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Effects of Different Rates of Maggot-Based Fertilizer and Banana Corm Liquid Organic Fertilizer on the Growth and Yield of Green Mustard (*Brassica juncea* L.)

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ABSTRACT

Sustainable nutrient management is essential to reduce dependence on synthetic fertilizers and improve soil health in leafy vegetable production. Maggot-based organic fertilizer derived from Black Soldier Fly residues and banana corm liquid organic fertilizer (LOF) represent promising circular bioeconomy inputs; however, evidence on their comparative and combined effects on green mustard (*Brassica juncea* L.) remains limited. This study aimed to evaluate the effects of different rates of maggot fertilizer and concentrations of banana corm LOF on vegetative growth and yield components of green mustard. A factorial randomized block design was employed with maggot fertilizer rates (0, 100, 150, and 200 g polybag^{-1}) and LOF concentrations (40, 60, and 80 mL L^{-1}). Growth parameters (plant height, leaf number, leaf width) and yield components (fresh and edible weight) were analyzed using ANOVA followed by LSD (5%). Maggot fertilizer significantly increased plant height, leaf width, fresh weight, and edible yield, with optimal performance at 150–200 g polybag^{-1}. Banana corm LOF significantly increased leaf number but had limited effects on biomass. No significant interaction effects were observed. These findings demonstrate the effectiveness of maggot fertilizer as a sustainable basal nutrient source and support its integration into organic and low-input vegetable production systems.

INTRODUCTION

Green mustard (*Brassica juncea* L.) is an important leafy vegetable that significantly contributes to nutritional security and holds strategic economic value in tropical regions. The increasing global demand for leafy vegetables, driven by population growth and rising awareness of healthy dietary patterns, underscores the need for agricultural practices that are both productive and sustainable. However, conventional green mustard cultivation remains highly dependent on intensive inorganic fertilizer inputs, which have been associated with negative impacts on soil health, including the depletion of soil organic matter, disruption of soil microbial communities, and environmental degradation (Ariskaa et al., 2024; Zhang et al., 2022;). Transitioning toward organic fertilizers represents a viable pathway to address these challenges, with the potential to improve soil health while sustaining crop growth and productivity.

The reliance on chemical fertilizers in the cultivation of green mustard and other leafy vegetables has resulted in substantial adverse consequences. Excessive and prolonged application of synthetic fertilizers contributes to soil quality deterioration, characterized by reduced microbial diversity and declining soil organic matter (Auger et al., 2023). Moreover, chemical inputs are linked to increased environmental pollution through runoff and leaching, which degrade water quality and negatively affect surrounding ecosystems (Suhartini et al., 2022). Therefore, the adoption of sustainable agricultural practices necessitates a shift toward organic alternatives capable of mitigating these negative effects while enhancing crop quality.

Organic fertilizers, including those derived from agricultural waste through processes such as entomocomposting, play a promising role in promoting sustainable farming systems. Black Soldier Fly larvae

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(Hermetia illucens) are particularly notable for their capacity to convert organic waste into nutrient-rich fertilizer known as frass. This process not only supports waste valorization but also produces organic amendments that improve soil fertility and structure, thereby enhancing plant growth (Katchali et al., 2024; Mašková et al., 2025; Rehman et al., 2022). Previous studies have demonstrated that frass supplies essential nutrients and exerts positive effects on soil microbial communities (Arabzadeh et al., 2024;).

In addition to solid organic fertilizers, the production of liquid organic fertilizer (LOF) from banana corm represents an innovative strategy for valorizing agricultural biomass waste. Banana corm–based LOF has been reported to contain beneficial organic compounds and minerals that stimulate soil microbial activity and promote vegetative plant growth (Lasmini et al., 2023). This approach aligns with circular economy principles by encouraging waste recycling and nutrient cycling within agroecosystems. The integration of LOF with solid organic fertilizers may generate synergistic effects that enhance nutrient availability, improve soil health, and optimize plant growth dynamics (Fahni et al., 2023).

Despite these promising prospects, the existing body of literature remains largely focused on the isolated effects of conventional organic fertilizers, leaving a significant gap in understanding the interactions between solid and liquid organic fertilizers derived from non-conventional sources. Studies examining the combined contributions of insect-derived solid fertilizers and plant biomass–based liquid fertilizers on the growth of leafy vegetables such as Brassica juncea L. are still limited and often lack systematic dose–response evaluations (Luo, 2022). Addressing these knowledge gaps is essential for developing effective integrated fertilization strategies that leverage the complementary benefits of both solid and liquid organic inputs in tropical agroecosystems.

The integration of organic fertilizers from diverse sources, including BSFL residues and banana corm–based LOF, offers a promising pathway for advancing sustainable green mustard production. Through a factorial experimental design evaluating the individual and interactive effects of these fertilizers, this study aims to provide insights into optimal application rates that enhance plant growth while minimizing adverse environmental impacts. Ultimately, this integrated approach has the potential to enrich the literature on organic fertilization strategies and support both agricultural productivity and ecological sustainability.

MATERIALS AND METHODS

The study was conducted from February to March 2025 at Tirta Tani Farm, Pallangga District, Gowa Regency, South Sulawesi Province, Indonesia. The materials used in this study included green mustard seeds (*Brassica juncea* L.), water hyacinth compost, banana corm liquid organic fertilizer (LOF), EM-4, molasses, and chicken manure as raw materials for compost and LOF preparation. The equipment used comprised a digital scale, hoe, measuring tape, plot stakes, raffia string, scissors, documentation tools (camera), and stationery.

