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Testing Various Liquid Organic Fertilizers and Varieties for Yardlong Bean (Vigna unguiculata L.) on Limited Land in Pengempon Village, Sruweng, Kebumen

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Abstract: Limited agricultural land and the increasing volume of biodegradable household waste require cultivation technologies that are efficient, sustainable, and applicable to small-scale vegetable production. Liquid organic fertilizer (LOF) produced from fruit and vegetable waste has the potential to recycle organic materials while supplying nutrients for crop growth. **Objective:** This study aimed to evaluate the growth and yield responses of three yardlong bean varieties to different sources of waste-derived LOF under limited-land polybag cultivation. **Methods:** A quantitative experimental approach was employed using a 4 × 3 factorial Randomized Complete Block Design with three replications. The first factor consisted of four LOF treatments: no LOF, fruit-waste LOF, vegetable-waste LOF, and mixed fruit–vegetable waste LOF. The second factor comprised the Parade, Fantastik, and Komet varieties. Plant height, leaf number, pod number, and pod weight were measured directly. The data were analyzed using factorial analysis of variance, followed by Duncan's Multiple Range Test at the 5% significance level when significant differences were detected. **Results:** LOF application significantly supported early vegetative growth, particularly by increasing the number of leaves at two weeks after planting. Fruit-waste LOF produced the numerically highest leaf number, although its effect was statistically comparable to vegetable-waste and mixed fruit–vegetable waste LOFs. No marked differences were detected among the three varieties, while plant height and yield components showed relatively uniform responses during the first three harvests. **Implications:** Household fruit and vegetable waste can potentially be processed into an alternative fertilizer input to support the early establishment of yardlong bean in limited-land cultivation. Optimization of LOF concentration, application frequency, and nutrient composition is required to improve its contribution to pod production. **Originality:** The originality of this study lies in the simultaneous comparison of three waste-derived LOF sources and three yardlong bean varieties within a factorial polybag experiment under limited-land conditions.

Keywords: yardlong bean; liquid organic fertilizer; organic waste recycling; polybag cultivation; varietal response

INTRODUCTION

Yardlong bean (Vigna unguiculata L.) is an important horticultural commodity widely consumed as a source of plant protein, vitamins, minerals, and dietary fiber. Its relatively short cultivation period and adaptability to different growing environments make it suitable

for household-scale food production. However, yardlong bean cultivation increasingly faces constraints associated with declining soil fertility, limited availability of productive land, and continuous dependence on inorganic fertilizers (Badan Pusat, 2018). Prolonged and excessive inorganic fertilizer application may reduce soil quality and weaken the sustainability of crop production systems, while the conversion of agricultural land into residential and industrial areas further limits opportunities for conventional cultivation (Refaldi et al., 2021; Wang et al., 2021). Under these conditions, the use of yards, containers, and polybags represents a practical alternative for producing vegetables in areas with limited land. Therefore, the development of locally available, inexpensive, and environmentally responsible nutrient sources is important for supporting sustainable yardlong bean cultivation at the household and community levels (Ardiyanti et al., 2021; Baon Yosep, 2017; Nur et al., 2018; Rukmana, 1997)

Previous studies related to organic fertilization and yardlong bean cultivation can be classified into three main categories. The first category concerns the contribution of liquid organic fertilizer to soil fertility and plant growth (Aprilia & Sukur, 2022; Ardiyanti et al., 2021). Liquid organic fertilizer can supply macro and micronutrients, stimulate microbial activity, improve soil physical, chemical, and biological properties, and increase nutrient availability in the root zone (Amir et al., 2022; Chand et al., 2026). The second category focuses on the utilization of organic waste as fertilizer material. Fruit waste, including pineapple peel, contains organic matter and minerals that may be processed into fertilizer, while household and market vegetable waste can be fermented using microbial bioactivators such as EM4 to produce liquid organic fertilizer (Ibrahim, 2022; Nur et al., 2018). The third category examines fertilizer concentration, application frequency, and varietal responses in legume cultivation. Previous findings indicate that liquid organic fertilizer may improve vegetative growth and yield components of yardlong bean, although the magnitude of the response depends on fertilizer formulation, concentration, application interval, environmental conditions, and plant variety (Danga et al., 2026; Refaldi et al., 2021; Zahanis et al., 2022). Nevertheless, previous research has generally evaluated a single organic fertilizer source, a limited number of varieties, or cultivation under conventional field conditions. Comparative evidence regarding fruit-waste, vegetable-waste, and mixed-waste liquid organic fertilizers applied to several yardlong bean varieties under limited-land polybag cultivation remains insufficient.

