

Comparative Analysis of Banana Peel Varieties as Organic Fertilizer on Vegetative growth of *Vigna radiata* L. (Mung bean)

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ABSTRACT

Food waste management is a growing concern, with banana peels often discarded despite their potential agricultural benefits. Rich in essential nutrients such as potassium, phosphorus, and magnesium, banana peels can serve as an organic alternative to synthetic fertilizers. This study evaluates the effects of different banana peel varieties Saba, Lakatan, Latundan, and Senorita as organic fertilizer for the vegetative growth of *Vigna radiata* L. (mung bean) compared to urea. The experiment measured stem length, stem diameter, root length, leaf count, and biomass. A controlled experimental setup was used, with fertilizer applications conducted weekly for six weeks. Statistical analysis revealed that Senorita banana peels significantly enhanced root length ($F=6.499$, $p = 0.009$) and biomass ($F=4.318$, $p = 0.001$) compared to other treatments. However, no significant differences were observed in stem growth and leaf count. These findings highlight the potential of banana peels as an alternative to synthetic fertilizers. Further research is recommended to optimize application methods and evaluate long-term effects in different soil conditions.

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INTRODUCTION

The Philippines faces significant challenges in food waste management, discarding millions of tons of food annually, contributing to landfill waste and environmental pollution (Krause et al., 2023). Among these waste products, banana peels constitute

a substantial portion, as the country is one of the world's leading banana producers (Acevedo et al., 2021). Rather than dumping these peels in landfills, repurposing them into organic fertilizers is a sustainable alternative that reduces waste and enhances crop growth and soil health (Hariyono et al., 2021).

Banana peels are beneficial organic fertilizers, rich in potassium, phosphorus, and magnesium, which are essential for plant growth (Khanyile et al., 2024). They also contain bioactive compounds like polyphenols and antioxidants that further enhance growth (Petersen et al., 2019). Using banana peels helps reduce food waste and serves as a

cost-effective alternative to commercial fertilizers. In contrast, synthetic fertilizers can degrade soil and contribute to greenhouse gas emissions (Koochafkan et al., n.d.) leading to long-term soil infertility. Therefore, utilizing banana peels supports sustainable farming and addresses food waste challenges in the Philippines.

This study evaluates the effectiveness of different banana peel varieties Saba, Lakatan, Latundan, and Senorita on the vegetative growth of *Vigna radiata* L. (mung bean) to determine their potential as an eco-friendly and sustainable fertilizer option.

METHODOLOGY

Research Design

This experiment investigated the effects of different banana peel fertilizers on the growth of *V. radiata* using five treatments: Urea Control (T1), Saba Peelings (T2), Lakatan Peelings (T3), Latundan Peelings (T4), and Senorita Peelings (T5). A quantitative, parametric inferential approach was applied, with stem length, stem diameter, root length (longest and shortest), leaf count, and biomass as dependent variables, and the banana cultivar type as the independent variable. Each treatment had three replicates, with six seeds per replicate (arranged as three pots with two seeds per pot).

Collection and preparation of samples

Banana peels were sourced from local markets (e.g., Paco markets, banana cue stalls, fruit stands), sun-dried for 1–2 days, then ground into a fine powder and diluted to form a solution. Prior to drying, the peels were soaked in a saline solution (5 g of salt per liter of water) for one hour and rinsed.

V. radiata seeds, obtained from the Bureau of Plant and Industry (BPI) in Manila, were soaked for 24 hours and germinated for six hours on moist tissue. Seeds were transplanted into 15 cm diameter pots filled with 600 g of fertilized loam soil. Fertilizer application began one week after planting, with 100 ml of fertilizer solution applied 0.5 cm below the soil surface, 10 cm from the seedlings, and re-applied weekly. The fertilizer concentration began at 0.5% and increased by 0.5% every two weeks.

Data Collection and Analysis

To ensure precision, standardized methods were used: rulers measured stem and root lengths to the nearest centimeter and millimeter, respectively, while a vernier caliper measured stem diameter to the nearest millimeter, just below the first node. Biomass was assessed using a tare balance accurate to the nearest 0.5 grams. Data were analyzed using ANOVA, with significance set at 0.05, and visualized through a grouped bar chart.

RESULTS AND DISCUSSION

The present study aimed to compare the effectiveness of different varieties of banana peels as organic fertilizers in promoting the vegetative growth of *V. radiata*. Four varieties of banana peels were tested: Saba, Lakatan, Latundan, and Senorita. The primary parameters assessed were stem length, stem diameter, root length, leaf count and biomass. The control group, which received urea, showed no significant differences in measured parameters with banana-based fertilizers highlighting the potential of banana peels as a viable alternative to conventional fertilizers.

