

THE EFFECT OF COFFEE GROUNDS AND BIOCOMPOST AMELIORANTS ON THE GROWTH AND YIELD OF YERMUKA BEANS (*Vigna unguiculata* L.)

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Abstract: This study aims to examine the effect of coffee grounds and biocompost amendments on the growth and yield of winged beans. The method used in this study was a 4x3 factorial randomized block design (RBD) with 3 replicates, resulting in 36 experimental units multiplied by 2 samples, for a total of 72. The treatments tested consisted of two factors: The first factor, coffee grounds (K), had four levels: K_0 = control, K_1 = 50 grams/polybag, K_2 = 100 grams/polybag, and K_3 = 150 grams/polybag. The second factor, biocompost (B), had three levels: B_0 = control, B_1 = 50 grams/polybag, and B_2 = 100 grams/polybag. The parameters observed in this study were plant height, number of branches, and number of pods per plant. The results of the study showed a significant effect of coffee grounds amendment on the number of branches of the winged bean plant. The best coffee grounds amendment treatment was found in treatment K_3 (150 g/polybag). A significant effect was also found due to the application of biocompost, namely on plant height, number of branches, and dry seed weight. The best biocompost treatment was observed in treatment B_2 (100 g/polybag).

Keywords: Winged Bean, Coffee, Biocompost, Plants, Dosage.

1. Introduction

The cowpea (*Vigna unguiculata* L.) is an annual vine that produces pod-shaped fruits containing elongated round seeds that are dark red, black, or white in color with a central groove. In addition to being drought-tolerant, the cowpea has the ability to fix nitrogen from the soil (Mahdalena, 2020). The potential of cowpea (*Vigna unguiculata* L.) to contribute to national food security is significant, as this plant not only provides affordable plant-based protein to communities but is also highly resilient to various environmental conditions (Trustinah *et al.*, 2021). Cowpea exhibits a positive response to the application of nutrient-rich organic materials. Research by Yadav *et al.* (2019) shows that the use of organic materials can increase plant growth, leaf area, and cowpea yield. This improvement is due to more balanced nutrient availability and higher soil microbial activity.

Ameliorants are materials added to soil to improve its physical, chemical, or biological properties. Ameliorants can improve soil structure, increase cation exchange capacity (CEC), and support microbial activity in the soil. Additionally, the use of ameliorants such as organic matter, lime, zeolite, and biochar can also enhance the efficiency of dolomite fertilizer use.

Coffee grounds are organic waste rich in various nutrients essential for plant growth, namely nitrogen (N), phosphorus (P), and potassium (K) (Sharif *et al.*, 2020). Coffee grounds can be used as raw material for compost production or as a soil conditioner to enhance land productivity sustainably when properly processed. Due to their natural nutrient content, coffee grounds have significant potential for use as a soil conditioner. Previous studies have shown that coffee grounds increase the availability of nutrients in the soil and support the growth of crops such as legumes and vegetables (Silpa & Vijayalakshmi, 2023).

Biocompost is an organic fertilizer produced through natural or controlled decomposition processes with the assistance of microorganisms such as bacteria, fungi, and actinomycetes to

break down organic matter from cattle manure. This process produces compost rich in nutrients such as nitrogen (N), phosphorus (P), and potassium (K), which are essential for plant growth. Bio-compost can enhance soil fertility, improve soil structure, increase water absorption capacity, and support sustainable agriculture by reducing reliance on chemical fertilizers (Mofunanya *et al.*, 2021).

In the long term, the use of chemical fertilizers often reduces soil fertility through damage to soil structure, a decline in soil microorganisms, and a decrease in organic matter content. In addition, the combination of organic amendments such as coffee grounds and biocompost can help with sustainable agro-industrial waste management (Prathima *et al.*, 2024).

2. Literature Review

2.1 The role of coffee grounds as an ameliorant

One inexpensive and environmentally beneficial organic fertilizer is coffee grounds, which can increase plants' intake of nitrogen, phosphorus, and potassium, allowing them to grow healthily. Coffee grounds can be applied to soil, gardens, and plant pots to accelerate the release of nutrients. In addition, coffee grounds contain calcium, magnesium, and sulfur, which are good for plants (Sebayang, 2020). Organic fertilizers can improve soil properties, structure, and porosity, as well as the soil's ability to retain water (Mahanani *et al.*, 2023).

The use of coffee grounds can increase iron and zinc levels in plants because the residue acts as a chelating agent for iron and zinc in the soil. Furthermore, compared to commonly used organic materials such as cow and chicken manure, coffee grounds contain more N and K. Adding a mixture of coffee grounds and organic materials to the soil reduces the inhibitory activity of coffee grounds. However, the inhibitory effect on plant growth was examined in vitro using compost extraction liquid (Yamane *et al.*, 2019).

