to unfavorable environmental conditions.

Preparation of Planting Medium

The preparation and management of the planting medium involved several stages. Initially, the soil was cleaned of foreign materials, including weeds, organic debris, and gravel. The soil was subsequently heated to eliminate weed seeds and potential pathogenic organisms, such as fungi, bacteria, and nematodes. Afterward, 5 kg of prepared soil was placed into each polybag. Each polybag was supplemented with 500 g of goat manure as a basal fertilizer, which was evenly incorporated into the soil to improve soil conditions before planting.

Seed Planting

Bird's eye chili seeds obtained from an agricultural supply store were directly planted in polybags containing the prepared growth medium. Two seeds were planted in each polybag. Planting holes with a depth of 0.5–1 cm were made at the center of the soil surface. The seeds were positioned horizontally inside the holes and lightly covered with fine soil to facilitate seedling emergence. Initial watering was performed using a sprayer to maintain adequate moisture levels without causing soil compaction around the seeds.

Plant Maintenance and LOF Application

Plant maintenance consisted of irrigation and LOF application. Irrigation was performed regularly at 16:00 Central Indonesian Time (WITA) using the amount of water required to maintain soil moisture. The LOF treatments were applied according to the predetermined concentrations as follows:

a. P0 (control): 250 mL water without LOF + 500 g goat manure
b. P1 (10% LOF): 900 mL water + 100 mL LOF
c. P2 (15% LOF): 850 mL water + 150 mL LOF
d. P3 (20% LOF): 800 mL water + 200 mL LOF
e. P4 (25% LOF): 750 mL water + 250 mL LOF

The LOF was applied three times during the plant growth period, namely on days 14, 28, and 42 after planting.

Data Collection and Statistical Analysis

Agronomic data were collected through direct observation of bird's eye chili (*Capsicum frutescens*) growth performance in each experimental unit. The evaluated vegetative parameters included plant height and the number of leaves. Measurements were conducted periodically at 21, 35, and 49 days after planting (DAP).

The collected quantitative data were initially tabulated to calculate the mean values for each treatment group. The data were subsequently subjected to prerequisite tests, including normality analysis and homogeneity of variance testing. The effects of LOF treatments were analyzed using analysis of variance (ANOVA) at a significance level of $\alpha = 0.05$. When significant differences among treatments were detected, further mean comparisons were conducted using the Least Significant Difference (LSD) test.

RESULTS AND DISCUSSION

The application of coconut husk-derived liquid organic fertilizer (LOF) significantly influenced the vegetative growth responses of bird's eye chili (*Capsicum frutescens*) across the tested concentrations (P0–P4). Plant growth responses were assessed based on plant height and leaf number at 21, 35, and 49 days after planting (DAP). The dataset fulfilled the assumptions required for ANOVA, as confirmed by the Shapiro–Wilk normality test and Levene's test for homogeneity of variance.

Plant Height

The effects of coconut husk liquid organic fertilizer (LOF) concentrations on the vegetative growth of bird's eye chili were initially evaluated based on plant height measurements. The mean values of plant height obtained from each treatment and replication are presented in Table 1.

Table 1. Mean analysis of plant height of bird's eye chili in response to coconut husk liquid organic fertilizer application at 21, 35, and 49 days after planting (DAP).

Treatment	Replication I	Replication II	Replication III	Replication IV	Total	Mean
P0	18.7	8.0	17.7	14.9	59.3	14.8
P1	23.9	16.9	16.2	14.7	71.7	17.9
P2	28.5	25.3	25.4	26.4	105.7	26.4

Treatment	Replication I	Replication II	Replication III	Replication IV	Total	Mean
P3	15.6	17.3	16.5	20.6	70.0	17.5
P4	20.0	22.4	19.8	20.9	83.2	20.8

Based on the normality analysis of the mean plant height data presented in Table 1, all treatment groups (P0–P4) exhibited Shapiro–Wilk significance values above 0.05, with values of 0.181, 0.161, 0.211, 0.399, and 0.389, respectively. Therefore, the plant height data for all treatments were considered normally distributed and suitable for further analysis using the homogeneity test. The Levene's test result based on the mean value showed a significance value of 0.156 (>0.05), indicating that the variances among treatments were homogeneous. Since the assumptions of normality and variance homogeneity were fulfilled, the data met the statistical requirements for ANOVA, allowing the results to be interpreted reliably.