1. Experimental Design

This study employed a Randomized Block Design (RBD) with a factorial arrangement involving two treatment factors. The first factor was the application rate of water hyacinth compost (E), consisting of three levels: E1 = 20 ton ha^{-1}, E2 = 30 ton ha^{-1}, and E3 = 40 ton ha^{-1}. The second factor was the concentration of banana corm liquid organic fertilizer (P), consisting of three levels: P1 = 30 mL L^{-1} of water, P2 = 40 mL L^{-1} of water, and P3 = 50 mL L^{-1} of water.

The combination of the two factors resulted in nine treatments (3 × 3), each replicated three times, yielding a total of 27 experimental units.

2. Treatment Application

The experimental field was prepared and divided into plots according to the experimental design. Water hyacinth compost was applied as a basal fertilizer to each plot at the designated rates and thoroughly incorporated into the soil prior to planting. Green mustard seeds were first raised in a nursery and then transplanted into the experimental plots when the seedlings were approximately 10-14 days old or had developed 3-4 true leaves.

Banana corm liquid organic fertilizer was applied at the designated concentrations via soil drenching or foliar spraying during the vegetative growth stage at regular intervals (e.g., once per week). Crop management practices included irrigation, manual weeding, and mechanical pest and disease control, without the use of chemical pesticides.

RESULTS AND DISCUSSION

1. Plant Height

The observational data on plant height and the corresponding analysis of variance presented in the table below indicate that the maggot fertilizer treatment (M) had a highly significant effect on plant height. In contrast, the banana corm liquid organic fertilizer (P) and the interaction between maggot fertilizer and banana corm liquid organic fertilizer (M × P) did not show a significant effect on plant height.

Table 1. Plant height (cm) of green mustard (*Brassica juncea* L.) as affected by maggot fertilizer and banana corm liquid organic fertilizer.

Maggot fertilizer (g/polybag)	Banana corm LOF (mL L^{-1} water)			Mean	LSD 5%
	P1 (40)	P2 (60)	P3 (80)		
M0 (0)	33.47	31.62	36.42	33.83[b]	1.80
M1 (100)	36.33	39.57	38.53	38.14[a]	
M2 (150)	34.47	36.30	32.07	34.28[b]	
M3 (200)	38.58	37.03	37.95	37.86[a]	

Note: Means followed by different letters within the same column or row indicate significant differences at the 5% LSD test. M indicates maggot fertilizer treatments, and P indicates banana corm liquid organic fertilizer (LOF) concentrations.

The results in Table 1 show a significant positive effect of maggot fertilizer application on the plant height of green mustard, with the highest mean plant heights recorded at the application rates of 100 g (M1) and 200 g (M3) per polybag, reaching 38.14 cm and 37.86 cm, respectively. In contrast, the control treatment (M0) and the intermediate dose of 150 g (M2) resulted in lower plant heights, highlighting the importance of applying organic amendments at appropriate rates (Gaol, 2025).

Maggot-based fertilizers, particularly those derived from Black Soldier Fly larvae (Hermetia illucens), are known to be rich in nutrients, including macro- and micronutrients as well as organic matter. This combination substantially enhances soil microbial activity, improves soil structure, and increases nutrient availability for plant uptake (Ariskaa et al., 2024). The improved vegetative growth observed at the tested maggot fertilizer rates suggests that these application levels fall within an optimal range to support the early growth phase of green mustard, thereby enhancing physiological performance and overall biomass accumulation (Fahni et al., 2023).

The application of banana corm liquid organic fertilizer (LOF) at different concentrations (P1-P3) did not show a statistically significant effect on plant height. This finding indicates that the bioactive compounds and nutrients present in banana corm LOF were not sufficient to markedly promote vertical growth compared to solid organic inputs, particularly those derived from maggot frass. It is worth noting that although banana corm LOF may enhance other growth parameters, such as leaf number or biomass, its contribution to plant height in this study appears to be secondary (Inrianti et al., 2024; Analisa & Annisa, 2024). The limited effect may be attributed to nutrient release dynamics or the concentration of key growth-promoting components in the liquid fertilizer.

The absence of a significant interaction between maggot fertilizer and banana corm LOF further indicates that these two inputs functioned relatively independently in influencing plant growth. This suggests that, although both fertilizers can be beneficial, their combined application did not necessarily produce synergistic effects on plant height, which is consistent with findings from previous studies evaluating different fertilization strategies (Effendi et al., 2023; Nisaa et al., 2023). The suboptimal performance observed at the 150 g application rate may reflect nutrient imbalance or temporary nutrient immobilization during the decomposition of organic inputs, highlighting the need for further investigation to optimize fertilizer application strategies (Pratekno et al., 2024; Putri & Asngad, 2024; Desi et al., 2025).

Maggot fertilizer serves as an important and sustainable organic input, aligning with the growing recognition of the role of organic fertilizers in improving soil health and crop productivity while mitigating the adverse impacts of chemical fertilizers. These findings underscore the importance of adopting balanced fertilization strategies, in which the complementary advantages of solid and liquid organic fertilizers are harnessed to support sustainable agricultural practices.

