JOURNAL LA LIFESCI

VOL. 07, ISSUE 01 (039-56), 2026
DOI: 10.37899/journallalifesci.v7i1.2952

Growth Response of *Solanum melongena* L. with Fly Ash-Bottom Ash Combination Planting Media and Compost Fertiliser

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Article Info

Article history:
Received 24 December 2025
Received in revised from 39 January 2026
Accepted 15 March 2026

Keywords:
Solanum Melongena L.
Fly Ash–Bottom Ash
Compost
Vegetative Growth
Soil Conditioner

Abstract

The increase in coal combustion waste such as fly ash and bottom ash (FABA) has encouraged its use as a soil conditioner to support sustainable agriculture. This study aims to determine the vegetative growth response of Solanum melongena L. to a combination of FABA and compost as a planting medium. The study was conducted from June to October 2025 at the South Sumatra Fertiliser Company Experimental Garden using a completely randomised design (CRD) consisting of six treatments and four replicates, namely T0 = soil (control), T1 = soil 100% compost, T2 = soil compost 75% + FABA 25%, T3 = soil compost 50% + FABA 50%, T4 = soil compost 25% + FABA 75%, and P5 = soil FABA 100%. The parameters observed included plant height, stem diameter, and number of leaves at 6-10 weeks after planting. The data were analyzed using ANOVA and followed by Duncan's test and BNT at a 5% level. The results showed that the combination of growing media had a significant effect on all vegetative growth parameters. The best treatments were T1 (100% compost) and T2 (75% compost-25% FABA) with plant heights of 15.9 cm and 11 cm, respectively, stem diameters of 5.8 mm, and 12.3 and 10.5 leaves, respectively. These findings demonstrate a practical, environmentally friendly method to improve crop growth and manage waste sustainably.

Introduction

The increase in industrial activity in Indonesia has led to a rise in waste volumes. This condition has encouraged the community and companies to seek ways to utilise industrial waste, both solid and liquid. Some companies produce solid waste from steam and electricity generation operations that use coal as fuel. Coal boilers used by industrial companies can produce solid waste from combustion residues, namely fly ash and bottom ash (Harnawan et al., 2022). The increase in the volume of coal waste and the expanding area required for waste disposal necessitate the adoption of alternative waste management technologies. Fly ash and bottom ash (FABA) are classified as non-B3 waste (Government Regulation No. 22 of 2021). Recognizing waste codes N106 for fly ash and N107 for bottom ash highlights their importance in waste management, emphasizing the audience's role in ensuring proper classification and compliance for waste resulting from pulverised coal combustion in steam power plants (SPP).

Fly ash is a by-product of coal-fired power plants (Nayak et al., 2022). Fly ash can be used in agriculture as an alternative for land reclamation, transforming it into arable land and improving the physical, chemical, and nutritional characteristics of the soil. (Ansari et al., 2022). Based on the results of research by Jayengswasono & Wicaksono, 2022, fly ash application can stimulate an increase in the height of land water spinach plants at a dose of 40 tons/ha-1. At this dose, plants can increase P nutrient uptake by up to 47.50%, which is translocated to parts of the plant so that it can be used to stimulate growth. Bottom ash, with

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

larger particles than fly ash, is formed at the bottom of the coal combustion furnace, affecting its application properties. The use of fly ash and bottom ash waste has also been studied for use as a planting medium in agriculture. The addition of FABA is known to affect pH, thereby altering nutrient availability (Imran et al., 2024). FABA contains aluminosilicate minerals that are rich in nutrients that are almost identical to those found in soil, such as macro nutrients (K, Na, Ca, Mg) and micro nutrients (Fe, Cu, Zn, Mn) except for organic carbon and nitrogen because C and N are usually bound in the form of gas resulting from coal combustion (Putri et al., 2023; Restini & Dewi, 2023). FABA can be used as a soil conditioner because it contains macro- and micro-nutrients (Nugroho & Lestari, 2021). However, its effect on plant growth is relatively small, so it needs to be combined with organic fertilisers such as compost or manure.

Fertiliser is one of the materials used to enhance plant growth. Fertilization can be done using artificial fertilizers (inorganic fertilizers) or natural fertilizers (organic fertilizers). However, continuous application of inorganic fertilizers generally hurts soil conditions, causing the soil to harden quickly, become less able to retain water, and quickly become acidic. Therefore, inorganic fertilizers must be mixed with organic fertilizers, such as compost (Jailani, 2022). Examples of compost fertilisers from various types of raw materials include straw, plant residues, animal manure, rice husks, empty fruit bunches, mushroom media, organic waste, and dad organic industrial waste residues (Ministry of Agriculture Regulation Number 70 2011).

One factor influencing composting is the C/N ratio. Compost base materials with a C/N ratio of 20.1-25:1 is suitable for composting (Sakiah et al., 2022). Microorganisms that break down organic materials require carbon and nitrogen from the source material. Microorganisms require carbon as an energy source for growth, and nitrogen is required for protein synthesis (Sakiah et al., 2022). Given the potential of FABA as a growing medium, it is necessary to test its use, along with compost fertiliser, for the growth and yield of various vegetables commonly consumed in Indonesia, namely aubergines. Eggplant (*Solanum melongena* L.) is one of the vegetables whose growth is sensitive and responsive to changes in growing medium composition, nutrient levels, and environmental conditions. This study is expected to have a positive impact on eggplant growth and also reduce industrial waste in Indonesia.

Methods

Tools and Materials

The materials used in this experiment included: soil, *Solanum melongena* L. seeds, compost, fly ash and bottom ash, and botanical pesticides. The tools used in this experiment included: trays, 40 cm x 50 cm polybags, rulers/measuring tapes, buckets, shovels, hoes, sprayers, cameras, scissors, knives, writing instruments, label paper, markers, scales, and ovens.

Time and Place

This research was conducted at the South Sumatra Fertilizer Company Experimental Garden. The research was carried out from June 2025 to Oktober 2025. The research location was a greenhouse located in a lowland area with an altitude of approximately 10-20 meters above sea level, humidity of approximately 55%-80%, temperature of approximately 26^{o} C to 35^{o} C, and sufficient light intensity. These environmental characteristics played a role in supporting plant growth and development during the experiment. Visual information regarding the layout and conditions of the research location is presented in Figure 1 to provide an overview of the general experimental setup.

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

Figure 1. Experimental Garden Map

Research Design

The research was conducted using the experimental method. The experimental design used in this study was a basic Complete Randomized Design (CRD) with 6 treatments, namely 1 control and 5 treatments. Each treatment was repeated 4 times, resulting in 24 experimental units. The use of compost and FABA doses can be seen in Table 1.

Table 1. Combination of compost and FABA doses

Treatment	Doses	Soil (grams)	Compost (grams)	FABA (grams)
T0	Soil	10.000	-	-
T1	Soil: 100% compost + 0% FABA	7.500	2.500	-
T2	Soil: Compost 75% + FABA 25%	7.500	1.875	625
T3	Soil: Compost 50% + FABA 50%	7.500	1.250	1.250
T4	Soil: Compost 25% + FABA 75%	7.500	625	1.875
T5	Soil: Compost 0% + FABA 100%	7.500	-	2.500

Note: The (-) sign indicates that the treatment was not used.

Preparation of Planting Media

The growing media used were *fly ash, bottom ash*, and compost fertilizer. The growing media were placed in polybags measuring 40 cm x 50 cm with a capacity of 10 kg. The soil used for planting the seedlings was topsoil (Ferdian et al., 2023). The planting media was prepared based on a soil:treatment ratio of 3:1 (w/w). According to Syahlaa et al. (2024), a soil:planting media composition of 3:1 enhances plant growth, such as plant height, number of leaves, leaf area, fresh weight per plant, and dry weight per plant. The growing medium placed in polybags was left for 1–2 days to stabilize the physical and chemical conditions of the medium after mixing the materials prior to planting (Putra et al., 2025).