Table 2. Analysis of variance (ANOVA) for plant height of bird's eye chili in response to coconut husk liquid organic fertilizer application at 21, 35, and 49 days after planting (DAP)

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	301.163	4	75.291	7.450	0.002
Within Groups	151.582	15	10.106		
Total	452.745	19			

Note: Treatment effects were considered significant when the significance value (Sig.) was <0.05.

The ANOVA results presented in Table 2 showed a significance value of 0.002, which was lower than the significance threshold of 0.05. Therefore, the null hypothesis (H_0) was rejected, and the alternative hypothesis (H_1) was accepted. This statistical result indicates that the application of coconut husk-based liquid organic fertilizer significantly affected plant height in bird's eye chili. This finding was further supported by the calculated F-value of 7.450, which confirmed the presence of significant differences among the tested treatments. These differences indicate that variations in coconut husk LOF concentrations produced different responses in vegetative growth. To determine which treatment combinations differed significantly, a further analysis using the least significant difference (LSD/BNT) test was conducted, and the results are presented in Table 3.

Table 3. LSD (BNT) analysis of plant height of bird's eye chili in response to coconut husk liquid organic fertilizer application at 21, 35, and 49 days after planting (DAP)

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95%Confidence Interval	
					Lower Bound	Upper Bound
P0	P1	-2,8500	2,2478	0,224	-7,641	1,941
	P2	-11,3250	2,2478	0,000	-16,116	-6,534
	P3	-2,4250	2,2478	0,298	-7,216	2,366
	P4	-5,7000	2,2478	0,023	-10,491	-0,909
P1	P0	2,8500	2,2478	0,224	-1,941	7,641
	P2	-8,4750	2,2478	0,002	-13,266	-3,684
	P3	0,4250	2,2478	0,853	-4,366	5,216
	P4	-2,8500	2,2478	0,224	-7,641	1,941

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95%Confidence Interval	
					Lower Bound	Upper Bound
P2	P0	11,3250	2,2478	0,000	6,534	16,116
	P1	8,4750	2,2478	0,002	3,684	13,266
	P3	8,9000	2,2478	0,001	4,109	13,691
	P4	5,6250	2,2478	0,024	0,834	10,416
P3	P0	2,4250	2,2478	0,298	-2,366	7,216
	P1	-0,4250	2,2478	0,853	-5,216	4,366
	P2	-8,9000	2,2478	0,001	-13,691	-4,109
	P4	-3,2750	2,2478	0,166	-8,066	1,516
P4	P0	5,7000	2,2478	0,023	0,909	10,491
	P1	2,8500	2,2478	0,224	-1,941	7,641
	P2	-5,6250	2,2478	0,024	-10,416	-0,834
	P3	3,2750	2,2478	0,166	-1,516	8,066

Note: A significance value (Sig.) <0.05 indicates a significant difference between the two compared treatments (I and J).

Based on the results presented in Table 3, the P2 treatment (15% LOF concentration) showed significant differences compared with all other treatments (P0, P1, P3, and P4), with significance values below 0.05. The largest mean difference was observed between P2 and P0, reaching 11.325 cm, followed by differences between P2 and P3 (8.900 cm), P2 and P1 (8.475 cm), and P2 and P4 (5.625 cm). Meanwhile, the treatment combinations P0–P1, P0–P3, P1–P3, P1–P4, and P3–P4 did not show statistically significant differences (Sig. >0.05). These results indicate that P2 (15% LOF concentration) provided the most favorable growth response among all tested treatments.