2. Number of leaves (leaves)

The observational data on the number of leaves indicate that the banana corm liquid organic fertilizer (P) treatment had a significant effect on the number of leaves. In contrast. maggot fertilizer (M) and the interaction between maggot fertilizer and banana corm liquid organic fertilizer (M × P) did not show significant effects on the number of leaves.

Table 2. Mean number of leaves of green mustard as affected by maggot fertilizer and banana corm liquid organic fertilizer.

Maggot fertilizer (g/polybag)	Banana corm LOF (mL L^{-1} water)		
	P1 (40)	P2 (60)	P3 (80)
M0 (0)	10.78	11.44	13.11
M1 (100)	12.33	12.78	12.33
M2 (150)	10.78	13.00	13.22
M3 (200)	12.33	11.89	12.89
Mean	11.56^{c}	12.28^{b}	12.89^{a}
LSD 5%		0.51	

Note: Means followed by different letters within the same column or row indicate significant differences at the 5% LSD test. M indicates maggot fertilizer treatments, and P indicates banana corm liquid organic fertilizer (LOF) concentrations.

The results presented in Table 2 show a significant effect of banana corm liquid organic fertilizer (LOF) on the number of leaves of green mustard, demonstrating a clear positive dose–response relationship. Specifically, the highest mean number of leaves was obtained at the highest concentration, P3 (80 mL L^{-1}), with an average of 12.89 leaves. This treatment produced a significantly higher number of leaves than P2 (60 mL L^{-1}) and P1 (40 mL L^{-1}), which recorded 12.28 and 11.56 leaves, respectively (Sugiharti et al., 2022; Hapsari & Suparno, 2023).

The positive effect of banana corm LOF on leaf development can be attributed to its composition, which is rich in nutrients and bioactive compounds that enhance physiological processes associated with leaf initiation and expansion. As reported in previous studies, liquid organic fertilizers generally improve nutrient uptake efficiency and stimulate metabolic activity during the vegetative growth phase, thereby facilitating leaf formation (Wang et al., 2024; Lagon et al., 2022). The optimal response observed at 80 mL L^{-1} indicates that this concentration effectively balances the availability of growth-promoting compounds, thereby maximizing leaf production in green mustard under the experimental conditions.

In contrast, variations in the application rate of maggot fertilizer did not result in statistically significant differences in leaf number across all treatments tested within the range of 0–200 g $polybag^{-1}$. This finding indicates that although maggot fertilizer contributed beneficial nutrients to support overall plant growth, its specific effect on leaf proliferation during the experimental period was relatively limited. Instead, maggot fertilizer appeared to play a more prominent role in enhancing other growth parameters, such as plant height or biomass accumulation, as reflected by the dominant effects of the solid organic amendment (Marasini et al., 2024; Raihan et al., 2022; Putra, 2023). This pattern suggests that the nutrients supplied by maggot fertilizer were sufficient to sustain general plant growth, but the targeted stimulation of leaf initiation was less pronounced.

The absence of a significant interaction between maggot fertilizer and banana corm LOF further indicates that these two organic amendments functioned relatively independently in influencing plant growth. This observation is consistent with findings from other studies showing that different fertilizer types may exert differential effects on specific plant growth parameters, reflecting the complex dynamics of nutrient availability in organic farming systems (Nahar & Nitu, 2023; Park et al., 2021). Therefore, the combination of these fertilizers may provide complementary benefits, supporting the potential application of integrated fertilization strategies that optimize not only leaf number but also other key growth traits in leafy vegetables.

This study highlights the important role of banana corm LOF in stimulating leaf formation compared with solid organic amendments such as maggot fertilizer. These findings underscore the importance of adopting integrated fertilization approaches that combine solid and liquid organic nutrient sources to enhance multiple aspects of green mustard growth. Further research is warranted to explore the synergistic potential of combined organic fertilization practices to improve the sustainability and productivity of vegetable cultivation.

3. Leaf Width (cm)

The observational data on leaf width presented in Table 3 indicate that the maggot fertilizer treatment (M) had a highly significant effect on leaf width. In contrast, banana corm liquid organic fertilizer (P) and the interaction between maggot fertilizer and banana corm liquid organic fertilizer (M × P) did not show significant effects on leaf width.

Table 3. Mean leaf width (cm) of green mustard as affected by maggot fertilizer and banana corm liquid organic fertilizer.

Maggot fertilizer (g/polybag)	Banana corm LOF (mL L^{-1} water)			Mean	LSD 5%
	P1 (40)	P2 (60)	P3 (80)		
M0 (0)	12.85	13.38	13.67	13.30[b]	0.96
M1 (100)	15.60	15.58	14.95	15.38[ab]	
M2 (150)	14.77	16.62	16.43	15.94[a]	
M3 (200)	13.93	15.28	17.05	15.42[a]	

Note: Means followed by different letters within the same column or row indicate significant differences at the 5% LSD test. M indicates maggot fertilizer treatments, and P indicates banana corm LOF concentrations.