Seed Sowing

The eggplant seeds used were of the Lezata F1 variety. The Lezata F1 variety showed the highest yield compared to other varieties, such as an average plant height increase of 44.04 cm, a flower-to-fruit conversion rate of 5.76%, a fruit count of 2.47 fruits, and the highest fruit weight of 20.71 g (Sinaga et al., 2023). The eggplant seeds were soaked in warm water for 15

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minutes, then wrapped in a damp cloth and left for 24 hours (Ferdo et al., 2022). The eggplant seeds were placed in a tray containing topsoil with a depth of 1.0-2.0 cm and covered lightly with soil (Harleni & Maliki, 2024). The seeds are watered daily until the plants are 25-30 days old and have at least 4 true leaves.

Seedling Planting

Eggplant seedlings are planted after 25-30 days of germination and are done in the afternoon around 4:00-6:00 PM. Select healthy seedlings with strong vigor, fresh green leaves, and 3-4 leaves (Musliadi et al., 2022). Planting is done by making planting holes 10-15 cm deep in each polybag (Nazari et al., 2023).

Watering

Watering is done manually in the morning and afternoon with the same volume of water for each treatment, amounting to 500 ml. This watering volume was set to maintain relatively uniform water availability during plant growth even though the growing media had different compositions.

Maintenance

Weed control is done manually by pulling weeds by hand. Pest and disease control can be done using botanical pesticides, namely the use of betel leaves. Pest and disease control was carried out using botanical pesticides made from betel leaves at a dose of 100 g of fresh betel leaves extracted in 1 L of water. The solution is applied by spraying evenly on all plants with a volume of ±50-100 ml per plant. The application is carried out periodically during the research period when symptoms of attack are found, so that pest control is uniform across all treatments.

Observation

Parameters used to measure eggplant plant growth include plant height, stem diameter, and number of leaves. Observations are conducted weekly from 6 to 10 week after planting (WAP).

Soil Medium Analysis

The growing medium samples analysed were taken before the eggplants were planted, namely soil, FABA and compost mixed according to the specified dosage. The growing medium parameters analysed were pH, organic carbon, total nitrogen content, available phosphorus, magnesium, potassium, calcium, iron, manganese and sodium. Before analysis, the growing medium samples were dried first. The sample medium used was 1,000 grams. The growing medium analysis was conducted at the Sampoerna Agro Laboratory. Table 2 shows the parameters and methods used for growing medium analysis.

Table 2. Observation parameters measured and measeurement methods in growing medium analysis

Parameter	Method
pH	H_2O 1:5 (pH meter)
C-Organic (%)	Walkey and Black (Titration FeSO4 1N)
N-total (%)	*Kjeldahl* (titration NaOH 0,05N)
P-available (ppm)	*Bray 1 (Spectrophotometer)*
Mg-, Ca-, K-, dan Na-exchangeable (cmol/kg)	NH4OAC 1 N extract (*flame photometer*)
Fe, Mn total (mg/100g)	25% in HCl AAS

Source : Eviati et al., 2023

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

Results and Discussion

Soil Medium Analysis

Soil media can be categorised based on soil fertility levels, namely very low, low, moderate, high, and very high, as well as soil acidity based on pH categories, namely very acidic (<4,5), acidic (4,5-5,5), slightly acidic (5,5-6,5), neutral (6,5-7,5), slightly alkaline (7,5-8,5), and alkaline (8,5). Based on the results of the analysis of the planting medium content in each treatment, it is known that T0 is a treatment whose pH can be categorised as very acidic. A decrease in soil pH (very acidic) can reduce the content of microelements, increase the concentration of several microelements such as Fe, Cu, and Zn, and decrease the content of other microelements such as B, Mo, and Mn, thereby affecting nutrient absorption by plants (Wang et al., 2025). The content of micronutrients, such as Mn and Fe, in the soil is related to soil pH, aeration, organic matter, moisture, and as a component of silicate minerals, with the total amount of manganese in the soil ranging from 20 to 3000 mg/kg, with an average of 600 mg/kg, while iron ranges from 20,000 to 550,000 mg/kg (Obeng et al., 2024; Yaacob et al., 2022). T1 and T2 can be categorised as acidic pH. T3, T4, and T5 can be categorised as slightly acidic ph.

Adding FABA to the growing medium at different concentrations can increase the soil pH from highly acidic to slightly acidic. The increase in soil pH is related to the content of basic minerals such as calcium (Ca), magnesium (Mg), and potassium (K) in fly ash-bottom ash (FABA) from coal combustion acts as a soil ameliorant by increasing cation exchange capacity (CEC), base saturation, and reducing toxic aluminium (Al) saturation (Lotse Tedontsah et al., 2023; Putri et al., 2023; Wenyika et al., 2025). In addition, increasing pH and base saturation reduces aluminum (Al) saturation which is toxic to plants, thereby reducing the risk of Al toxicity and improving plant growth in acidic soils (Lațo et al., 2025; Owusu et al., 2024; Zhang et al., 2025). However, the analysis results also show that the use of high-concentration FABA without additional organic matter can reduce the organic carbon and total nitrogen content, indicating that FABA is not a source of organic matter or nitrogen (Putri & Yawahar, 2023). The results of the analysis of soil properties in the growing medium based on the specified treatments can be seen in Table 3.

Table 3. Analysis of growing media in terms of fertility and acidity

Treatment	Parameter Sifat Tanah									
	pH	C-organik (%)	N-total (%)	P-tersedia (ppm)	Mg-dd (cmol/kg)	Ca-dd (cmol/kg)	K-dd (cmol/kg)	Na-dd (cmol/kg)	Fe-total (mg/100g)	Mn-total (mg/100 g)
T0	4,24	1,76	0,14	1,63	0,13	0,22	0,23	0,10	4264,422	8,46
T1	5,39	3,67	0,29	248,48	2,04	3,21	5,92	1,65	3797,89	12,67
T2	5,50	2,63	0,22	45,16	1,87	4,41	4,85	2,52	3765,99	13,99
T3	5,67	1,96	0,19	7,37	1,39	3,86	3,06	2,65	4234,67	15,14
T4	5,79	1,18	0,10	3,51	1,35	5,05	1,59	3,14	3801,54	13,07
T5	5,92	1,02	0,08	5,86	0,72	3,93	0,22	3,05	3863,17	13,36

Based on (Suntoro et al., 2023), the assessment criteria for several soil properties, such as organic C, total N, P, Mg, Ca, K, Na, have different fertility levels, ranging from very low, low, medium, high, and very high. Based on the results of the study conducted by examining the fertility level assessment criteria in the growing medium, it was found that there are several nutrients, both macro and micro nutrients. The results of the study show that T0 has a very acidic pH, which affects macro and micro nutrients that are classified as very low or low. Meanwhile, T1 has good nutrient assessment criteria with a high or very high category, except for Mg, which has a low category. T2 had fairly good nutrient assessment criteria when

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

compared to other combinations of FABA and compost fertilizer, such as T3, T4, and T5. T2 had nutrient availability in the moderate, high, and very high categories, except for Mg, which was in the very low category. One factor that can influence the availability of macro and micro nutrients is changes in the pH of the growing medium. The interaction between pH and nutrient availability is also complex because pH affects solubility, ion form, and nutrient content in the soil, as well as the ability of plant roots to absorb them (Barrow & Hartemink, 2023). The presence of compost in the growing medium plays a crucial role in supporting the effectiveness of FABA. Compost contributes to increased organic carbon and total nitrogen content, improves cation exchange capacity, enhances nutrient utilisation efficiency, and supports soil microorganism activity (Gao et al., 2025; Mulatu & Bayata, 2024; Rais et al., 2021).