2.2 The Role of Biocompost

The application of biocompost can enhance the vegetative growth of winged bean plants. The use of biocompost at specific ratios shows a significant increase in plant height, number of leaves, and dry weight. Biocompost can increase chlorophyll content in leaves, contributing to more efficient photosynthesis (Hastuti *et al.*, 2020). The use of bio-compost can increase the organic matter content in the soil, which contributes to improved availability of nutrients such as potassium, nitrogen, and phosphorus, which are important for peanut growth. Adding compost can improve soil texture and permeability, enhancing the soil's ability to retain water and support root growth. This is important for maintaining soil moisture, especially in areas with low rainfall (Sembiring *et al.*, 2019).

Biocompost also controls plant diseases. Microorganisms in biocompost can act as biological control agents, protecting plants from pathogen infections such as *Fusarium* spp. This is very important for keeping plants healthy and reducing the use of chemical pesticides (Suryanto *et al.* 2023).

3. Method

This research will be conducted at the Research and Agrotourism Garden of the Faculty of Agriculture, Abulyatama University, located in Blang Bintang, Aceh Besar Regency, from February to May 2025. The tools to be used in this study include research nameplates, 35×40 cm poly bags, hoes, measuring tapes, scales/balances, watering cans, stakes, ropes, buckets, cameras, writing tools, and others. The materials to be used include peanut seeds, coffee grounds as an ameliorant, and bio-compost. g. This study employs a Randomized Block Design

(RBD) 4x3 factorial pattern, consisting of 3 replications, resulting in 36 experimental units. The treatments used in this study are

Coffee Grounds Dose (K), namely:

$K_0 = 0$ kg/polybag (Control)
 $K_1 = 50$ grams/polybag (10 tons/ha)
 $K_2 = 100$ grams/polybag (20 tons/ha)
 $K_3 = 150$ grams/polybag (30 tons/ha)

Biokompos dosage (B):

$B_0 = 0$ kg/polybag (Control)
 $B_1 = 50$ grams/polybag (10 tons/ha)
 $B_2 = 100$ grams/polybag (20 tons/ha)

The data analysis used was a Randomized Block Design (RBD). The mathematical model of the design used in this study was:

$$Y_{ijk} = \mu + B_i + K_j + B_k + (KB)_{jk} + \varepsilon_{ij}$$

Where:

Y_{ijk} = Observation results of the effect of coffee grounds (K) at level j and the effect of biocompost (B) at level k in replicate i
 μ = Overall average value
 B_i = Effect of replication at level i (i = 1, 2, 3)
 K_j = Effect of coffee grounds at level j (j = 1,2,3)
 B_k = Effect of bio-compost at level i (k = 1,2,3)
 $(KB)_{jk}$ = Interaction effect between coffee grounds (K) at level j and biocompost (B) at level k
 ε_{ij} = Experimental error effect due to the application of biocompost fertilizer at levels i and j in group k

The data obtained were then analyzed using an F-test, and if a significant effect was observed, a Honest Significant Difference (HSD) test was conducted at the 5% level ($HSD_{0.05}$), defined as:

$$HSD_{0.05} = q_{0.05} (p.dbA) \sqrt{(KTA/r)}$$

Notes:

$BNJ_{0.05}$ = Significant difference at the 5% level
 $q_{0.05}$ = Standard q value at the 5% level, number of treatments and degrees of freedom
 db_A = Degrees of freedom
 KT_A = Random mean square
 r = Number of replications

Research Implementation

Soil Analysis

Soil analysis is conducted prior to planting by collecting soil samples for testing and transporting them to a laboratory to determine the nutrient content of the soil.

Site Preparation

Site preparation involves clearing and leveling the area around the site to be used for placing polybags, removing shrubs, debris, and wood piles. Site preparation takes one week.

Planting Medium Preparation

The soil used is taken from the Research and Agrotourism Garden of the Faculty of Agriculture, Abulyatama University. However, the soil is first dried and sieved to ensure that debris does not enter the polybags. The soil is then filled into polybags measuring 35 x 40 cm. Medium preparation is conducted simultaneously with land preparation.

Labeling of Treatments

Labeling of the polybags was done one week after media preparation (before planting the peanut seeds into the polybags). Labeling was done to distinguish the treatments to be applied to each peanut plant.

Biocompost Application

Biocompost application is done two weeks before planting to allow the soil time to absorb the nutrients it contains. Biocompost is applied through several simple steps to ensure its benefits are maximally felt by the plants and soil. First, the biocompost must be sieved to remove clumps or foreign objects that may be present, making it easier to spread evenly. Next, the biocompost is applied directly to the soil surface or mixed into the topsoil layer at a depth of approximately 10-15 cm. Ensure that the biocompost is spread evenly so that every part of the soil receives sufficient nutrients.