The LSD analysis further demonstrated that treatments P1 (10%), P2 (15%), P3 (20%), and P4 (25%) were statistically grouped together, indicating no significant differences among these four concentrations. Nevertheless, based on the mean plant height values, P2 exhibited the highest growth performance compared with the other treatments. In contrast, the control treatment (P0) showed lower growth performance, likely due to limited nutrient availability. A similar response was observed in P1, where the relatively low fertilizer concentration may have been insufficient to meet plant nutritional requirements. Conversely, the higher concentrations applied in P3 and P4 may have resulted in nutrient imbalance, which contributed to variations in plant height among treatments.

The superior vegetative growth response observed in P2 (15% LOF concentration) compared with P1 (10%), P3 (20%), P4 (25%), and the control treatment suggests that an optimum nutrient concentration was achieved at this level. Differences in plant responses among treatments may be associated with variations in the availability of macro- and micronutrients that support physiological processes during vegetative development. The relatively high potassium (K) content in coconut husk, combined with nitrogen (N), phosphorus (P), calcium (Ca), magnesium (Mg), and other organic compounds, may contribute to improved nutrient availability and uptake by plants. These conditions can stimulate metabolic activity and vegetative growth, as reflected by increased plant height (Wijaya et al., 2017). Potassium plays an important role in enhancing plant height and strengthening stems. The high potassium content in coconut husk LOF may also support photosynthetic activity in bird's eye chili plants (Rahayu et al., 2022).

Number of Leaves

In addition to plant height, the effect of coconut husk LOF application was assessed based on leaf production as an important indicator of vegetative growth. The mean number of leaves recorded for each treatment and replication is presented in Table 4.

Table 4. Mean analysis of the number of leaves of bird's eye chili plants in response to coconut husk liquid organic fertilizer application at 21, 35, and 49 days after planting (DAP)

Treatment	Replication I	Replication II	Replication III	Replication IV	Total	Mean
P0	14	12	13	14	52	13
P1	16	12	13	13	54	13
P2	21	25	23	22	90	23
P3	15	13	14	14	56	14
P4	15	16	14	13	59	15

Based on the results presented in Table 4, the normality test for the number of leaves showed that all treatment groups (P0–P4) had Shapiro–Wilk significance values greater than 0.05, with values of 0.972, 0.683, 0.850, 0.683, and 0.972, respectively. These results indicate that the data distribution for the number of leaves met the assumption of normality and was suitable for further statistical analysis. The Levene's test showed a significance value of 0.420 (>0.05), indicating that the variances among treatments were homogeneous. Since both assumptions of normality and homogeneity were fulfilled, the data were subsequently analyzed using ANOVA.

Table 5. Analysis of variance (ANOVA) for the number of leaves of bird's eye chili plants in response to coconut husk liquid organic fertilizer application at 21, 35, and 49 days after planting (DAP)

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	283.800	4	70.950	46.780	0.000
Within Groups	22.750	15	1.517		
Total	306.550	19			

Note: Treatment effects were considered significant when the significance value (Sig.) was <0.05.

The ANOVA results presented in Table 5 showed that the model significance value (p-value) was 0.000, which was substantially lower than the significance level of $\alpha = 0.05$. This result indicates that the null hypothesis (H_0) was rejected, confirming that coconut husk liquid organic fertilizer significantly affected leaf production in bird's eye chili plants. The significant differences among fertilizer concentration levels were further supported by the calculated F-value of 46.780, which indicated substantial variation in plant responses among treatments. To determine the specific differences between treatment groups, further analysis using the LSD (BNT) test was performed, as presented in Table 6.

Table 6. LSD (BNT) analysis of the number of leaves of bird's eye chili plants in response to coconut husk liquid organic fertilizer application at 21, 35, and 49 days after planting (DAP).