Plant Height

Based on observations conducted on *S. melongena* L. plants, it was found that the average plant height of *S. melongena* increased each week, from 6 WAP to 10 WAP. The observation results can be seen in Figure 2 regarding the average plant height each week.

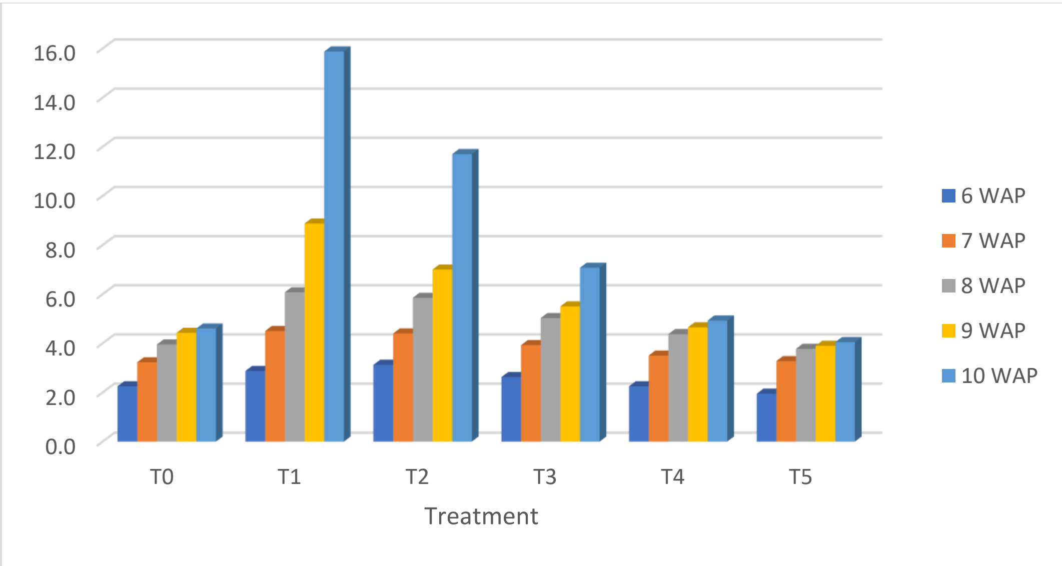

Figure 2. Graph of average plant height S.melongea

The results of the analysis of variance (ANOVA) showed a response in plant height when different growing media treatments were applied. The analysis results can be seen in Table 4 regarding the average plant height.

Based on Figure 2 and Table 4, the results of plant height analysis at 6 to 10 weeks after planting (WAP) show that growth between weeks provides a clearer analysis of the timing of treatment effects and plant growth response patterns. At 6 WAP, the differences in plant height between treatments were still relatively small, although T2 and T1 began to show a higher tendency than other treatments. T1 and T2 were significantly different from the control treatment and other treatments, indicating that the treatment effects began to appear at 7 WAP. The results of the observation showed that treatment T1 (soil and compost) provided the highest average plant height at 7 to 10 WAP, except at 6 WAP with an average height of 2,9. T1 had a very significant increase in plant height at 8 to 10 WAP. T2 had a fairly high average at 6 WAP to 10 WAP, when compared to other FABA treatments, such as T3, T4, and T5, and was better than the control treatment. T2 and T3 had a more noticeable increase in plant height at 9 WAP to 10 WAP, but the increase was not as rapid as T1. Conversely, treatments T0, T4, and T5 showed relatively low plant height increases, but did not show a very significant increase at 8 to 10

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

WAP, with final plant heights only reaching 4,6, 4,9, and 4,1 cm, respectively. The morphology of plant height in each treatment can be seen in Figure 3.

Table 4. Average plant height growth of *S. melongena*

Treatment	**Average plant height (cm)**				
	6 WAP	**7 WAP**	**8 WAP**	**9 WAP**	**10 WAP**
T0	2,3 ab	3,2 a	4,0 a	4,4 ab	4,6 a
T1	2,9 bc	4,5 b	6,1 d	8,9 d	15,9 d
T2	3,1 c	4,4 b	5,9 cd	7,0 c	11,7 c
T3	2,6 abc	3,9 ab	5,0 bc	5,5 b	7,1 b
T4	2,3 ab	3,5 a	4,4 ab	4,7 ab	4,9 a
T5	2,0 a	3,3 a	3,8 a	3,9 a	4,1 a
Notes :	The numbers followed by letters in the column are based on Duncan's test at the 5% level.				

Figure 3. Plant height S. melongena at T0 (a), T1 (b), T2 (c), T3 (d), T4 (e), and T5 (f)

Overall, the use of a mixture of fly ash and bottom ash in the right dosage can increase plant height by improving soil conditions and providing essential nutrients to the growing medium (Ahmad et al., 2021; An et al., 2024; Putri & Yawahar, 2023). Conversely, the control treatment (T0) and T5 (soil and 100% FABA) showed the lowest growth. This indicates that compost application plays an important role in improving soil conditions and increasing the availability of essential nutrients that support plant physiological processes. This condition is in line with Table 3 in T1, which has the highest organic C content (3.76%), the highest total N (0.29%), and very high available P (248.48 ppm). The high organic carbon content reflects the

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

availability of organic matter as an energy source for soil microorganisms that play a role in nitrogen and phosphorus mineralization, making nutrients more easily absorbed by plants (Zając & Skrajna, 2024). Nitrogen plays a key role in chlorophyll formation and stem elongation, while phosphorus supports cell division and meristem tissue development(Fathi & Afra, 2023; Li et al., 2023).

The combination of 75% compost and 25% FABA (T2) also showed good results because FABA can neutralise acidic pH, thereby increasing nutrient availability. The availability of micro-nutrients, such as Ca, Mg, Fe, and Si, can contribute to the vegetative growth of plants in the formation of plant tissues (Hamanaka et al., 2022; Horvatinec et al., 2024). However, in the treatment with 100% FABA (T5), growth was inhibited due to increased pH and the accumulation of excess elements, namely Na or heavy metals, which can interfere with nutrient absorption (Kuźnia, 2025; Restini & Dewi, 2023). Low levels of organic carbon and nitrogen in the growing medium cause a decrease in soil microorganism activity, resulting in slower nutrient mineralization and limited nutrient availability for plants (Putri & Yawahar, 2023). These results are consistent with the study (Suhartini et al., 2022), which states that FABA can be used as a soil conditioner only at certain doses, as the high alkalinity of the growing medium can reduce the availability of several important nutrients. High doses of fly ash (40-50%) tend to cause toxic effects that inhibit growth and can cause plants to become stunted or growth to be inhibited (Ahmad et al., 2021; Suwankamnoed et al., 2025). Therefore, the combination of compost and FABA in a balanced ratio has been proven to significantly increase plant height through improved soil fertility and structure

Stem Diameter

Based on observations conducted on *S. melongena* plants, it is known that the average stem diameter of *S. melongena* plants increased every week for T0, T1, T2, T3, and T4, while T5 at 8 WAP to 10 WAP experienced inhibition. The observation results can be seen in Figure 4 regarding the average stem diameter of plants every week.