To address this research gap, the present study aimed to evaluate the growth and yield responses of three yardlong bean varieties Parade, Fantastik, and Komet to different sources of liquid organic fertilizer under limited-land cultivation in Pengempon Village, Sruweng District, Kebumen Regency. The fertilizer treatments consisted of no liquid organic fertilizer, fruit-waste liquid organic fertilizer, vegetable-waste liquid organic fertilizer, and a combination of fruit- and vegetable-waste liquid organic fertilizer. Plant height, number of leaves, pod weight, and number of pods were examined to determine the individual effects of fertilizer source and variety as well as the interaction between these two factors. Through this factorial approach, the study seeks to identify whether waste-derived liquid organic fertilizer can support yardlong bean cultivation in polybags and whether its effectiveness differs among the tested varieties.

This study argues that fermented fruit and vegetable waste can provide plant-available organic compounds and nutrients that support the vegetative and reproductive development of yardlong bean. It was hypothesized that plants receiving liquid organic fertilizer would demonstrate better growth and yield than plants receiving no liquid organic fertilizer. Differences in the composition of fruit waste, vegetable waste, and their combination were also expected to produce different plant responses. In addition, Parade, Fantastik, and Komet were expected to respond differently because each variety may possess distinct genetic characteristics related to nutrient utilization, vegetative development, and yield formation. Accordingly, a significant interaction between liquid organic fertilizer source and yardlong bean variety was anticipated, indicating that the effectiveness of a fertilizer source may depend on the variety to which it is applied.

RESEARCH METHOD

The units of analysis in this study were yardlong bean plants (Vigna unguiculata L.) cultivated in polybags under limited-land conditions. The research was conducted from November 2025 to February 2026 in Pengempon Village, Sruweng District, Kebumen Regency, Central Java, Indonesia. The study examined the growth and yield responses of three yardlong bean varieties Parade, Fantastik, and Komet following the application of liquid organic fertilizers produced from different organic-waste sources. The experiment comprised 12 treatment combinations and 36 experimental units. Plant height, number of leaves, pod weight, and number of pods per plant were used as the principal indicators of plant response.

This study employed a quantitative experimental approach using a 4 × 3 factorial Randomized Complete Block Design with three replications. The factorial design was selected because it allowed the simultaneous examination of two treatment factors and their possible interaction. The first factor was the source of liquid organic fertilizer, consisting of P0 = without liquid organic fertilizer, P1 = fruit-waste liquid organic fertilizer, P2 = vegetable-waste liquid organic fertilizer, and P3 = mixed fruit–vegetable waste liquid organic fertilizer. The second factor was yardlong bean variety, consisting of V1 = Parade, V2 = Fantastik, and V3 = Komet. The randomized block arrangement was intended to reduce the influence of environmental variability among experimental groups while enabling the estimation of the main effects of fertilizer source and variety as well as the interaction between the two factors.

The study used primary quantitative data obtained directly from observations and measurements of the experimental plants. The data sources consisted of plants grown under the 12 combinations of liquid organic fertilizer and variety treatments. Vegetative-growth data included plant height measured in centimeters and number of leaves recorded at one, two, and three weeks after planting. Yield data included pod weight measured in grams and number of pods per plant recorded during the first, second, and third harvests. Information concerning treatment application, crop-management activities, and harvest observations was recorded throughout the experimental period to support the interpretation of plant growth and yield responses.