The results showing a highly significant effect of maggot fertilizer on the leaf width of green mustard highlight the important role of organic amendments in plant growth. Specifically, this study found that the application of maggot fertilizer at rates of 150 g polybag^{-1} (M2) and 200 g polybag^{-1} (M3) produced the widest leaves, measuring 15.94 cm and 15.42 cm, respectively, compared with the control treatment of 13.30 cm (M0) (Badi'ah, 2025). This finding is consistent with the results reported by Subrata et al. (2024), who emphasized the positive effects of nutrient-rich organic fertilizers on the vegetative growth of green mustard. The intermediate response observed at M1 (100 g polybag^{-1}), with a leaf width of 15.38 cm, suggests a plateau effect in leaf expansion, whereby further increases in nutrient availability do not proportionally enhance growth beyond a certain threshold (Taufik et al., 2023).

The concentrations of banana corm liquid organic fertilizer (P1–P3) did not show a significant effect on leaf width. This indicates that the leaf expansion characteristics of green mustard are more strongly influenced by solid organic amendments, such as maggot fertilizer, which provide a more stable supply of nutrients compared with liquid inputs. The limited effectiveness of liquid fertilizer may be attributed to rapid nutrient leaching or suboptimal delivery of essential macronutrients, such as nitrogen and potassium, which play critical roles in leaf growth (Marpaung et al., 2021). This finding suggests that structural leaf development is closely associated with the basal nutrient supply derived from complex organic materials (Sharma, 2025).

Improvements in the biochemical and physical properties of the soil following maggot fertilizer application can be attributed to its high organic matter content, enhanced soil structure, and increased microbial activity. These factors synergistically improve nutrient availability and uptake, which are crucial for physiological processes contributing to leaf expansion (Hidayat et al., 2024). Wider leaves not only reflect enhanced cell expansion but also increase the photosynthetic surface area, thereby supporting optimal growth conditions characterized by adequate nitrogen and potassium availability (Cendekianesti et al., 2022).

The absence of a significant interaction between maggot fertilizer and banana corm LOF indicates that these two amendments tend to function independently. This reinforces the view that a comprehensive nutrient management approach is required to maximize plant growth parameters. This finding is consistent with similar studies reporting that solid organic fertilizers generally exert more pronounced effects than liquid fertilizers, particularly under low-fertility soil conditions (Yavaş & Hussain, 2022). The lack of synergistic effects suggests a preference for specific fertilizer types to achieve optimal growth outcomes in Brassica species.

4. Fresh Weight per Plant (g)

The observational data on fresh weight per plant indicate that the maggot fertilizer treatment (M) had a highly significant effect on fresh weight per plant. In contrast, banana corm liquid organic fertilizer (P) and the interaction between maggot fertilizer and banana corm liquid organic fertilizer (M × P) did not show significant effects on fresh weight per plant.

Table 4. Mean fresh weight (g) of green mustard as affected by maggot fertilizer and banana corm liquid organic fertilizer.

Maggot fertilizer (g/polybag)	Banana corm LOF (mL L⁻¹ water)			Mean	LSD 5%
	P1 (40)	P2 (60)	P3 (80)		
M0 (0)	79.00	90.43	67.92	79.12[b]	13.60
M1 (100)	91.18	111.70	100.27	101.05[a]	
M2 (150)	95.53	108.57	116.03	106.71[a]	
M3(200)	105.68	100.77	136.02	114.16[a]	

Note: Values followed by different letters within the same column (a, b) indicate significant differences at the 5% LSD test level.

The analysis presented in Table 4 indicates a significant effect of maggot fertilizer application on the fresh weight of green mustard. Specifically, the highest mean fresh weight was obtained under the M3 treatment (200 g polybag⁻¹), reaching 114.16 g per plant, which was higher than that recorded for M2 (150 g polybag⁻¹) at 106.71 g and M1 (100 g polybag⁻¹) at 101.05 g. These values were significantly greater than those of the control treatment (M0), which produced a mean fresh weight of only 79.12 g. These results reinforce findings from previous studies highlighting the benefits of organic amendments in enhancing biomass accumulation in vegetable crops, particularly under conditions of limited or imbalanced nutrient availability (Le et al., 2025).

Increasing application rates of maggot fertilizer consistently enhanced fresh biomass yield, reflecting a direct relationship between improvements in soil fertility through organic inputs and plant growth performance. The mechanisms underlying this response are likely associated with increased nutrient availability and improved soil quality resulting from the application of maggot-based organic fertilizers. The organic matter supplied by maggot fertilizer contributes to improved soil physical properties, enhanced water-holding capacity, and stimulated microbial activity, which collectively promote more efficient nutrient uptake by plants (Manuel et al., 2022; Abbas et al., 2024).

The application of banana corm LOF did not result in significant differences in fresh weight. Although the highest numerical value was observed under the M3P3 combination (136.02 g), the main effect of LOF concentration was not statistically significant. This indicates that solid organic amendments such as maggot fertilizer played a more dominant role in determining biomass production than liquid inputs. This finding is consistent with studies reporting that solid organic inputs generally provide a more stable nutrient supply compared to liquid fertilizers, which are more prone to leaching and less capable of sustaining nutrient availability over time (Viotti et al., 2024; Picariello et al., 2024).

The relatively lower effectiveness of banana corm LOF compared with maggot fertilizer underscores the importance of organic matter decomposition as a sustained nutrient source. Moreover, the absence of a significant interaction between maggot fertilizer and banana corm LOF suggests that these two fertilizers acted independently in influencing fresh weight. This independence highlights the need for synergistic organic nutrient management strategies, in which solid amendments meet the primary nutrient requirements of crops such as green mustard, while liquid fertilizers serve a supplementary role (Hefner et al., 2024).