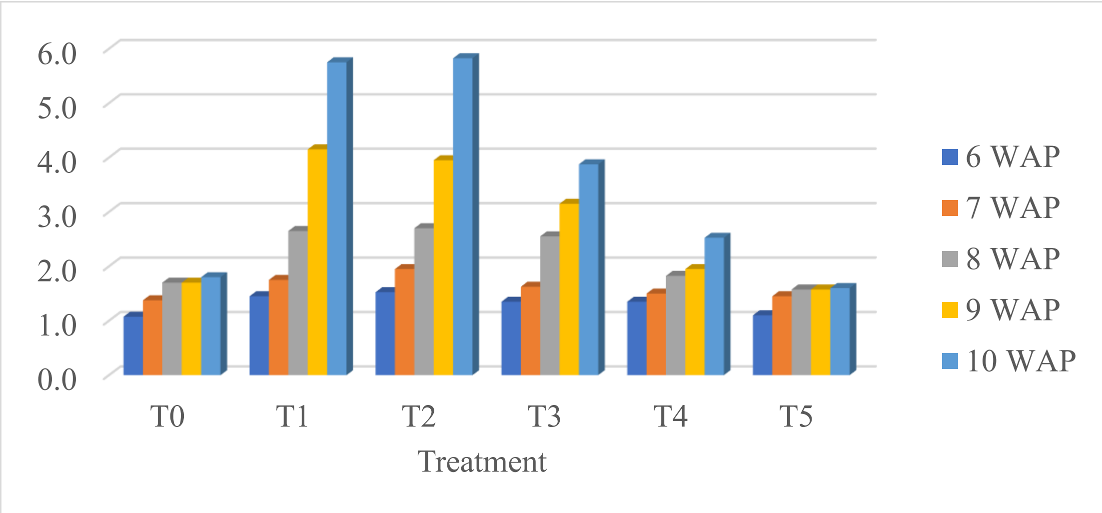

Figure 4. Graph of the average stem diameter S. melongena

The results of the analysis of variance (ANOVA) showed a response in the stem diameter of the plants when given different growing media treatments. The analysis results can be seen in Table 5.

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Table 5. Average stem diameter growth of *S. melongena*

Treatment	Average stem diameter of plants (mm)				
	6 WAP	7 WAP	8 WAP	9 WAP	10 WAP
T0	1,1 a	1,4 a	1,7 a	1,7 ab	1,8 a
T1	1,5 c	1,8 c	2,7 b	4,2 d	5,8 d
T2	1,5 c	2,0 d	2,7 b	4,0 d	5,8 d
T3	1,4 bc	1,6 bc	2,6 b	3,2 c	3,9 c
T4	1,4 bc	1,5 ab	1,8 a	2,0 b	2,5 b
T5	1,1 ab	1,5 ab	1,6 a	1,6 a	1,6 a

The numbers followed by letters in the columns are based on Duncan's test at the 5% level for 6 WAP, 8 WAP, and 10 WAP. And the LSD test at the 5% level for 7 WAP and 9 WAP.

Based on Figure 4 and Table 5, growing media T1, T2, T3, and T4 showed significant differences in stem diameter compared to T0 and T5, which showed no significant differences at 10 WAP. The composition of growing media T1 (soil and compost) and T2 (soil, 25% FABA, and 75% compost) produced the best plant stem diameter, namely 5,8 mm at 10 WAP, while the composition of growing media T5 (soil and FABA) showed the lowest plant stem diameter growth, namely 1,6 mm. T1 and T2 showed that 8 WAP and 10 WAP had the same diameter results. This is in line with the results in Table 3, which explains that P1 has a higher fertility level, while T2 has met the minimum nutrient requirements and soil chemical conditions necessary to support optimal stem diameter growth. In both treatments, the soil pH was in the acidic category, which provides macro nutrients, while the nitrogen, phosphorus, potassium, and calcium content did not become limiting factors for the growth of the stem strengthening tissue (Yuan et al., 2025). This indicates a maximum growth response limit, so that an increase in soil fertility within a certain level is not followed by an increase in plant stem diameter.

T3 and T4 showed a decrease in stem diameter compared to T1 and T2, although they were still higher than the control. The results of the growing medium analysis in Table 3 show that an increase in the proportion of FABA was followed by a decrease in organic C and total N content, which has the potential to limit cambium cell division and stem strengthening tissue formation. This condition explains that the increase in stem diameter in T3 and T4 was partial and did not reach the optimal growth level. The composition of the T5 growing medium (soil and FABA) showed the lowest stem diameter growth, namely 1.6 mm, and was not significantly different from the control, indicating growth inhibition at high FABA doses without the addition of organic matter can be seen in Table 5 at 8 to 10 WAP. The low organic carbon and total nitrogen content in this growing medium limits the availability of essential nutrients and reduces the soil's capacity to support secondary stem growth (Bragg et al., 2025). This indicates that FABA cannot function as the main nutrient source but is only effective as a soil ameliorant when combined with organic matter. The morphological characteristics of stem diameter in each treatment can be seen in Figure 5.

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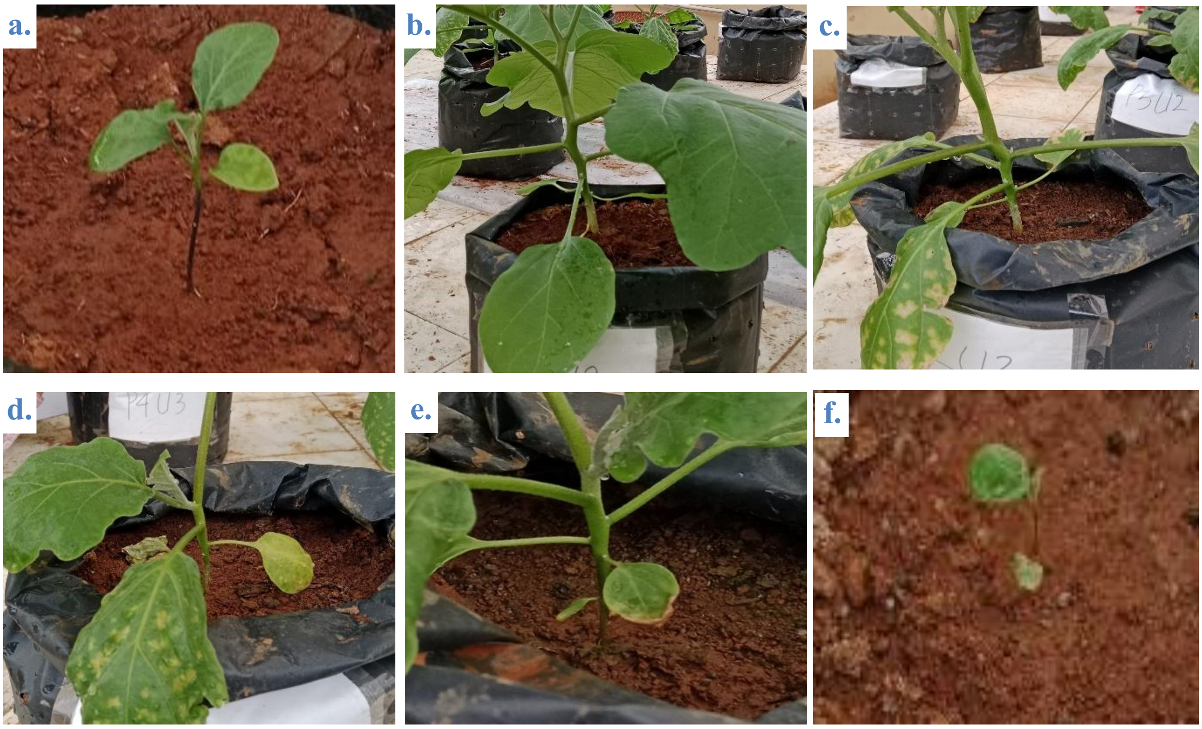

Figure 5. Stem diameter of S. melongena at T0 (a), T1 (b), T2 (c), T3 (d), T4 (e), dan T5 (f)

Based on Figure 5, it is known that T1 and T2 have relatively large, sturdy stems that are not easily knocked down compared to plants with stunted growth such as T0 and T5. The increase in stem diameter indicates good secondary growth, which is related to the availability of nutrients and favourable soil conditions. Nutrients such as nitrogen and phosphorus play an important role in stimulating plant growth, including increases in biomass and stem length, which are related to cell division and elongation in the cambium (Feng et al., 2025; Morrison et al., 2024). Compost contains potassium and magnesium, which play a role in the formation of stem-strengthening tissues and the lignification process (Manea et al., 2024). In addition, the silica in FABA also helps strengthen cell walls and improve the efficiency of water and nutrient transport in the stem (Hamanaka et al., 2022; Valeev & Kondratiev, 2023). The use of FABA in limited doses can improve soil aggregate stability and promote stem growth without causing toxicity (Horvatinec et al., 2024). Similar research by Fajarindo et al., 2024, shows that the addition of coal ash and lignite compost improves soil pH and increases corn stem diameter growth. Thus, the increase in stem diameter in the combined compost and FABA treatment is due to the synergy between the increased nutrient availability from the compost and the improved soil structure from the FABA.