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
P0	P1	-0,500	0,871	0,574	-2,36	1,36
	P2	-10,250	0,871	0,000	-12,11	-8,39
	P3	-1,500	0,871	0,106	-3,36	0,36
	P4	-2,000	0,871	0,036	-3,86	-0,14
P1	P0	0,500	0,871	0,574	-1,36	2,36
	P2	-9,750	0,871	0,000	-11,61	-7,89
	P3	-1,000	0,871	0,269	-2,86	0,86
	P4	-1,500	0,871	0,106	-3,36	0,36
P2	P0	10,250	0,871	0,000	8,39	12,11
	P1	9,750	0,871	0,000	7,89	11,61
	P3	8,750	0,871	0,000	6,89	10,61
	P4	8,250	0,871	0,000	6,39	10,11
P3	P0	1,500	0,871	0,106	-0,36	3,36
	P1	1,000	0,871	0,269	-0,86	2,86
	P2	-8,750	0,871	0,000	-10,61	-6,89
	P4	0,500	0,871	0,574	-2,36	1,36
P4	P0	2,000	0,871	0,036	0,14	3,86
	P1	1,500	0,871	0,106	-0,36	3,36
	P2	-8,250	0,871	0,000	-10,11	-6,39
	P3	0,500	0,871	0,574	-1,36	2,36

Note: A significance value (Sig.) <0.05 indicates a significant difference between the compared treatments (I and J).

The LSD analysis presented in Table 6 demonstrated that the P2 treatment (15% LOF concentration) differed significantly from all other treatments (P0, P1, P3, and P4), with a significance value of 0.000 (< α = 0.05). The largest mean difference was observed between P2 and P0, reaching 10.250 leaves, followed by differences between P2 and P1 (9.750 leaves), P2 and P3 (8.750 leaves), and P2 and P4 (8.250 leaves). Conversely, the treatment combinations P0–P1, P0–P3, P1–P3, P1–P4, and P3–P4 showed no statistically significant differences (Sig. >0.05). These findings demonstrate that P2 was statistically superior to all other treatments, indicating that a 15% coconut husk LOF concentration was the optimum dosage for increasing leaf production in bird's eye chili.

The absence of greater growth responses in P3 and P4 compared with P2 may be attributed to the fact that the nutrient requirements of plants were optimally fulfilled at the 15% concentration level. Increasing the LOF concentration beyond this level may have caused excessive nutrient availability, increased osmotic pressure, nutrient imbalance, potential phytotoxic effects, and reduced nutrient uptake efficiency, thereby limiting further vegetative growth. Therefore, the application of coconut husk LOF should consider the optimum concentration to ensure that supplied nutrients can be utilized efficiently by bird's eye chili plants (Setiawan, 2016).

Furthermore, excessive application of LOF may disrupt nutrient balance. Coconut husk is known to contain relatively high potassium (K) levels. When supplied in excessive amounts, potassium may interfere with the absorption of other essential nutrients, such as calcium (Ca), magnesium (Mg), and nitrogen (N), due to nutrient antagonism. This imbalance can negatively affect physiological processes within plants, ultimately inhibiting vegetative growth. Thus, even when nutrients are available in large quantities, plants may not be able to utilize them effectively (Luh et al., 2021).

CONCLUSION

The application of coconut husk liquid organic fertilizer significantly affected the vegetative growth of cayenne pepper (*Capsicum frutescens*). Different fertilizer concentrations resulted in significant variations in plant height and number of leaves, with the 15% concentration treatment showing the most favorable vegetative growth response compared with the control and other treatments. These findings indicate that coconut husk liquid organic fertilizer has potential as an alternative organic fertilizer to support the vegetative growth of cayenne pepper. Further studies involving the generative growth phase, yield-related parameters, and field-scale evaluation are needed to confirm its effectiveness and practical application in sustainable crop production.