The positive response of fresh weight to maggot fertilizer application can also be explained by its role in enhancing carbon assimilation processes and water accumulation in plant tissues. Improved soil conditions support better root development and overall plant health, which is consistent with the findings of Cendekianesti et al. (2025), who reported that organic amendments can significantly increase fresh weight through improvements in soil health and nutrient dynamics.

5. Edible Weight per Plant (g)

The observational data on edible weight per plant indicate that the maggot fertilizer treatment (M) had a highly significant effect on edible weight per plant. In contrast, banana corm liquid organic fertilizer (P) and the interaction between maggot fertilizer and banana corm liquid organic fertilizer (M × P) did not show significant effects on edible weight per plant.

Table 5. Mean edible weight (g) of green mustard as affected by maggot fertilizer and banana corm liquid organic fertilizer.

Maggot fertilizer (g/polybag)	Banana corm LOF (mL L⁻¹ water)	Mean	LSD 5%

	P1 (40)	P2 (60)	P3 (80)		
M0 (0)	75.95	86.83	64.20	75.66b	13.17
M1 (100)	87.16	107.34	95.65	96.71a	
M2 (150)	91.51	103.77	110.59	101.95a	
M3(200)	101.64	95.89	130.43	109.32a	

Note: Values followed by different letters within the same column (a and b) indicate significant differences at the 5% LSD test level.

The results presented in Table 5 indicate that the application of maggot fertilizer had a significant effect on the edible weight of green mustard. The highest mean edible weight, 109.32 g per plant, was obtained at the highest application rate, M3 (200 g polybag^{-1}), followed by M2 (150 g polybag^{-1}) at 101.95 g and M1 (100 g polybag^{-1}) at 96.71 g. In contrast, the control treatment (M0) produced only 75.66 g. This pattern demonstrates a clear positive correlation between increasing rates of maggot fertilizer and higher consumable biomass, consistent with the findings of Purnamasari et al. (2022), who reported improvements in growth parameters of pakchoi following the application of maggot frass.

The increase in edible weight can be attributed to the positive effects of maggot fertilizer on soil fertility and nutrient availability dynamics. The application of organic amendments, particularly those enriched with biologically derived nutrients such as maggot frass, has been shown to improve soil structure and enhance soil microbial activity. These improvements facilitate more efficient nutrient uptake and greater allocation of photosynthates to edible plant parts, as reported in several studies on Brassica crops (Sakhiri et al., 2024; Meiramkulova et al., 2022).

Differences in the concentrations of banana corm liquid organic fertilizer (P1–P3) did not result in statistically significant differences in edible weight. Although the highest numerical value was observed under the M3P3 treatment combination (130.43 g), the main effect of banana corm LOF on consumable biomass was not significant. This indicates that edible biomass production was more strongly influenced by solid organic amendments such as maggot fertilizer than by liquid inputs (Pratama et al., 2022). This finding is in agreement with Astanti et al. (2023), who reported that solid organic amendments not only support plant growth more consistently than liquid fertilizers but also provide more sustained nutrient availability.

The positive relationship between maggot fertilizer and edible weight underscores the importance of nutrient availability in promoting plant growth. As illustrated by Mbarki et al. (Drogoudi & Pantelidis, 2021), enhanced nutrient availability through organic amendments promotes greater plant vigor and increased biomass allocation to edible parts. The increase in soil organic matter content resulting from maggot fertilizer application also contributes to improvements in soil physical and biological properties, thereby enhancing nutrient uptake dynamics and leading to increased edible weight.

The absence of a significant interaction between maggot fertilizer and banana corm LOF indicates that these two inputs functioned independently in influencing edible yield. This highlights the importance of targeted input strategies in organic farming systems, where appropriate combinations of organic amendments can be effectively utilized to maximize crop productivity (Wondimu, 2024). Overall, these findings reinforce the role of maggot fertilizer as a key organic input for enhancing the edible yield of green mustard and its potential integration into sustainable, nutrient-based agricultural management practices.

CONCLUSIONS

This study demonstrates that maggot-based organic fertilizer effectively improves growth and edible yield of green mustard, particularly at 150–200 g polybag^{-1}, by enhancing nutrient availability and soil conditions. Banana corm liquid organic fertilizer mainly supports leaf development and functions as a complementary input. Growers are recommended to prioritize maggot fertilizer for productivity gains, while future studies should evaluate long-term soil health and field-scale performance.

REFERENCES

Abbas, A., Naveed, M., Khan, K., Ashraf, M., Siddiqui, M., Abbas, N., & Ali, L. (2024). The Efficacy of Organic

Amendments on Maize Productivity, Soil Properties and Active Fractions of Soil Carbon in Organic-Matter Deficient Soil. Spanish Journal of Soil Science, 14. https://doi.org/10.3389/sjss.2024.12814

Analisa. W. and Annisa. F. (2024). Pengaruh Pupuk Organik Cair Gedebog Pisang Terhadap Pertumbuhan dan Hasil Beberapa Jenis Tanaman Sayur. Majalah Ilmiah Methoda. 14(3). 318-325. https://doi.org/10.46880/methoda.vol14no3.pp318-325

Arabzadeh. G., Delisle-Houde. M., Vandenberg. G., Deschamps. M., Dorais. M., Derôme. N., & Tweddell.