Number of Leaves

Based on observations made on *S. melongena* plants, it is known that the average number of *S. melongena* leaves increased every week for T0, T1, T2, T3, and T4, while T5 at 9 WAP to 10 WAP experienced inhibition. The results of the observations can be seen in Figure 6 regarding the average number of plants leaves each week.

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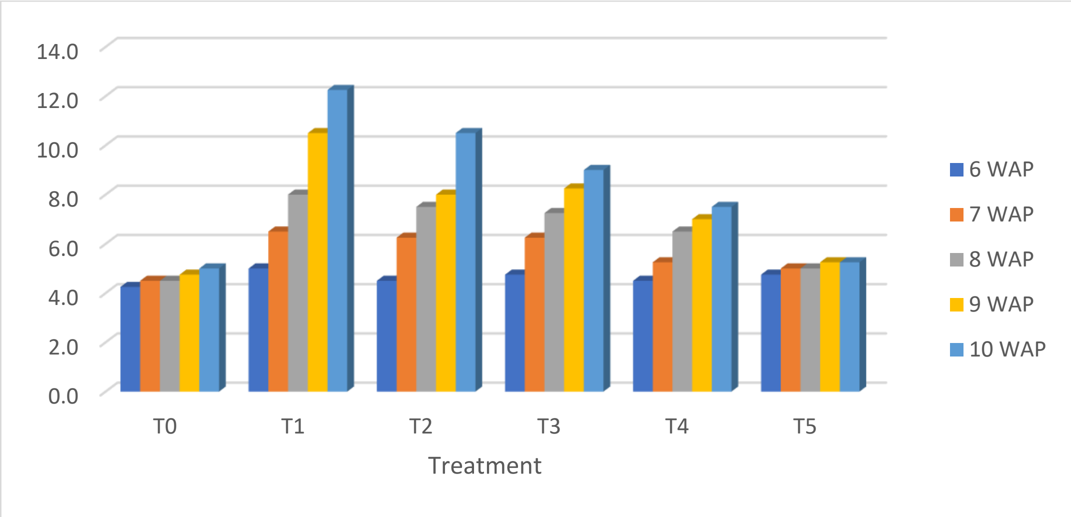

Figure 6. Graph of the average number of leaves S. melongena

The results of the analysis of variance (ANOVA) showed a response in the number of plant leaves when different growing media treatments were applied. The analysis results can be seen in Table 6 regarding the average number of plant leaves.

Table 6. Average growth of the number of leaves *S. melongena*

Treatment	**Average number of plant leaves (leaves)**				
	6 WAP	**7 WAP**	**8 WAP**	**9 WAP**	**10 WAP**
T0	4.3 tn	4.5 a	4.5 a	4.8 a	5.0 a
T1	5.0 tn	6.5 c	8.0 d	10.5 c	12.3 d
T2	4.5 tn	6.3 c	7.5 cd	8.0 b	10.5 cd
T3	4.8 tn	6.3 c	7.3 c	8.3 b	9.0 bc
T4	4.5 tn	5.3 b	6.5 b	7.0 b	7.5 b
T5	4.8 tn	5.0 ab	5.0 a	5.3 a	5.3 a

The numbers followed by letters in the columns are based on Duncan's test at the 5% level for 6 WAP, 9 WAP, and 10 WAP. And the LSD test at the 5% level for 7 WAP and 8 WAP. The letter tn indicates no significant difference.

Based on Figure 6 and Table 6, growing media T1, T2, T3, and T4 are significantly different in terms number of plant leaves compared to T0 and T5, which are not significantly different at 10 WAP. The composition of growing medium T1 (soil and compost) produced the highest average number of plant leaves, namely 12,3 leaves at 10 WAP, followed by T2 and T3, which showed a significant increase compared to the control. At the beginning of the observation 6 WAP, the differences between treatments were not yet apparent, but the positive effects of organic matter and FABA began to appear after 7 WAP to 10 WAP. The composition of growing medium T0 (soil) showed the lowest number of plant leaves, namely 5,0 leaves. The results of the leaf number data were also related to morphological observations in each treatment, which can be seen in Figure 7

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

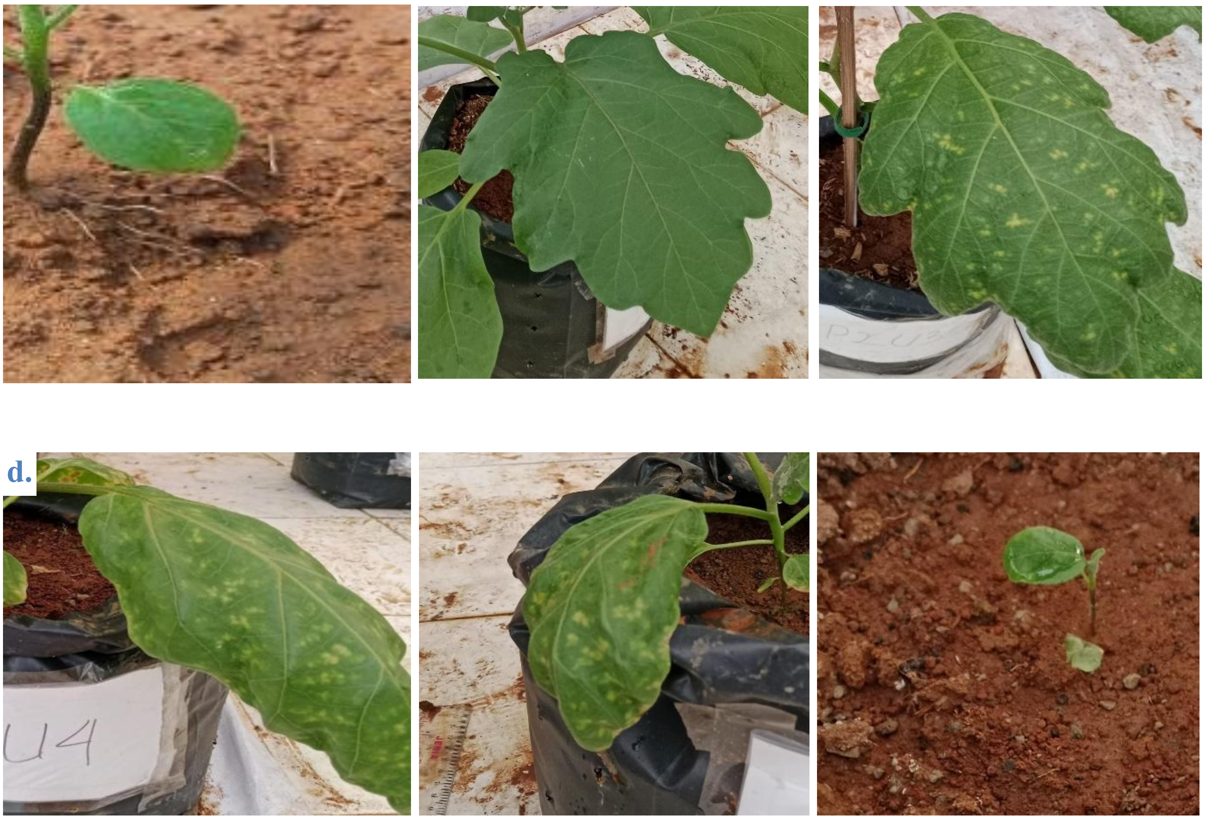

Figure 7. Leaf morphology of S. melongena at T0 (a), T1 (b), T2 (c), T3 (d), T4 (e), and T5 (f)

Based on the results of leaf morphology research, such as leaf spots in treatments using FABA, this indicates chlorosis related to disturbances in the absorption or utilisation of nutrients, particularly N, P, Mg, and Fe. Chlorosis in older leaves is often associated with mobile nutrient deficiency, as these elements are transferred to younger leaves to maintain photosynthetic activity and plant growth (Ghimirey et al., 2024; Song et al., 2024). In treatments with higher FABA proportions, the reduction in soil organic carbon and total nitrogen content has the potential to inhibit chlorophyll formation, causing leaves to lose their normal green colour and develop yellow spots. Cao et al., 2024 explain that increased nitrogen availability from organic matter promotes new leaf formation and expands the photosynthetic area. Additionally, compost and vermicompost, which are rich in organic matter, contain various plant hormones including auxın and cytokinin that directly support plant development and cell differentiation (Rehman et al., 2023; Sienkiewicz et al., 2024).