Data collection began with seed preparation and crop establishment. Yardlong bean seeds were soaked in water for 30 minutes before sowing, after which two seeds were planted in each 25 × 25 cm polybag containing the prepared growing medium. Standard crop-management practices, including irrigation, staking, weeding, fertilization, and pest and disease control, were applied uniformly to all experimental units. The liquid organic fertilizers were produced through a 14-day fermentation process using fruit waste, vegetable waste, or a mixture of fruit and vegetable waste combined with molasses, water, and EM4. Liquid organic fertilizer application began two weeks after planting at a dose of 75 mL per polybag according to the assigned treatment, whereas plants in the control treatment received no liquid organic fertilizer. Plant height and leaf number were measured at one, two, and three weeks after planting, while pod weight and pod number were measured during the first three harvest periods.

The collected data were analyzed using factorial analysis of variance at the 5% significance level to determine the main effect of liquid organic fertilizer source, the main effect of yardlong bean variety, and the interaction between the two factors. Before the analysis of variance was performed, the data were examined for normality and homogeneity of variance to evaluate whether the assumptions of parametric analysis were satisfied. When the analysis of variance indicated a statistically significant treatment effect, mean comparisons were conducted using Duncan's Multiple Range Test at the 5% significance level. All statistical analyses were performed using IBM SPSS Statistics version 26, and the results were interpreted based on the treatment means, measures of variation, F-values, and probability values.

RESULT

Early vegetative response

The application of LOF improved leaf development during the early vegetative stage of yardlong bean. The clearest response was observed at two weeks after planting, when plants receiving LOF produced more leaves than plants grown without LOF. This response indicates that nutrients supplied by fermented organic waste were readily utilized during the initial growth phase.

Among the LOF sources, fruit-waste LOF produced the highest average number of leaves (6.00 leaves), followed closely by vegetable-waste LOF (5.98 leaves) and mixed fruit–vegetable waste LOF (5.87 leaves). Plants without LOF produced the lowest leaf number (5.63 leaves). The three LOF sources showed comparable performance, suggesting that fruit waste, vegetable waste, and their combination can all be used as potential raw materials for LOF production, as illustrated in Figure 1.

Table 1. Effect of liquid organic fertilizer source on the number of leaves of yardlong bean at two weeks after planting.

Treatment	Number of leaves
P0 (without LOF)	5.63 b
P1 (fruit-waste LOF)	6.00 a
P2 (vegetable-waste LOF)	5.98 a
P3 (mixed fruit–vegetable waste LOF)	5.87 a

Note: Values followed by the same letter are in the same DMRT 5% group.

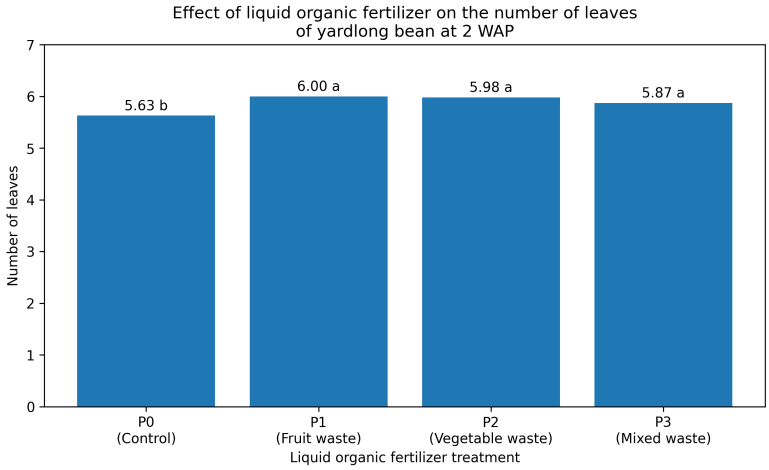

Figure 1. Mean number of leaves of yardlong bean at 2 WAP under different liquid organic fertilizer treatments.

Plant height and yield response

Plant height during the first three weeks after planting showed a relatively uniform growth pattern among LOF sources and varieties. This indicates that the early effect of LOF was more clearly expressed in leaf formation than in vertical plant elongation.

