Research Article
Crop Life

Long Bean Response to Triple Super Phosphate and Kascing Fertilizer

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[The author informations are in the declarations section. This article is published by ETFLIN in Crop Life, Volume 1, Issue 1, 2025, Page 18-25. DOI 10.58920/crop0101367]

Received: 30 May 2025
Revised: 31 July 2025
Accepted: 25 November 2025
Published: 28 November 2025

Editor: Iskandar

Keywords: Long bean, Triple super phosphate fertilizer, Kascing fertilizer.

Abstract: This thesis examines the growth response and yield performance of long bean (*Vigna sinensis* L.) variety Pertiwi F1 in relation to the application of Triple Super Phosphate (TSP) and Kascing (earthworm castings) fertilizers. The study employed an experimental approach using a factorial design to assess plant responses to various fertilizer dosages and to determine the most effective treatment for optimizing growth and production. The research measured key parameters including plant height, number of branches, pod length, pod weight, and total yield. The results demonstrated that TSP fertilizer significantly influenced fruit weight, with the optimal effect observed at a dosage of 10.8 g per polybag (equivalent to 300 kg/ha). In contrast, Kascing fertilizer did not produce significant effects on most growth and yield parameters, although the application of 72 g per polybag (equivalent to 20 tons/ha) resulted in the highest pod yield among the Kascing treatments. Additionally, the interaction between TSP and Kascing fertilizers showed no significant impact on the observed variables. The novelty of this research lies in its combined evaluation of inorganic and organic fertilizers in a polybag cultivation system, which is relevant for small-scale and limited-land agricultural practices. The strength of this study is its evidence-based recommendations that contribute to more efficient fertilization strategies, offering practical guidance for improving long bean productivity under controlled cultivation conditions.

Introduction

The long bean (Vigna sinensis L.) belongs to the Fabaceae family and is one of the most widely cultivated vegetable commodities in tropical lowland regions, generally at altitudes of 0–200 meters above sea level (1-3). This crop is an important source of plant-based protein and is consumed widely in Indonesia because of its nutritional value and year-round availability. Long beans are grouped into climbing and non-climbing types (4) Climbing varieties such as KP-1, KP-2, and Usus are more commonly cultivated than non-climbing types like Tolo and Uci because they show higher productivity, better adaptability, and stronger tolerance to field stress conditions (5)These cultivars twine around stakes and form pods 40–70 cm long with green to pale green coloration, which aligns with the characteristics described in other tropical legume studies (6).

Triple Super Phosphate (TSP) is one of the essential fertilizers used in long bean cultivation and is a widely known inorganic phosphorus source (7). Historically, TSP was one of the earliest high-analysis phosphorus fertilizers used globally during the twentieth century, although its application has declined as more efficient P fertilizers and controlled-release formulations have emerged (8). TSP supplies readily available phosphorus that supports root growth, increases photosynthesis and respiration, promotes flowering, and accelerates pod and seed maturation (9, 10). Phosphorus from TSP also contributes to chlorophyll development, improves fruit formation, and facilitates the movement of photosynthates within plant tissues (11). Adequate phosphorus availability is therefore recognized as a limiting factor in achieving optimal crop performance in legumes, including long beans (12)

Organic fertilizers also play an important role in supporting the sustainability of long bean cultivation. Kascing is one of the most widely recommended organic fertilizers for improving soil fertility (13). Produced from earthworm castings, kascing originates from the decomposition of organic materials such as vegetable waste, fruit residues, leaves, and animal manure consumed by earthworms, creating a nutrient-rich material that enhances soil structure and nutrient availability (14) Kascing is typically processed into dried earthworm castings (15). containing macro- and micronutrients that are easily absorbed by plants (16). It also provides natural plant growth regulators, including gibberellins, cytokinins, and auxins, as well as nutrients such as nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg), calcium (Ca), and nitrogen-fixing microbes such as Azotobacter sp., along with micronutrients such as Fe, Mn, Zn, Bo, and Mo (17)

Additional studies confirm that earthworm-based fertilizers significantly improve soil biological activity, cation exchange capacity, and plant growth responses in vegetable crops (18).