Soil management that increases organic matter, such as the use of organic fertilisers and soil pH management, can improve nitrogen and magnesium absorption efficiency and support chlorophyll formation and plant health (Wang et al., 2025; Yao et al., 2024). Additionally, the relatively high Ca content of FABA can disrupt the balance of other cations such as Mg and K. Imbalances in cations such as Ca, Mg, and K can inhibit leaf cell elongation and cause leaf morphological deformities, including curled leaves and uneven leaf surfaces. Cation imbalance can disrupt plant physiological functions, such as osmotic stress and stomatal dysfunction, which contribute to leaf morphological changes (Roșca et al., 2023; Yang et al., 2024).

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Conclusion

The combination of FABA growing medium and compost fertilizer significantly affects the vegetative growth response of Solanum melongena L. in terms of plant height, stem diameter, and number of leaves. The 100% compost treatment (T1) yielded the best results as it increased organic carbon and total nitrogen content, but the combination of 75% compost + 25% FABA (T2) provided optimal nutrients absorbed by the purple eggplant plants and increased the pH of the growing medium. Meanwhile, the use of 100% FABA (T5) reduced growth due to increased pH and the potential for heavy metal accumulation. The use of FABA is recommended only at low doses and in combination with compost to maintain nutrient balance and reduce the risk of ionic stress. Further research is needed to determine safe application limits and evaluate the long-term effects of FABA use on soil quality and plant growth. Further research is needed to analyze nutrient availability after planting, as pre-planting analyses do not fully represent nutrient availability conditions during vegetative growth.

Acknowledgment

The author would like to thank the South Sumatra Fertilizer Company Experimental Garden for the permission and facilities provided during the research. Thanks, are also extended to Sriwijaya University, Faculty of Science, Conservation Biology Study Programme, and my family for providing support and guidance during this research.

References

Ahmad, G., Khan, A. A., & Mohamed, H. I. (2021). Impact of The Low And High Concentrations of Fly Ash Amended Soil on Growth, Physiological Response, and Yield oof Pumpkin (*Cucurbita moschata Duch*. Ex Poiret L.). *Environmental Science and Pollution Research*, *28*(14), 17068–17083. https://doi.org/10.1007/s11356-020-12029-8

An, C., Han, F., Li, N., Zheng, J., Li, M., Liu, Y., & Liu, H. (2024). Improving Physical and Chemical Properties of Saline Soils with Fly Ash Saline and Alkaline Amendment Materials. *Sustainability (Switzerland)* , *16*(8). https://doi.org/10.3390/su16083216

Ansari, M. S., Ahmad, G., Khan, A. A., Mohamed, H. I., & Elhakem, A. (2022). Coal Fly Ash And Nitrogen Application As Eco-Friendly Approaches For Modulating The Growth, Yield, And Biochemical Constituents Of Radish Plants. *Saudi Journal of Biological Sciences*, *29*(6), 103306. https://doi.org/10.1016/j.sjbs.2022.103306

Barrow, N. J., & Hartemink, A. E. (2023). The Effects Of Ph On Nutrient Availability Depend On Both Soils And Plants. *Plant and Soil*, *487*(1–2), 21–37. https://doi.org/10.1007/s11104-023-05960-5

Bragg, D., Romanyà, J., Blanco-Moreno, J. M., & Sans, F. X. (2025). Tracking Soil Organic Carbon and Nitrogen Under Organic Management: A Temporal Perspective. *Agriculture (Switzerland)*, *15*(20), 1–19. https://doi.org/10.3390/agriculture15202117

Cao, H., Liu, J., Ma, S., Wu, X., Fu, Y., & Gao, Y. (2024). Selection of Suitable Organic Amendments to Balance Agricultural Economic Benefits and Carbon Sequestration. *Plants*, *13*(17), 1–22. https://doi.org/10.3390/plants13172428

Eviati, Sulaeman, Usman, L. H. L. A., Prihatini, H. E. T. R., & Wuningrum, P. (2023). Analisis Kimia Tanah, Tanaman, Air, Dan Pupuk. In *Petunjuk Teknis Edisi*. Kementerian Pertanian Republik Indonesia. https://tanahpupuk.bsip.pertanian.go.id

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

Fajarindo, F., Suwardi, S., Iskandar, I., & Limin, A. (2024). Utilizing Coal Ash and Lignite Enriched-Compost to Improve Chemical Properties of Ultisols. *Journal of Tropical Soils*, *29*(1), 41–48. https://doi.org/10.5400/jts.2024.v29i1.41-48

Fathi, A., & Afra, J. M. (2023). Plant Growth and Development in Relation to Phosphorus: A review. *Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Nacoca*, *80*(1), 1–7. https://doi.org/10.15835/buasvmcn-agr

Feng, R., Wang, S., Ma, J., Wang, N., Wang, X., Ren, F., Li, H., Liang, D., Hu, J., Li, X., & Li, L. (2025). Nutrient Additions Regulate Height Growth Rate but Not Biomass Growth Rate of Alpine Plants Through the Contrasting Effect of Total and Available Nitrogen. *Plants*, *14*(7). https://doi.org/10.3390/plants14071143

Ferdian, I., Faizal, M., & Hasanudin, H. (2023). Potensi Fly Ash dan Bottom Ash Sebagai Sumber Alternatif Top Soil di Lahan Reklamasi Pasca Tambang Batubara. *Jurnal Penelitian Sains*, *25*(1), 81. https://doi.org/10.56064/jps.v25i1.793

Ferdo, S., Andayani, S., Setiawan, Rahayu, S., & Tamtomo, F. (2022). Pengaruh Pupuk Kandang Ayam Dan Npk Pak Tani Terhadap Pertumbuhan Dan Hasil Tanaman Terong (Solanum Melongenal.) Pada Tanah aluvial. *Jurnal Pertanian Dan Pangan*, *4*(1), 1–9.

Gao, S., Medina, M., Gonzalez-Ospina, L., Burce, K., Burce, K., & Melbourne, A. (2025). Boosting Soil Health And Crop Nutrients With Locally Sourced Biochar And Compost In Sacramento Urban Agriculture. *Frontiers in Sustainable Food Systems*, *9*(April), 1–13. https://doi.org/10.3389/fsufs.2025.1546426

Ghimirey, V., Chaurasia, J., & Marahatta, S. (2024). Plant Nutrition Disorders: Insights From Clinic Analyses and Their Impact on Plant Health. *Agriculture Extension in Developing Countries*, *2*(1), 09–17. https://doi.org/10.26480/aedc.01.2024.09.17

Hamanaka, A., Sasaoka, T., Shimada, H., & Matsumoto, S. (2022). Amelioration of acidic soil using fly Ash for Mine Revegetation in Post-Mining Land. *International Journal of Coal Science and Technology*, *9*(33), 1–6. https://doi.org/10.1007/s40789-022-00499-9

Harleni, & Maliki, I. (2024). Respon Pertumbuhan Tanaman Terong Ungu (*Solanum melogena* L) Terhadap Pemberian Pupuk Kandang Sapi Dan Pupuk Organik Cair (POC). *Jurnal Fakultas Pertanian- Agrosasepa*, *2*(1), 1–8.