Pod number and pod weight during the first to third harvests also showed a relatively uniform response across fertilizer sources and varieties. The 75 mL per polybag application rate appeared sufficient to stimulate early leaf development, but further optimization of application rate and frequency may be needed to strengthen its effect on yield formation.

The varieties Parade, Fantastik, and Komet displayed comparable growth and yield responses under limited land conditions. This pattern indicates that the three varieties were able to adapt to the experimental environment and responded similarly to the applied LOF sources.

DISCUSSION

The improvement in leaf number following LOF application demonstrates the contribution of waste-derived organic fertilizer to early vegetative growth of yardlong bean. Leaf formation is closely related to nitrogen availability because nitrogen supports chlorophyll synthesis, cell division, and leaf expansion. In addition, the fermentation process using EM4 may enrich LOF with beneficial microorganisms and organic compounds that improve nutrient availability around the root zone. This response pattern is clearly presented in Figure 1.

Fruit-waste LOF gave the highest leaf number, although vegetable-waste LOF and mixed LOF produced very similar responses. This finding suggests that different biodegradable waste sources can provide comparable fertilizing value when processed through fermentation. From a practical perspective, this is important because farmers and households can use locally available fruit or vegetable waste to produce organic fertilizer without depending on a single raw material source.

The stronger response in leaf development compared with plant height and yield components indicates that the applied LOF primarily supported early vegetative growth. During reproductive growth, yardlong bean requires a more balanced and continuous nutrient supply to support flowering, pod setting, and pod filling. Therefore, the single application rate used in this study may need to be adjusted through higher concentrations, more frequent applications, or integration with solid organic fertilizer and balanced inorganic nutrients.

The comparable response among Parade, Fantastik, and Komet indicates that varietal differences were not the main determinant of crop performance under the present limited land system. Environmental conditions, growing medium characteristics, watering, and nutrient supply may have played a greater role in shaping the observed growth and yield patterns. This also suggests that the tested LOF sources can be applied across these varieties for supporting early plant establishment.

Overall, the study highlights the agronomic and environmental potential of converting fruit and vegetable waste into LOF for yardlong bean cultivation. Although the main contribution was observed during early growth, this technology remains relevant for limited land farming because it is low-cost, accessible, and supports organic waste recycling. Further studies should refine LOF formulation, nutrient concentration, and application schedule to increase its contribution to pod yield.

CONCLUSION

Waste-derived liquid organic fertilizer supported the early vegetative growth of yardlong bean, as indicated by the significant increase in leaf number at two weeks after planting compared with the treatment without liquid organic fertilizer. Fruit-waste liquid organic fertilizer produced the numerically highest mean leaf number, although its effect was comparable to those of vegetable-waste and mixed fruit–vegetable waste liquid

organic fertilizers. No marked differences were detected among the Parade, Fantastik, and Komet varieties under the limited-land polybag cultivation conditions applied in this study.

The scientific contribution of this study lies in providing comparative evidence on the use of fruit waste, vegetable waste, and their combination as raw materials for liquid organic fertilizer in the cultivation of three yardlong bean varieties. The findings demonstrate that locally available household organic waste has the potential to be processed into an alternative fertilizer input for supporting early plant establishment. The study also provides an experimental basis for developing organic-waste recycling practices that can be integrated into small-scale and limited-land vegetable cultivation.

This study was limited to one cultivation location, three replications, a single liquid organic fertilizer dose of 75 mL per polybag, and a relatively short observation period. The nutrient composition of each liquid organic fertilizer was not analyzed, and the applied treatment did not produce a clearly demonstrated improvement in yield components. Consequently, the findings cannot yet be generalized to different environmental conditions, fertilizer formulations, or cultivation systems. Future research should examine several fertilizer concentrations and application intervals, analyze the chemical and microbial characteristics of the fertilizers, extend observations throughout the production cycle, and evaluate their integration with solid organic or balanced nutrient sources to improve pod number and pod weight.

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