Ariskaa. R., Surono. S., & Sukmawati. D. (2024). Enhancing the quality of Kasgot biofertilizer using Pichia cecembensis UNJCC Y-157 and amino acids to boost mustard greens (*Brassica juncea* L.) growth. bjts. 1(2). 10-19. https://doi.org/10.70158/buitenzorg.v1i2.10

Astanti, Y., Nandari, W., Santoso, D., Hasanah, K., & Puryani, P. (2023). Inisiasi Kelompok Masyarakat Pengelola Sampah Organik Dengan Budidaya Maggot Bsf (*Black Soldier Fly*) Di Padukuhan Dukuh, Sinduhrjo, Ngaglik, Sleman, D.I Yogyakarta. Dharma Jurnal Pengabdian Masyarakat, 4(2), 67. https://doi.org/10.31315/dlppm.v4i2.11069

Auger. L., Deschamps. M., Vandenberg. G., & Derôme. N. (2023). Microbiota is structured by gut regions. life stage. and diet in the Black Soldier Fly (*Hermetia illucens*). Frontiers in Microbiology. 14. https://doi.org/10.3389/fmicb.2023.1221728

Badi'ah, B. (2025). Respons Pertumbuhan Sawi Hijau (*Brassica juncea* L.) terhadap Aplikasi POC Berbasis Daun Gamal (*Gliricidia sepium*). Daun Jurnal Ilmiah Pertanian Dan Kehutanan, 12(1), 23-31. https://doi.org/10.33084/daun.v12i1.9816

Cendekianesti, R., Prihastanti, E., & Haryanti, S. (2022). Pertumbuhan Tanaman Sawi (*Brassica rapa* L.) dengan Pupuk Organik Berbahan Azolla pinnata dan Telur Keong Mas (*Pomacea cannaliculata*). Al-Kauniyah Jurnal Biologi, 15(1), 74-87. https://doi.org/10.15408/kauniyah.v15i1.16919

Desi. P., Raksun. A., Mertha. I., & Sedijani. P. (2025). The Effect of NPK Fertilizer and Banana Peel Liquid Organic Fertilizer on The Growth of Red Chili (*Capsicum annum* L). Jurnal Biologi Tropis. 25(2). 2203-2209. https://doi.org/10.29303/jbt.v25i2.9243

Drogoudi, P. and Pantelidis, G. (2021). Comparative effects of gibberellin A3, glycine betaine, and Si, Ca, and K fertilizers on physiological disorders and yield of pomegranate cv. Wonderful. Journal of the Science of Food and Agriculture, 102(1), 259-267. https://doi.org/10.1002/jsfa.11354

Effendi. A. (2023). Growth and production of upland rice (*Oryza sativa* L.) in ultisol using liquid organic fertilizer and NPK. Jurnal Agronomi Indonesia (Indonesian Journal of Agronomy). 51(3). 433-441. https://doi.org/10.24831/jai.v51i3.47352

Fahni. Y., Sanjaya. A., Saputri. D., & Herlambang. A. (2023). The Implementation of Rotary POC Technology for Organic Fertilizer Production in Tarahan Village. South Lampung. Abdimas Jurnal Pengabdian Masyarakat. 6(4). 4807-4813. https://doi.org/10.35568/abdimas.v6i4.4126

Gaol. D. (2025). Increasing Growth and Yield of Soybeans (*Glycine max* L.) by Providing Banana Stem LOF and SP-36 Fertilizer. Jurnal Agronomi Tanaman Tropika (Juatika). 7(3). https://doi.org/10.36378/juatika.v7i3.4394

Hapsari. N. and Suparno. S. (2023). Effect of Concentration Variation of Liquid Organic Fertilizer Application on the Growth of Mustard Plants. Jurnal Penelitian Pendidikan Ipa. 9(7). 4894-4900. https://doi.org/10.29303/jppipa.v9i7.2837

Hefner, M., Amery, F., Denaeghel, H., Loades, K., & Kristensen, H. (2024). Composts of diverse green wastes improve the soil biological quality, but do not alleviate drought impact on lettuce (*Lactuca sativa* L.) growth. Soil Use and Management, 40(1). https://doi.org/10.1111/sum.13016

Hidayat, R., Dewi, E., & Purnamayati, L. (2024). Characteristics of Liquid Organic Fertilizer Made from Milkfish

Viscera (Chanos chanos Forsskal) at Differents Long Time Fermentation. JZS, 23-33. https://doi.org/10.56946/jzs.v2i2.444

Inrianti. I., Tuhuteru. S., Pumoko. P., & Kogoya. G. (2024). Community Assistance in Producing Environmentally Friendly Mol Organic Waste Based on Banana Stems and Corm in Koya Koso Village. Abepura District. Jayapura Regency. Papua. Indonesia. Abdimas Jurnal Pengabdian Masyarakat. 7(4). 2037-2042. https://doi.org/10.35568/abdimas.v7i4.5452