Harnawan, P., Dame, T. M., & Perdana, S. (2022). NPK 15-10-12 dengan Pengisi Abu Terbang: Pengembangan Pupuk dan Pengujian pada Tomat. *Jurnal Ilmu Pertanian Indonesia*, *28*(1), 162–169. https://doi.org/10.18343/jipi.28.1.162

Horvatinec, J., Buczny, J., & Ondrasek, G. (2024). Fly Ash Application Impacts Master Physicochemical Pedovariables: A Multilevel Meta-Analysis. *Journal of Environmental Management*, *368*. https://doi.org/10.1016/j.jenvman.2024.122066

Imran, Hanum, F. F., Wardhana, B. S., Suharto, T. E., & Febriani, A. V. (2024). Karakterisasi Komposisi Kimia Dan Potensi Pemanfaatan Campuran Tanah Gambut Kalimantan Timur Dengan Fly Ash Dan Bottom Ash Untuk Pertanian. *Jurnal Crystal: Publikasi Penelitian Kimia Dan Terapannya*, *6*(2), 72–161.

Jailani. (2022). Pengaruh Pemberian Pupuk Kompos Terhadap Pertumbuhan Tanaman Tomat (*Licopersicum esculentum* Mill). *Jurnal Sains Dan Aplikasi*, *10*(1), 1–8.

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

Jayengswasono, P., & Wicaksono, K. S. (2022). Pemanfaatan Abu Terbang Batubara Untuk Meningkatkan Ketersediaan P, Serta Pengaruhnya Terhadap Pertumbuhan Tanaman Kangkung Darat (*Ipomoea reptans* Poir). *Jurnal Tanah Dan Sumberdaya Lahan*, *9*(2), 457–464. https://doi.org/10.21776/ub.jtsl.2022.009.2.27

Kuźnia, M. (2025). A Review of Coal Fly Ash Utilization: Environmental, Energy, and Material Assessment. *Energies*, *18*(52), 1–19. https://doi.org/10.3390/en18010052

Lațo, A., Berbecea, A., Lațo, I., Crista, F., Crista, L., Sala, F., & Radulov, I. (2025). Mitigating Soil Acidity: Impact of Aglime (CaCO3) Particle Size and Application Rate on Exchangeable Aluminium and Base Cations Dynamics. *Sustainability (Switzerland)*, *17*(18). https://doi.org/10.3390/su17188135

Li, X., Zhang, X., Wang, S., Hou, W., & Yan, L. (2023). The Combined Use of Liquid Fertilizer and Urease/Nitrification Inhibitors on Maize Yield, Nitrogen Loss and Utilization in the Mollisol Region. *Plants*, *12*(1486), 1–13. https://doi.org/10.3390/plants12071486

Lotse Tedontsah, V. P., Mbog, M. B., Bitom-Mamdem, L., Ngon Ngon, G. F., Edzoa, R. C., Tassongwa, B., Bitom, D., & Etame, J. (2023). Spatial Distribution and Evolution of pH as a Function of Cation Exchange Capacity, Sum of Exchangeable Bases, and Organic Matter and Aluminum in the Soils of Foumban. *Applied and Environmental Soil Science*, *2023*, 1–11. https://doi.org/10.1155/2023/5172804

Manea, E. E., Bumbac, C., Dinu, L. R., Bumbac, M., & Nicolescu, C. M. (2024). Composting as a Sustainable Solution for Organic Solid Waste Management: Current Practices and Potential Improvements. *Sustainability (Switzerland)*, *16*(15), 1–25. https://doi.org/10.3390/su16156329

Morrison, C. R., Hart, L., Wolf, A. A., Sedio, B. E., Armstrong, W., & Gilbert, L. E. (2024). Growth-Chemical Defence-Metabolomic Expression Trade-Off Is Relaxed As Soil Nutrient Availability Increases For A Tropical Passion Vine. *Functional Ecology*, *38*(5), 1320–1337. https://doi.org/10.1111/1365-2435.14537

Mulatu, G., & Bayata, A. (2024). Vermicompost as Organic Amendment: Effects on Some Soil Physical, Biological Properties and Crops Performance on Acidic Soil: A Review. *Frontiers in Environmental Microbiology*, *10*(4), 66–73. https://doi.org/10.11648/j.fem.20241004.11

Musliadi, Haris, A., & Ralle, A. (2022). Pengaruh Waktu Tanam Yang Berbeda Terhadap Pertumbuhan Dan Produksi Terung Hijau (*Solanum molagena* L.) Yang Ditumpangsarikan Dengan Sawi Hijau *(Brassica juncea* L.). *Jurnal AGrotekMAS*, *3*(2), 75–85. https://doi.org/10.33096/agrotekmas.v3i2.249

Nayak, D. K., Abhilash, P. P., Singh, R., Kumar, R., & Kumar, V. (2022). Fly Ash For Sustainable Construction: A Review Of Fly Ash Concrete And Its Beneficial Use Case Studies. *Cleaner Materials*, *6*(June), 100143. https://doi.org/10.1016/j.clema.2022.100143

Nazari, A. P. D., Susylowati, & Putri, S. E. (2023). Pertumbuhan dan Hasil Tanaman Terung Ungu (Solanum melongena L.) dengan Pemberian Pupuk Organik Cair Kulit Pisang. *Jurnal Agroekoteknologi Tropika Lembab*, *5*(2), 92–99.

Nugroho, B. L. A., & Lestari, N. D. (2021). Pengaruh Abu Terbang Batubara Terhadap Sifat Kimia Tanah Dan Serapan Timbal (Pb) Oleh Tanaman Akar Wangi (*Vetiveria*

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

zizanioides L.). *Jurnal Tanah Dan Sumberdaya Lahan*, *8*(2), 471–480. https://doi.org/10.21776/ub.jtsl.2021.008.2.18

Obeng, S. K., Martin, K., Balík, J., Cernˇ ý, J., & Sedláˇ, O. (2024). Manganese: From Soil to Human Health—A Comprehensive Overview of Its Biological and Environmental Significance. *Nutrients*, *16*(3455), 1–18.

Owusu, S., Hartemink, A. E., Zhang, Y., Csorba, Á., & Michéli, E. (2024). Exchangeable acidity and pedotransfer functions for the soils of Ghana. *European Journal of Soil Science*, *75*(2), 1–16. https://doi.org/10.1111/ejss.13460

Peraturan Menteri Pertanian Nomor 70/Permentan/SR.140/10/2011. (2011). Peraturan Menteri Pertanian Nomor 70/Peraturan Menteri Pertanian Republik Indonesia/SR.140/10/2011 Tentang Pupuk Organik, Pupuk Hayati Dan Pembenah Tanah. *Permentan*, 16.

Peraturan Pemerintah Nomor 22 Tahun 2021 tentang Pedoman Perlindungan dan Pengelolaan Lingkungan Hidup.

Putra, A. A. G., Sukasana, I. W., & Sastrawan, I. P. A. (2025). Respon Tanaman Bawang Merah (*Allium ascalonicum* L.) Terhadap Variasi Media Tanam Dan Aplikasi Dosis *Trichoderma* Sp. Berbeda. *Yalamga*, *19*(3), 893–902.