RECOMMENDATION

Based on the findings of this study, cayenne pepper farmers are encouraged to consider the application of coconut husk-derived POC at a 15% concentration as an affordable and environmentally friendly organic fertilizer option. Future studies should evaluate the effects of coconut husk POC during the generative phase of cayenne pepper growth, including flowering, fruit development, and yield performance. In addition, further research should incorporate additional growth parameters, such as stem diameter and root length, and assess its effectiveness in other horticultural crops to obtain a more comprehensive understanding of the potential role of coconut husk POC in supporting sustainable agricultural practices.

ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to Universitas Tadulako for providing research facilities and academic support throughout the implementation of this study. The authors also extend their deepest appreciation to the academic supervisors for their valuable time, guidance, and constructive suggestions during the completion of this research. Furthermore, the authors acknowledge the continuous support, encouragement, and motivation provided by family members and colleagues throughout the research process. The authors also appreciate the dedication and perseverance invested in overcoming various challenges encountered during the study, which contributed to the successful completion of this scientific work.

REFERENCES

Agustina, R., Mulyani, H., & Farida, N. (2021). Manfaat penggunaan pupuk organik cair (POC) pada pertumbuhan bunga *Aglaonema*. *Artikel Hasil Pengabdian Kepada Masyarakat, 3*(2), 185–189.

Bulkaini, et al. (2022). Inovasi teknologi pembuatan pupuk organik cair berbasis limbah sabut kelapa. *Jurnal Pengabdian Magister Pendidikan IPA, 5*(2), 204–208.

Driantama, I., Walida, H., & Lestari, W. (2021). Respons pemberian pupuk organik cair limbah rumah tangga terhadap pertumbuhan tanaman cabai rawit (*Capsicum frutescens* L.). *Journal Agroplasma, 8*(2), 46–53.

Fauzani, A. R., Ilyasa, F., Perwira Hadi, A., Aini, R., Siahaya, P. A., Mayani, E., & Nuriadi, N. (2025). Utilization of coconut fiber organic waste into cocopeat planting media in Aik Prapa Village. *Jurnal Wicara Desa, 3*(1), 109–116.

Faizi, M., Pratiwi, S. H., & Purnamasari, R. T. (2020). Respons pertumbuhan dan hasil tanaman terung (*Solanum melongena* L.) akibat aplikasi pupuk organik sabut kelapa limbah pupuk organik cair (POC). *Jurnal Agroteknologi Merdeka Pasuruan, 4*(2), 5–19.

Irwansyah. (2024). Analisis kandungan nitrogen pada pupuk organik cair dengan kulit pisang, sabut kelapa, dan daun gamal dengan bioaktivator ragi tape. *Journal Agro Industrial and Sustainability, 1*(2), 1–6.

Luh, N., Gede Laviola, N. K., Yunita Sari, N. K., & Dwipayani Lestari, N. K. (2021). Pengaruh pemberian pupuk organik cair (POC) terhadap pertumbuhan vegetatif dan generatif tanaman cabai rawit (*Capsicum frutescens* L.). *Jurnal Media Sains, 5*(1), 24–28.

Mahardian, F., & Zulkifli. (2024). Pengaruh POC sabut kelapa dan pupuk daun GrowMore terhadap produksi tanaman melon (*Cucumis melo* L.). *Jurnal Agroteknologi, Agribisnis, dan Akuakultur, 4*(1), 14–22.

Marschner, P. (2012). *Marschner's mineral nutrition of higher plants* (3rd ed.). Academic Press. https://doi.org/10.1016/C2009-0-63043-9

Muktamar, Z., Justi, R., Setiawan, B., & Fahrurrozi, F. (2020). The effects of organic amendments on soil fertility and plant growth under tropical agricultural systems. *International Journal of Agricultural Technology, 16*(4), 943–956.

Mulyanto, N. R., Assajad, Z. N., Antika, T., Madja, M. D. N. S., Rifaldo, A., Azzahra, N. P. F. A., Faadhila, I. H., Zahrani, A. S., & Hilwan, A. (2025). Pemanfaatan limbah organik perkebunan dan feses domba garut menjadi pupuk organik cair di Desa Ciputri, Kecamatan Pacet, Cianjur. *Jurnal Pusat Inovasi Masyarakat, 7*(1), 80–88.