Katchali. M., Senagi. K., Onyango. E., Beesigamukama. D., Tanga. C., Athanasiou. G., & Tonnang. H. (2024). Unveiling Environmental Influences on Sustainable Fertilizer Production through Insect Farming. Sustainability. 16(9). 3746. https://doi.org/10.3390/su16093746

Lagon. J., Abad. R., Bayogan. E., & Silvosa-Millado. C. (2022). Growth and Yield of Screenhouse-grown potted Pechay (*Brassica rapa* L. ssp. chinensis cv. Black Behi) in selected Davao-produced Composts. MJST. 20(2). https://doi.org/10.61310/mndjstea.0990.22

Lasmini. S., Hayati. N., Nasir. B., & Wahyuni. G. (2023). Effect of concentration of banana corm liquid organic fertilizer and dosage of bokashi fertilizer on growth and yield of long bean (*Vigna sinensis* L.). Iop Conference Series Earth and Environmental Science. 1253(1). 012012. https://doi.org/10.1088/1755-1315/1253/1/012012

Le, T., Lee, J., Shim, S., Jung, J., Kim, S., Hong, S., & Hwang, S. (2025). Effects of Liquid Bio-Fertilizer on Plant Growth, Antioxidant Activity, and Soil Bacterial Community During Cultivation of Chinese Cabbage (*Brassica rapa* L. ssp. pekinensis). Microorganisms, 13(5), 1036. https://doi.org/10.3390/microorganisms13051036

Luo. G. (2022). Review of waste phosphorus from aquaculture: Source. removal and recovery. Reviews in Aquaculture. 15(3). 1058-1082. https://doi.org/10.1111/raq.12727

Manuel, R., Machado, A., Ottaiano, L., Cozzolino, E., Machado, R., Alves-Pereira, I., & Mori, M. (2022). Soil, Water and Nitrates Management in Horticultural Production., https://doi.org/10.3390/books978-3-0365-4576-9

Marasini. K., Joshi. J., Yogi. B., Chhetri. D., Ghimire. A., & Shrestha. G. (2024). A Comprehensive Study on the Effects of Organic Fertilizers on Growth and Yield of Broad Leaf Mustard (*Brassica juncea* var. rugosa) cv. Manakamana Rayo. AgroEnviron. Sustain., 2(1). 11-18. https://doi.org/10.59983/s2024020102

Marpaung, M., Neneng, L., & Akhmadi, A. (2021). The Effect of Organic Biofertilizer on The Growth of Mustard Greens (*Brassica Rapa* Var. Parachinensis L) in Peat Soils as a Support for Practicum Material for Plant Growth and Development in Grade XII High School. Gamaproionukleus, 2(1), 33-44. https://doi.org/10.37304/jpmipa.v2i1.3688

Mašková. Z., Medo. J., Kolesár. E., Tančinová. D., Ivanišová. E., Urminská. D., & Barboráková. Z. (2025). Hermetia illucens in the Process of Kitchen Waste Biodegradation: The Effect of Different Approaches to Waste Storage on the Microbiological Profile and Nutritional Parameters of the Larvae. Insects. 16(1). 87. https://doi.org/10.3390/insects16010087

Meiramkulova, K., Devrishov, D., Kakabayev, A., Марзанов, Н., Kurmanbayeva, A., Adilbektegi, G., & Mkilima, T. (2022). Investigating the Influence of Fly Attractant on Food Waste Recovery through Fly Larvae Production. Sustainability, 14(17), 10494. https://doi.org/10.3390/su141710494

Nahar. K. and Nitu. S. (2023). Influence of Seed Cake as Organic Fertilizer on Growth. Dry Matter Production and Root Development of Two Cultivars of C4 Plant. Maize (*Zea mays*) under Lab Conditions. International Journal of Plant & Soil Science. 35(20). 875-886. https://doi.org/10.9734/ijpss/2023/v35i203879

Nisaa. R., Setyaningsih. M., Anugrah. D., & Dewi. T. (2023). Use of Liquid Organic Fertilizer from Kepok Banana Peel (*Musa acuminata*) on the Growth of Mustard Plants (*Brassica juncea*). Jurnal Biologi

Tropis. 23(4). 465-471. https://doi.org/10.29303/jbt.v23i4.5662

Park. H., Kazerooni. E., Kang., Al-Sadi. A., & Lee. I. (2021). Melatonin Enhances the Tolerance and Recovery Mechanisms in *Brassica juncea* (L.) Czern. Under Saline Conditions. Frontiers in Plant Science. 12. https://doi.org/10.3389/fpls.2021.593717

Picariello, E., Fornasier, F., Bilotto, M., Mignoli, E., Baiano, S., & Morra, L. (2024). Eco-Sustainability of Soils in Baby-Leaf Crop Systems under Tunnel through the Application of C-Rich Inputs: Towards Combating Soil Degradation. Horticulturae, 10(5), 476. https://doi.org/10.3390/horticulturae10050476

Pratama, I., Hapsari, U., Prasetyatama, Y., & Soetiarso, L. (2022). The Effect of Fertilizer Variations from Organic Waste on the Growth of Mustard Plants (*Brassica juncea* L.) in Integration Farming System. https://doi.org/10.2991/absr.k.220305.029