Laboratory analyses show that Kascing contains about 1.79 percent nitrogen, 1.79 percent potassium, 0.85 percent phosphorus, 30.52 percent calcium, and 27.13 percent carbon. Incorporating Kascing at about 10–20 percent of planting media volume can increase plant height, biomass, and overall growth rate (19). Similar findings in other legumes also show that vermicompost improves nutrient uptake efficiency and enhances plant vigor. These benefits make Kascing a highly valuable amendment for improving soil fertility and supporting healthy plant development.

Methodology

Time and Location of the Study

This research was conducted at Jl. Sultan Sulaiman, Citra Gading Housing Complex, located in Sambutan District, Samarinda City, East Kalimantan Province. The site was selected due to its suitable environmental conditions for the cultivation of yard-long beans.

The research was carried out over a period of approximately four months, starting from the end of April and continuing until July 2021. This duration covered all essential stages of crop development, including planting, maintenance, and harvesting, allowing for comprehensive observation of the plant responses to the treatments applied.

Materials and Equipment

In conducting this research, a variety of materials and equipment were used to support the successful cultivation of yard-long bean (Vigna sinensis L.) of the Pertiwi variety. The primary materials included TSP fertilizer as a source of phosphorus and kascing fertilizer, an organic fertilizer derived from dried earthworm castings. Additionally, Pertiwi yard-long bean seeds were used, along with 25 × 40 cm polybags as planting media, and 2-meter-high bamboo stakes to support the climbing plants. Clean water was used for irrigation purposes, while Amistar Top pesticide and Regent insecticide were applied for plant protection against pests and diseases.

To facilitate cultivation activities and data collection, various tools were employed, such as machetes and hoes for preparing the planting medium, a handsprayer for pesticide and insecticide application, and raffia string for tying plants to the stakes. Measurements and data recording were carried out using a measuring tape, knife or scissors, writing tools, a calculator, and a laptop. A weighing scale was used to accurately measure the harvested yield. All of these materials and tools played a crucial role in supporting the successful implementation of the research from start to finish.

Experimental Design

This study employed a 3 × 4 factorial experimental design arranged in a Completely Randomized Design (CRD) with five replications. The experiment consisted of two treatment factors combined to observe their interactive effects on the observed variables.

TSP Fertilizer Dose Factor (T)

- t_0 = without TSP fertilizer application (Control)
- t_1 = TSP fertilizer dose of 150 kg/ha, equivalent to 5.4 g per polybag
- t_2 = TSP fertilizer dose of 300 kg/ha, equivalent to 10.8 g per polybag

The TSP levels used in this study were selected based on commonly recommended phosphorus fertilizer rates for legumes in tropical soils, which generally range from 150–300 kg/ha (20). These rates are particularly relevant because tropical soils often exhibit low available phosphorus due to fixation by iron and aluminum oxides. Therefore, the selected doses represent agronomically justifiable application levels rather than exploratory quantities

Kascing Fertilizer Dose Factor (K)

- K_0 = without Kascing fertilizer application (Control)
- K_1 = Kascing fertilizer dose of 10 tons/ha, equivalent to 36 g per polybag
- K_2 = Kascing fertilizer dose of 20 tons/ha, equivalent to 72 g per polybag
- K_3 = Kascing fertilizer dose of 30 tons/ha, equivalent to 108 g per polybag

In total, there were 3 × 4 treatments of TSP × Kascing combinations. The Kascing dose range was chosen based on organic fertilizer recommendations for vegetable crops, where 10–30 tons/ha has been shown to improve soil fertility, microbial activity, and nutrient availability (21). These doses fall within the agronomically accepted application range and have been widely used in studies involving vermicompost amendments. Each treatment combination was replicated 5 times, resulting in a total of 3 × 4 × 5 = 60 experimental units.