Putri, A. A., & Yawahar, J. (2023). Pemanfaatan Fly Ash-Bottom Ash (Faba) Sebagai Campuran Media Tanam Terhadap Pertumbuhan, Hasil Dan Kualitas Tomat. *Agriculture*, *18*(1), 49–61. https://doi.org/10.36085/agrotek.v18i1.5419

Putri, A., Iskandar, I., Oktariani, P., & Limin, A. (2023). Effect of Coal Ash Enriched Compost on Soil Chemical Properties of Ultisols. *IOP Conference Series: Earth and Environmental Science*, *1266*(1). https://doi.org/10.1088/1755-1315/1266/1/012076

Rais, M. A., Suryaningtyas, D. T., Baskoro, D. P. T., Suwardi, Hazra, F., & Iskandar. (2021). Utilization Of Fly Ash - Bottom Ash, Compost And Arbuscular Mycorrhizal Fungi On Growth Of Crops. *IOP Conference Series: Earth and Environmental Science*, *756*(1). https://doi.org/10.1088/1755-1315/756/1/012065

Rehman, S. ur, De Castro, F., Aprile, A., Benedetti, M., & Fanizzi, F. P. (2023). Vermicompost: Enhancing Plant Growth and Combating Abiotic and Biotic Stress. *Agronomy*, *13*(4), 1–25. https://doi.org/10.3390/agronomy13041134

Restini, E. R., & Dewi, Y. S. (2023). Pemanfaatan Limbah Batubara Fly Ash Dan Bottom Ash Sebagai Campuran Media Tanam. *Prosiding Seminar Nasional Inovasi Teknologi*, 26–37.

Roșca, M., Mihalache, G., & Stoleru, V. (2023). Tomato Responses To Salinity Stress: From Morphological Traits To Genetic Changes. *Frontiers in Plant Science*, *14*(February), 1–26. https://doi.org/10.3389/fpls.2023.1118383

Sakiah, Tarigan, A. E., Tarigan, D. M., Nadeak, T., & Sitinjak, R. R. (2022). *Pupuk Organik Kompos*. Medan:Unpri Press.

Sienkiewicz, A., Krasowska, M., Kowczyk-Sadowy, M., Obidziński, S., Piotrowska-Niczyporuk, A., & Bajguz, A. (2024). Occurrence Of Plant Hormones In Composts Made From Organic Fraction Of Agri-Food Industry Waste. *Scientific Reports*, *14*(1), 1–13. https://doi.org/10.1038/s41598-024-57524-x

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

Sinaga, M., Mangardi, M., & Husein, N. (2023). Uji Pertumbuhan Dan Hasil Enam Varietas Tanaman Terung (*Solanum melongena*, L.) Pada Tanah Podsolik Merah Kuning. *Piper*, *19*(2), 125–134. https://doi.org/10.51826/piper.v19i2.916

Song, J., Yang, J., & Jeong, B. R. (2024). Characterization of Physiology, Photosynthesis, and Nutrition Based on Induced Deficiencies of Macro- and Micronutrients in Basil (Ocimum basilicum L.). *Agronomy*, *14*, 1–17. https://doi.org/10.3390/agronomy14010208

Suhartini, S., Utami, R. N., Kurniati, E., Simamora, L. L., Putri, C. A. U., Supartono, B., & Melville, L. (2022). Potential Use Of Coal Ash As Growing Media: Effect On The Plant's Growth And Future Estimation For Land Reclamation. *AFSSAAE Advances in Food Science, Sustainable Agriculture and Agroindustrial Engineering*, *5*(1), 77–94.

Suntoro, S., Hikmah, F., Mujiyo, M., & Syamsiyah, J. (2023). The Distribution Of Soil Fertility Index And Its Interaction With Earthworms Density Under Organic, Semi-Organic, And Inorganic Rice Fields. *Soil Science Annual*, *74*(4), 1–15. https://doi.org/10.37501/soilsa/184158

Suwankamnoed, S., Meksiriporn, B., Sripana, N., & Sutjaritvorakul, T. (2025). Physicochemical Characterization and Effects of Fly Ash Generated From Biochar Briquettes on the Growth of Chinese Celery Cabbage (Brassica Rapa Subsp. Pekinensis). *Applied Ecology and Environmental Research*, *23*(3), 3917–3928. https://doi.org/10.15666/aeer/2303_39173928

Syahlaa, H., Nurmayulis, Firnia, D., & Rohmawati, I. (2024). Pengaruh Konsentrasi Pupuk Organik Cair Daun Kelor Dan Kombinasi Media Tanam terhadap Pertumbuhan Dan Hasil Tanaman Pakcoy (Brassica rapa L.). *Jurnal Agritechno*, *17*(02). http://agritech.unhas.ac.id/ojs/index.php/at

Valeev, D., & Kondratiev, A. (2023). Current State of Coal Fly Ash Utilization: Characterization and Application. *Materials*, *16*(27), 1–6. https://doi.org/10.3390/ma16010027

Wang, T., Yu, L., Wang, Z., Yang, C., Dong, F., Yang, D., Xi, H., Sun, Z., Bol, R., Awais, M., Yang, L., & Fu, H. (2025). Effect Of Simulated Acidification On Soil Properties And Plant Nutrient Uptake Of Eggplant In Greenhouse. *Frontiers in Plant Science*, *16*(March), 1–11. https://doi.org/10.3389/fpls.2025.1558458

Wenyika, P., Enesi, R. O., Gorim, L. Y., & Dyck, M. (2025). Effects Of Liming On Soil Physical And Chemical Properties In Europe And North America: A Review. *Agrosystems, Geosciences and Environment*, *8*(3), 1–38. https://doi.org/10.1002/agg2.70175

Yaacob, N. S., Ahmad, M. F., Sivam, A., Hashim, E. F., Maniyam, M. N., Sjahrir, F., Dzulkafli, N. F., Wan Mohd Zamri, W. M. I., Komatsu, K., Kuwahara, V. S., & Abdullah, H. (2022). The Effectiveness of Soil Extracts from Selangor Peat Swamp and Pristine Forest Soils on the Growth of Green Microalgae sp. *Forests*, *13*(1), 1–21. https://doi.org/10.3390/f13010079

Yang, M., Zhou, D., Hang, H., Chen, S., Liu, H., Su, J., Lv, H., Jia, H., & Zhao, G. (2024). Effects of Balancing Exchangeable Cations Ca, Mg, and K on the Growth of Tomato Seedlings (Solanum lycopersicum L.) Based on Increased Soil Cation Exchange Capacity. *Agronomy*, *14*(3), 1–13. https://doi.org/10.3390/agronomy14030629

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

Yao, R., Bai, R., Yu, Q., Bao, Y., & Yang, W. (2024). The Effect of Nitrogen Reduction and Applying Bio-Organic Fertilisers on Soil Nutrients and Apple Fruit Quality and Yield. *Agronomy*, *14*(2). https://doi.org/10.3390/agronomy14020345

Yuan, Y., Zhu, Y., Zhao, Y., Wang, M., Qu, Z., Lv, D., Liu, Y., Song, Y., Wang, T., Li, C., & Feng, H. (2025). Soil pH and Nutrient Stoichiometry as Key Drivers of Phosphorus Availability in Crop Rotation Systems. *Agronomy*, *15*(1023), 1–12. https://doi.org/10.3390/agronomy15051023

Zając, M., & Skrajna, T. (2024). Effect of Composted Organic Waste on Miscanthus sinensis Andersson Yield, Morphological Characteristics and Chlorophyll Fluorescence and Content. *Agronomy*, *14*(8). https://doi.org/10.3390/agronomy14081672

Zhang, H., Zhu, X., Huang, J., Zeng, Y., Xie, R., Tan, J., Chen, Y., & Gan, L. (2025). Replacing Fused Calcium–Magnesium Phosphate With Diammonium Phosphate Increases Exchangeable Aluminum In Acidic Sugarcane (Saccharum officinarum L.) soils. *Scientific Reports*, *15*(1), 1–11. https://doi.org/10.1038/s41598-025-25264-1

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)