Pratiwi, N. L. G. L., Sari, N. K. Y., & Lestari, N. K. D. (2021). Pengaruh pemberian pupuk organik cair (POC) terhadap pertumbuhan vegetatif dan generatif tanaman cabai rawit (*Capsicum frutescens* L.). *Jurnal Media Sains, 5*(1), 24–28.

Rahayu, N. Y., Djawartiningsih, R., & Sulistyono, A. (2022). Pengaruh jenis dan tingkat konsentrasi pupuk organik cair terhadap pertumbuhan dan hasil tanaman cabai rawit (*Capsicum frutescens*). *Journal Agrium, 19*(3), 197–206.

Ramli, N. (2023). Penggunaan pupuk organik cair sabut kelapa terhadap pertumbuhan dan hasil tanaman terung ungu (*Solanum melongena* L.). *Jurnal Penelitian Agrosamudra, 10*(1), 40–47.

Rozen, N., Putri, N. E., Kusumawati, A., & Setiawan, R. B. (2023). Demonstrasi plot pupuk organik cair (POC) sabut kelapa dan batang pisang di KWT Banda Langik. *Jurnal Warta Pengabdian Andalas, 30*(1), 144–152.

Savci, S. (2012). An agricultural pollutant: Chemical fertilizer. *International Journal of Environmental Science and Development, 3*(1), 73–80. https://doi.org/10.7763/IJESD.2012.V3.191

Sari, I., Riono, Y., Syaputra, R., Sari, R. P., Alwi, M., Al Ansyari, M. L., & Ninsix, R. (2025). Pengaruh pemberian pupuk organik cair batang pisang (POC) terhadap pertumbuhan dan produksi tanaman cabai rawit (*Capsicum frutescens* L.) di tanah gambut. *Jurnal Agro Indragiri, 10*(1), 45–62.

Setiawan, C. K. (2016). Pengaruh konsentrasi pupuk organik cair diperkaya *Rhizobacteri* osmotoleran terhadap pertumbuhan dan hasil tanaman padi pada kondisi cekaman kekeringan. *[Nama Jurnal belum tersedia], 4*(2), 65–74.

Surtono, A., Putri, S. S., Rahmawati, E. D., Setiawan, J., Maharani, N., Fitria, R. W., & Kezia, H. (2023). Sosialisasi pembuatan pupuk organik cair dari sabut kelapa kepada kelompok tani Bahagia di Desa Karang Anyar, Kecamatan Wonosobo, Kabupaten Tanggamus. *BUGUH: Jurnal Pengabdian Kepada Masyarakat, 3*(2), 153–158.

Syahril, M., Yuliana, A., & Rahmawati, S. (2022). Analisis prospek pengembangan usahatani cabai rawit (*Capsicum frutescens* L.) di Indonesia. *Jurnal Agribisnis Indonesia, 10*(2), 145–154.

Tahar, M., Nur, S., & Firman. (2024). Pemanfaatan sabut kelapa sebagai bahan dasar pembuatan pupuk organik cair (POC) ramah lingkungan di Desa Balombong. *Sipakaraya: Jurnal Pengabdian Masyarakat, 3*(1), 45–51.

Tilman, D., Cassman, K. G., Matson, P. A., Naylor, R., & Polasky, S. (2002). Agricultural sustainability and intensive production practices. *Nature, 418*, 671–677. https://doi.org/10.1038/nature01014

Wijaya, R., Damanik, M. M. B., & Fauzi. (2017). Aplikasi pupuk organik cair dari sabut kelapa dan pupuk kandang ayam terhadap ketersediaan dan serapan kalium serta pertumbuhan tanaman jagung pada tanah Inceptisol Kwala Bekala. *Jurnal Agroteknologi, 5*(2), 249–255.

Yiğit, S. (2025). Reevaluating the reliability of common multiple comparison tests. *Agronomy Journal, 117*(4).