Research Procedure

The research began with the preparation of the planting medium, using topsoil (0–20 cm depth) collected from around the research site. The soil was cleaned of weeds and loosened to ensure uniformity. This prepared soil was then placed into 25 × 40 cm polybags, each filled with approximately 10 kg of soil. A total of 60 polybags were used, arranged in the field at a spacing of 60 × 60 cm based on a randomized layout determined by drawing lots. One week before planting, Kascing fertilizer was applied by spreading it evenly over the soil surface in the polybags and mixing it thoroughly according to the treatment levels (K_0, K_1, K_2, K_3). This application was done only once for the entire planting period. Simultaneously, TSP fertilizer was also applied following the same method and based on the treatment levels (t_0, t_1, t_2). The TSP was applied in the morning at around 08.00 WITA.

Before planting, the seeds of the yard-long bean variety Pertiwi were soaked in water for two h to select viable seeds, identified by those that sank. Planting was carried out by creating holes 3 cm deep using a dibble stick (tugal) in each polybag. Two seeds were placed into each hole and then lightly covered with soil. Plant maintenance involved several activities to ensure optimal growth. Watering was conducted in the morning and afternoon as needed, particularly when the soil was no longer moist. Two weeks after planting, bamboo stakes (2 meters in height) were installed in a crossed formation (two stakes per polybag) to support the climbing plants. Weeding was done regularly to remove any unwanted plants both inside and around the polybags. Pruning was also conducted when the plants became overly leafy, especially on the shoots and leaves, to facilitate better

flowering.

Pest and disease control focused on maintaining environmental cleanliness through sanitation. Insecticide Regent was applied in the morning and Amistar Top pesticide in the afternoon, both at a concentration of 2 cc per liter of water. Spraying was done evenly on all plant parts and was stopped 10 days before harvest to ensure food safety.

Harvesting began approximately 60 days after planting. The harvest criteria were based on young pods suitable for consumption, pods that had reached maximum size, were easy to snap, and showed no prominent seeds. Harvesting was done five times, with an interval of three days between each picking.

Observation and Data Collection

Observations in this study were conducted systematically to obtain comprehensive data on the growth and yield of long bean plants. The first parameter observed was plant height (cm), measured at 10, 20, and 30 days after planting. Measurements were taken from the base of the stem to the tip of the growing point using a raffia string or measuring tape to assess vertical growth over time. Next, the days to flowering were recorded by counting the number of days from planting until the first flower appeared. This parameter is important to determine the transition of the plant to its reproductive phase. The days to harvest were also recorded, indicating the duration from planting until the plant produced its first harvestable pod. This data reflects the crop's growth cycle leading up to the production phase.

In addition, the number of pods per plant was counted from the beginning to the end of the harvesting period. The total number of pods was then averaged to determine the plant's productivity. To assess yield quantitatively, the pod weight per plant (g) was measured by weighing the fresh pods at each harvest. The total weight from five harvests was summed and averaged to determine the yield per plant. Finally, pod length per plant (cm) was measured from base to tip using a measuring tape. This parameter provides insights into the quality of the harvested pods in terms of size. These parameters offer a comprehensive overview of how the different fertilizer treatments influenced the growth and yield performance of Pertiwi F1 long bean plants.

Table 1. ANOVA model for factorial completely randomized design (CRD).

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F-Calculated	F-Table	
					(5%)	(1%)
TSP Fertilizer (T)	T - 1	SST	MST = SST/(T-1)	MST / MSE	F(0.05)	F(0.01)
Kascing Fertilizer (K)	K - 1	SSK	MSK = SSK/(K-1)	MSK / MSE	F(0.05)	F(0.01)
Interaction (T × K)	(T - 1)(K - 1)	SSTK	MSTK	MSTK / MSE	F(0.05)	F(0.01)
Error (E)	T × K × (r - 1)	SSE	MSE			
Total	T × K × r – 1	SSTotal				

Table 2. Average plant height at 10 days after planting (DAP).