The timing of biocompost application is crucial to ensure its effectiveness for plant growth. Biocompost should be applied two weeks before planting to allow sufficient time for the organic matter in the biocompost to fully decompose and be absorbed by the soil. If used during the plant growth period, biocompost application is also ideally done in the morning or evening when environmental temperatures are lower to reduce evaporation and maintain soil moisture.

Coffee Grounds Application

The coffee grounds application process begins with collecting raw materials from various sources, such as coffee shops or households. The coffee grounds used must be free of contaminants, such as plastic or chemicals. Before application, the coffee grounds are analyzed to determine their nutrient content, such as pH analysis.

To ensure that coffee grounds are safe and effective for use on soil and plants, it is important to measure their pH before use. Each type of plant has an ideal pH range for growth, so knowing the pH of coffee grounds helps adjust the application rate to avoid disrupting soil pH balance. Coffee grounds that are too acidic can alter the soil overall, especially when used in large quantities. Additionally, soil microorganisms, which play a crucial role in providing nutrients to plants and decomposing organic matter, are highly sensitive to pH changes. Their activity can be disrupted if the coffee grounds' pH is inappropriate, ultimately affecting the nutrient supply process. Coffee grounds are used by mixing them with soil before planting as a base fertilizer. Coffee grounds are applied only once, at treatment doses of 50 grams/polybag, 100 grams/polybag, and 150 grams/polybag.

Planting

Peanut seeds are planted in 35 x 40 cm polybags prepared with a planting hole depth of 2-3 cm, with 2 seeds per polybag. The distance between polybags is 30 cm, and the distance between rows is 30 cm.

Maintenance

Maintenance of cowpea plants includes watering, weeding, pest and disease control, pruning, and weed removal.

Harvesting

Harvesting of cowpea (*Vigna unguiculata* L.) is done at the appropriate time to ensure optimal seed quality and quantity, generally between 60-65 days after planting. Harvesting is done only once.

Plant Observations

Parameters observed include:

The Observations include plant height (cm), number of branches (branches), weight of 100 seeds (g), number of pods per plant (pods), and dry seed weight (g). Plant height measurement starts from the soil surface to the top of the tallest plant using a measuring tape. Plant height measurement is conducted three times at 14 DAP, 28 DAP, and 42 DAP. Branch count measurements are taken three times at 14 DAP, 28 DAP, and 42 DAP. Dry seed weight, pod count per plant, and 100-seed weight are measured after harvest by weighing the entire peanut plant in each polybag.

4. Finding and Discussion

4.1 The Effect of Coffee Grounds as a Soil Conditioner

Plant Height (cm)

The average height of peanut plants at 14, 28, and 42 days after planting due to the application of coffee grounds is presented in Table 2 as follows:

Table 1. Average height of peanut plants at 14, 28, and 42 days after planting due to the application of coffee grounds

Coffee Grounds Dosage	Plant Height (cm)		
	14 DAP	28 DAP	42 DAP
K ₀ (Without coffee grounds)	22,3 a	50,1 a	84,67 a
K ₁ (50 g/polybag)	21,6 a	43,56 a	110,22 a
K ₂ (100 g/polybag)	20,9 a	46,11 a	79,89 a
K ₃ (150 g/polybag)	19,9 a	47,89 a	89,67 a
BNJ0,05	3,36	12,14	44,88

Note: Figures followed by the same letter in the same column are not significantly different at the 5% level (BNJ).

Table 1 shows that the height of peanut plants at 14, 28, and 42 days after planting indicates that coffee grounds treatment did not significantly affect plant height growth. The tallest plants were found in the 50 g/polybag coffee grounds treatment, which did not differ significantly in all trials.

Number of Branches (branches)

The average number of peanut branches resulting from the application of coffee grounds is presented in Table 2 as follows.

Table 2. Average number of peanut branches at 14, 28, and 42 days after planting resulting from the application of coffee grounds

Coffee Grounds Dose	Number of Branches		
	14 DAP	28 DAP	42 DAP
K ₀ (Without coffee grounds)	1,89 b	13,11 a	30,22 a
K ₁ (50 g/polybag)	1,67 ab	11,22 a	30,11 a
K ₂ (100 g/polybag)	1,22 a	11,78 a	30,00 a
K ₃ (150 g/polybag)	2,00 b	12,11 a	30,78 a
BNJ0,05	0,46	4,29	6,71

Note: Figures followed by the same letter in the same column are not significantly different at the 5% level (BNJ).