Pratekno. T., Adam. D., & Lestari. W. (2024). Optimizing Bitter Mustard Plants (*Brassica Juncea* L.) Growth and Production by Administering Inorganic Fertilizer and Liquid Organic Fertilizer. Jurnal Agronomi Tanaman Tropika (Juatika). 6(2). https://doi.org/10.36378/juatika.v6i2.3631

Purnamasari, L., Anggraini, R., Muhlison, W., Sucipto, I., & Hwang, S. (2022). Aplikasi limbah padat budidaya maggot terhadap pertumbuhan dan produksi tanaman pakcoy (*Brassica chinensis* L.). ANIMPRO, 3, 126-134. https://doi.org/10.25047/animpro.2022.347

Putra. S. (2023). Growth of Green Sawy (*Brassica Juncea* L.) After Fertilized Liquid Organic Fertilizer. Pro-Stek. 5(1). 11. https://doi.org/10.35194/prs.v5i1.3217

Putri. A. and Asngad. A. (2024). Efektivitas Pupuk Organik Cair Limbah Jerami Padi dan Batang Pisang Terhadap Pertumbuhan dan Kandungan Fosfor Tanaman Sawi Hijau (*Brassica juncea* L.). Bioedusains Jurnal Pendidikan Biologi Dan Sains. 7(1). 229-241. https://doi.org/10.31539/bioedusains.v7i1.9970

Raihan. M., Hasan. M., Wadud. A., Roshni. N., & Ferdous. J. (2022). Vegetative and Reproductive Parameters of Carrot Influenced by Tree Fresh Leaf Biomass Application as a Source of Organic Matter. Journal of Agroforestry and Environment. 15(2). 7-13. https://doi.org/10.55706/jae1512

Rehman. K., Hollah. C., Wiesotzki. K., Rehman. R., Rehman. A., Zhang. J., & Aganovic. K. (2022). Black soldier fly. Hermetia illucens as a potential innovative and environmentally friendly tool for organic waste management: A mini-review. Waste Management & Research the Journal for a Sustainable Circular Economy. 41(1). 81-97. https://doi.org/10.1177/0734242x221105441

Sharma, N. (2025). Influence of Organic and Inorganic Nutrient Sources on Growth and yield attributes of Mustard in Semi-arid Region. Journal of Advances in Biology & Biotechnology, 28(11), 420-428. https://doi.org/10.9734/jabb/2025/v28i113246

Subrata, I., Suanda, I., Nina, V., & Widana, I. (2024). Optimalisasi Konsentrasi Pupuk Organik Cair Biogusuan Terhadap Respon Pertumbuhan Vegetatif Tanaman Sawi Hijau (*Brassica juncea* L.). emasains, 13(1), 57-67. https://doi.org/10.59672/emasains.v13i1.3603

Sugiharti. I., Raksun. A., & Mertha. I. (2022). The effect of liquid organic fertilizer from tofu industrial waste and EM4 on the growth of mustard greens (*Brasicajuncea* L.). Jurnal Pijar Mipa. 17(4). 554-559. https://doi.org/10.29303/jpm.v17i4.3412

Suhartini. S., Rohma. N., Elviliana. E., Santoso. I., Paul. R., Listiningrum. P., & Melville. L. (2022). Food waste to bioenergy: current status and role in future circular economies in Indonesia. Energy Ecology and Environment. 7(4). 297-339. https://doi.org/10.1007/s40974-022-00248-3

Taufik, T., Dharmawibawa, I., & Masiah, M. (2023). Uji Pemberian Pupuk Organik Cair Fermentasi Daun Gamal terhadap Pertumbuhan Tanaman Sawi (*Brassica juncea* L.) sebagai Panduan Lembar Kerja Mahasiswa. Bioscientist Jurnal Ilmiah Biologi, 11(2), 1640. https://doi.org/10.33394/bioscientist.v11i2.8562

Viotti, C., Bertheau, C., Martz, F., Yung, L., Placet, V., Ferrarini, A., & Chalot, M. (2024). Digestate Improves Stinging Nettle (Urtica dioica) Growth and Fiber Production at a Chlor-Alkali Site. Plants, 13(17), 2425. https://doi.org/10.3390/plants13172425

Wang. B., Xiao. Y., Wang. G., Zhu. Y., Zhou. R., Feng. H., & Li. H. (2024). Preharvest sodium selenite treatments affect the growth and enhance nutritional quality of purple leaf mustard with abundant anthocyanin. Frontiers in Nutrition. 11. https://doi.org/10.3389/fnut.2024.1447084

Wondimu, M. (2024). Screening of Common Bean Genotypes for Their Resistance to Bean Stem Maggot (Ophiomyia Spp.) in Ethiopia. Plant Protection, 8(1), 01-08. https://doi.org/10.33804/pp.008.01.4937

Yavaş, İ. and Hussain, S. (2022). Recent Progress on Melatonin-Induced Salinity Tolerance in Plants: An Overview. Turkish Journal of Agriculture - Food Science and Technology, 10(8), 1447-1454. https://doi.org/10.24925/turjaf.v10i8.1447-1454.5125

Zhang. G., Xu. Y., Zhang. S., Xu. A., Meng. Z., Ge. H., & Ma. D. (2022). Transformation Capability Optimization and Product Application Potential of Proteatia brevitarsis (Coleoptera: Cetoniidae) Larvae on Cotton Stalks. Insects. 13(12). 1083. https://doi.org/10.3390/insects13121083