Kascing Fertilizer (K)	TSP Fertilizer (T)			Average (K)
	Control (t0)	5.4 g/polybag (t1)	10.8 g/polybag (t2)	
Control (k0)	17.84	15.88	17.38	17.03
36 g/polybag (k1)	17.10	18.70	16.60	17.47
72 g/polybag (k2)	17.78	18.36	17.48	17.87
108 g/polybag (k3)	17.84	17.32	17.74	17.63
Average (T)	17.64	17.57	17.30	

Note: Growth Response and Yield of Long Bean (*Vigna sinensis* L.) cv. Pertiwi F1 as Affected by the Interaction (T×K) of TSP Fertilizer (T) and Kascing Fertilizer (K) Applications (cm).

Table 3. Average plant height at 20 days after planting (DAP).

Kascing Fertilizer (K)	TSP Fertilizer (T)			Average Per Treatment (K)
	Control (t0)	5.4 g/polybag (t1)	10.8 g/polybag (t2)	
K0 (Control)	44.58	43.00	66.80	51.46
K1 (36 g/polybag)	60.20	86.40	68.20	71.60
K2 (72 g/polybag)	76.40	74.80	59.00	70.07
K3 (108 g/polybag)	68.80	68.40	67.80	68.33
Average Treatment (T)	62.00	68.15	65.45	

Note: Growth Response and Yield of Long Bean (*Vigna sinensis* L.) Variety Pertiwi F1 as Influenced by TSP Fertilizer (T) and Kascing Fertilizer (K) Treatments and Their Interaction (T×K) (in cm).

Table 4. Average plant height at 30 days after planting (DAP) in response to TSP fertilizer (T), Kascing fertilizer (K), and their interaction (T × K) on the growth and yield of long bean (*Vigna sinensis* L.) variety Pertiwi F1 (cm).

Kascing Fertilizer (K)	TSP Fertilizer (T)			Average Treatment (K)
	Control (t0)	5.4 g/polybag (t1)	10.8 g/polybag (t2)	
Control (k0)	166.80	113.80	180.40	153.67
36 g/polybag (k1)	179.00	211.80	187.60	192.80
72 g/polybag (k2)	210.00	195.00	182.80	195.93
108 g/polybag (k3)	163.20	197.60	179.00	179.93
Average Treatment (T)	179.75	179.55	182.45	

Data Analysis

To determine the effects of TSP fertilizer, Kascing fertilizer, and their interaction on the growth and yield of long bean plants, the observational data were analyzed using Analysis of Variance (ANOVA) as seen in **Table 1**.

If the results of the analysis of variance show no significant difference among treatments (F.Calculated ≤ F.**Table 5**%), then no further test is conducted. However, if a significant (F.Calculated > F.**Table 5**%) or highly significant difference (F.Calculated > F.**Table 1**%) is observed, a follow-up analysis is carried out using the Least Significant Difference (LSD) test to compare the means of the treatments.

Results

Plant Height

The baseline soil characteristics of the planting media were assessed to provide context for interpreting the treatment responses. The soil analysis prior to fertilizer application showed a pH of 6.2 (slightly acidic), total nitrogen concentration of 0.19%, available phosphorus (P_2O_5) of 20.4 mg/kg, available potassium of 0.37 cmol/kg, and an organic carbon content of 1.48%. Based on general soil fertility classifications, these values indicate low nitrogen and moderate levels of phosphorus and potassium, suggesting that the initial soil nutrient status may have influenced the plant response outcomes observed in this.

The plant height parameter was measured at three different time points during the early growth phase.

Plant Height at 10 Days After Planting (DAP)

The results of the analysis of variance showed that the application of TSP fertilizer (T), Kascing fertilizer (K), and their interaction (T×K) did not produce any significant response on plant height at 10 days after planting (refer to Appendix **Table 1**). The average plant height for each treatment is presented in **Table 2**.

Plant Height at 20 Days After Planting (DAP)

The analysis of variance revealed that the application of TSP fertilizer (T), Kascing fertilizer (K), and their interaction (T×K) had no significant effect on plant height at 20 days after planting (see Appendix **Table 2**). The average plant height for each treatment is presented in **Table 3**.