Table 2 shows that at 14 days after planting, the highest number of branches was found in treatment K₃ (150 g/polybag), which was not significantly different from K₁ (50 g/polybag) and K₀ (control) but was significantly different from K₂ (100 g/polybag). At 28 DAP and 42 DAP, there were no significant differences in the number of branches due to the various coffee grounds dose treatments applied.

Dry seed weight (g)

The average number of pods per peanut plant due to coffee grounds application is presented in Table 3 as follows:

Table 3. Average dry seed weight in peanuts due to coffee grounds application

Coffee Grounds Dosage	Dry Seed Weight (g)
K ₀ (Without coffee grounds)	29,78 a
K ₁ (50 g/polybag)	33,78 a
K ₂ (100 g/polybag)	32,33 a
K ₃ (150 g/polybag)	33,89 a
BNJ0,05	7,69

Note: Figures followed by the same letter in the same column are not significantly different at the 5% level (BNJ).

Table 3 shows that the highest dry seed weight was found in treatment K₃ (150 g/polybag), which was not significantly different from all other treatments tested. This difference in results was influenced by differences in the amount of coffee grounds applied in each treatment. The application of coffee grounds had no effect on the maximum dry seed weight.

4.2 Effect of Biocompost Application

Plant Height (cm)

The average plant height of cowpea at 14, 28, and 42 days after sowing (DAS) due to bio-compost application is presented in Table 4 as follows:

Table 4. Average plant height of cowpea at 14, 28, and 42 DAP due to bio-compost application

Biocompost	Plant Height (cm)		
	14 DAP	28 DAP	42 HST
B ₀ (Without Biocompost)	20,8 a	38,92 a	66,5 a
B ₁ (50 grams/polybag)	21,8 a	50,25 b	109,58 ab
B ₂ (100 grams/polybag)	20,8 a	51,58 b	97,25 b
BNJ0,05	2,40	8,67	32,04

Note: Figures followed by the same letter in the same column are not significantly different at the 5% level (BNJ).

Table 4 shows that at 28 DAP and 42 DAP, the highest plant height of cowpeas was found in the application of biocompost in treatment B₁ (50 grams/polybag), which was not significantly different from the application of biocompost in treatment B₂ (100 grams/polybag) but was significantly different from treatment B₀ (control). At 14 DAP, there were no significant differences in plant height due to the various biocompost dose treatments.

Number of Branches (branches)

The average number of branches of winged beans at 14, 28, and 42 days after planting due to the application of biocompost is presented in Table 5 as follows:

Table 5. Average number of branches of winged beans at 14, 28, and 42 days after planting due to the application of biocompost

Biocompost	Number of Branches (branches)		
	14 DAP	28 DAP	42 DAP
B ₀ (Without Biocompost)	1,5 a	7,5 a	20,92 a
B ₁ (50 grams/polybag)	1,58 ab	14,0 b	35,58 ab
B ₂ (100 grams/polybag)	2 b	14,7 b	34,33 b
BNJ0,05	0,33	3,06	4,79

Note: Figures followed by the same letter in the same column are not significantly different at the 5% level (BNJ).

Table 5 shows that the highest number of branches of winged bean plants was found in the B₂ dose (100 grams/polybag), which was not significantly different from the other treatments. This is in line with the statement by Djafar & Afrina (2023) that organic sources, in the form of liquid or solid biocompost, have great potential for stimulating vegetative growth in plants.

Dry seed weight (g)

The average number of pods per planting of winged beans due to the application of biocompost is presented in Table 6 as follows:

Table 6. Average dry seed weight of winged beans due to the application of biocompost

Biocompost	Dry Seed Weight (g)
B ₀ (Without Biocompost)	28,25 a
B ₁ (50 grams/polybag)	33,58 ab
B ₂ (100 grams/polybag)	35,5 b
BNJ0,05	5,49

Note: Figures followed by the same letter in the same column are not significantly different at the 5% level (BNJ).

Table 6 shows that the highest dry seed weight of the peanut plant due to the application of bio-compost was found in treatment B₂ (100 g/polybag), and the lowest weight was in treatment B₀ (control), which was not significantly different from treatment B₁ (50 g/polybag) but was significantly different from treatment B₀.

5. Conclusion and Recommendation

The application of coffee grounds had a significant effect on the number of branches at 14 days after planting but had no significant effect on plant height and dry seed weight in winged bean plants. The application of biocompost had a significant effect on plant height, number of branches, and dry seed weight in winged bean plants. There was no significant interaction between the application of coffee grounds and bio-compost on the growth and yield of peanut plants.

Further research is needed on the use of coffee grounds and bio-compost as soil amendments with different crops.

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