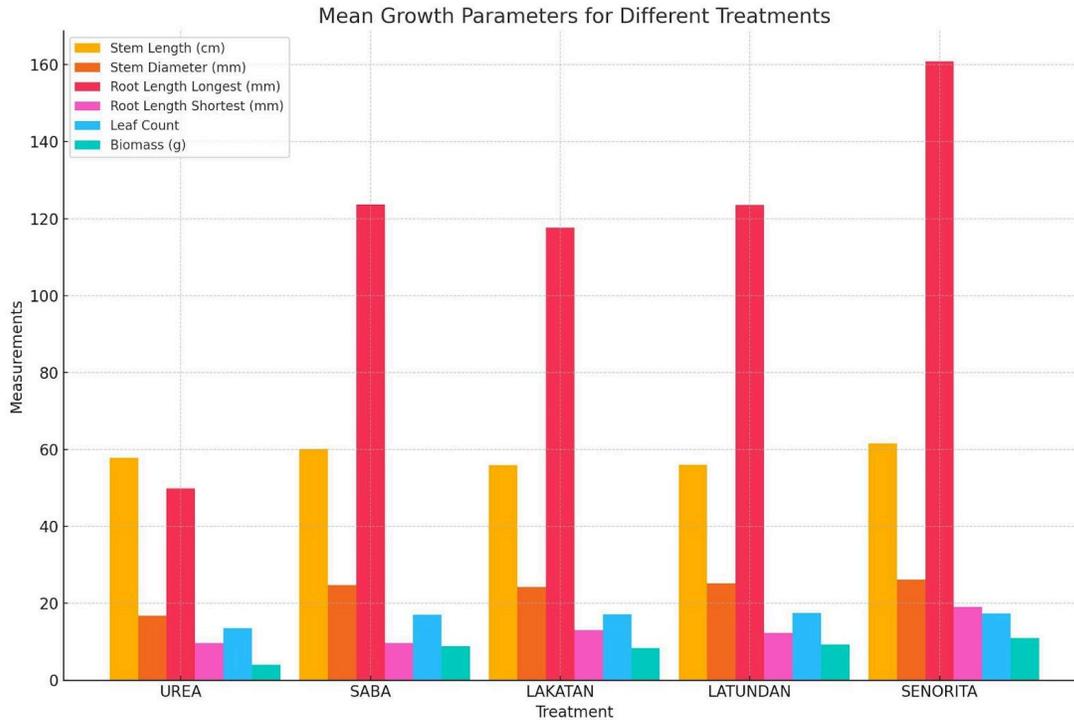


Figure 1. Grouped bar chart showing *V. radiata* grown on 5 different treatments

Table 1. Analysis of variance of vegetative indicators of 5 different treatments and its interpretation

| Indicator | F Value | P value | Interpretation |
|------------------------|---------|---------|-----------------|
| Stem Length | 0.406 | 0.803 | Not significant |
| Stem Diameter | 1.94 | 1.34 | Not significant |
| Root Length (Longest) | 4.318 | 0.009 | Significant |
| Root Length (Shortest) | 0.704 | 0.597 | Not significant |
| Leaf Count | 1.801 | 0.160 | Not significant |
| Biomass | 6.499 | 0.001 | Significant |

*p<0.05

Correlation between banana cultivars and vegetative growth parameters

Overall study established a positive correlation between the type of banana cultivar and vegetative growth parameters. Table 1 indicates no significant differences in stem length (F = 0.406, p =

0.803), stem diameter (F = 0.406, p = 0.803), and leaf count (F = 1.801, p = 0.160) across the five treatments. However, significant differences were observed in root length (F = 4.318, p = 0.009) and biomass (F = 6.499, p = 0.001), with Seniorita peels emerging as the most effective treatment. Despite the

lack of significant differences in most parameters, the Senorita treatment consistently exhibited superior vegetative growth, particularly in root length and biomass.

Key findings and observations under Senorita treatment plants

Although statistical analyses did not reveal significant differences for most parameters, a consistent trend of superior vegetative growth under the Senorita treatment was observed. Specifically, Senorita-treated plants showed the highest stem length (average of 16.8 cm), stem diameter (average of 6.7 mm), root length (average of 21.3 cm), leaf count (average of 32 leaves per plant), and overall biomass (average of 18.4 g) as shown in Fig 1.0.

DISCUSSION

Comparison with urea

Banana-based fertilizers demonstrated similar or superior results compared to urea, making them a preferable choice as shown in Fig 1.0. Organic fertilizers like banana peels offer a more balanced nutrient profile, including micronutrients and bioactive compounds which support long-term soil health and mitigate environmental stress (Khanyile et al., 2024, Zaini et al., 2022). This is consistent with the findings by Hariyono et al. (2021), which indicated that banana peel fertilizer could substitute KCL fertilizer. Therefore, banana peels are an effective sustainable replacement compared to conventional fertilizer.

Comparative analysis of banana peel cultivars on vegetative growth parameters

The variation in nutrient profiles among the banana cultivars likely affected growth outcomes.

Research by Hikal et al. (2022) indicates that the specific nutrient balance in banana peels varies significantly across the varieties. The diploid Senorita cultivar (AA group) stands out from the triploid cultivars which potentially affected the nutrient profile. However, there is limited research on the nutrient profiles of local banana cultivars in the Philippines to definitively correlate with the observed results. Regardless, a study conducted by Rai et al. (2+023) the nutritional composition of six local Balinese banana cultivars showed different mineral compositions of K, Ca, Fe, and P proving that genetic diversity provides different nutritional characteristics in banana cultivars.

CONCLUSION

The banana-based fertilizers, particularly Senorita, outperform Urea significantly in promoting root growth and biomass production in *V. radiata* L., making them a recommended choice for plant growth. Additionally, compared to urea, banana-based fertilizers are a more sustainable choice as it aligns with the global shift toward organic farming, helping reduce fruit peel waste and methane emissions from landfills.

RECOMMENDATION

The study found no significant effects on stem length, diameter, or leaf count, suggesting the need for further research with larger sample sizes and longer durations. Future studies should explore fertilizer combinations focusing on the optimal quantity and frequency of organic fertilizer applications based on the mineral composition of organic fertilizers could improve crop yields and support sustainable agricultural practices.

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DECLARATION REGARDING GENERATIVE AI IN SCIENTIFIC WRITING

The authors declare that no generative artificial intelligence (AI) or AI-assisted technologies were used at any stage of the study.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest relevant to this study.

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