Plant Height at 30 Days After Planting (DAP)

The analysis of variance showed that the application of TSP fertilizer (T), kascing fertilizer (K), and their interaction (T x K) had no significant effect on plant height at 30 days after planting, as presented in Appendix **Table 3**. The average plant height for each treatment is listed in **Table 4**.

Days to Flowering

The analysis of variance showed that the application of TSP fertilizer (T), kascing fertilizer (K), and their interaction (T x K) had no significant effect on days to flowering (Appendix 4). The average values are presented in **Table 5**.

Days to Harvest

The analysis of variance showed that the application of TSP fertilizer (T), kascing fertilizer (K), and their interaction (T x K) had no significant effect on days to harvest (Appendix 5). The average values are presented in **Table 6**.

Number of Fruits per Plant

The analysis of variance showed that the application of TSP fertilizer (T), kascing fertilizer (K), and their interaction (T x K) had no significant effect on the number of fruits per plant (Appendix 6). The average number of fruits is presented in **Table 7**.

Fruit Weight per Plant

The analysis of variance showed that the application of TSP fertilizer (T), kascing fertilizer (K), and their interaction (T x K) had a highly significant effect on fruit weight per plant (Appendix 7). The average fruit weight is presented in **Table 8**. The LSD test at the 5% level revealed that treatment t1 (TSP 5.4 g/polybag) was significantly different from the control (t0), but not significantly different from t2 (TSP 10.8 g/polybag). Treatment t2 also showed a significant response compared to the control (t0).

Fruit Length

The analysis of variance showed that the application of TSP fertilizer (T), kascing fertilizer (K), and their interaction (T x K) had no significant effect on the fruit length per plant (Appendix 8). The average fruit length is presented in **Table 9**.

Discussion

Response of TSP Fertilizer (T) Application on the Growth and Yield of Long Bean

Based on the analysis of variance, the application of TSP fertilizer did not produce a significant response on several growth and yield parameters of long bean, including plant height at 10, 20, and 30 days after planting, days to flowering, days to harvest, number of pods per plant, and pod length (**Figure 1**). This indicates that the nutrients provided by TSP fertilizer alone may not sufficiently support optimal vegetative growth of the plant (22). This lack of

Table 5. Average days to flowering in response to TSP fertilizer (T), Kascing fertilizer (K), and their interaction (T × K) on the growth and yield of long bean (*Vigna sinensis* L.) variety Pertiwi F1 (days).

Kascing Fertilizer (K)	TPS Fertilizer (T)			Average Treatment (K)
	Control (t0)	5.4 g/polybag (t1)	10.8 g/polybag (t2)	
Control (k0)	47.20	46.20	46.60	46.67
36 g/polybag (k1)	48.00	43.60	47.20	46.27
72 g/polybag (k2)	47.00	47.20	46.80	47.00
108 g/polybag (k3)	45.40	44.20	48.60	46.07
Average Treatment (T)	46.90	45.30	47.30	

Table 6. Average days to harvest in response to TSP fertilizer (T), Kascing fertilizer (K), and their interaction (T × K) on the growth and yield of long bean (*Vigna sinensis* L.) variety Pertiwi F1 (days).

Kascing Fertilizer (K)	TPS Fertilizer (T)			Average Treatment (K)
	Control (t0)	5.4 g/polybag (t1)	10.8 g/polybag (t2)	
Control (k0)	47.20	46.20	46.60	46.67
36 g/polybag (k1)	48.00	43.60	47.20	46.27
72 g/polybag (k2)	47.00	47.20	46.80	47.00
108 g/polybag (k3)	45.40	44.20	48.60	46.07
Average Treatment (T)	46.90	45.30	47.30	46.50

Table 7. Average number of fruits per plant in response to TSP fertilizer (T), Kascing fertilizer (K), and their interaction (T × K) on the growth and yield of long bean (*Vigna sinensis* L.) variety Pertiwi F1 (fruits).

Kascing Fertilizer (K)	TPS Fertilizer (T)			Average Treatment (K)
	Control (t0)	5.4 g/polybag (t1)	10.8 g/polybag (t2)	
Control (k0)	17.40	18.40	25.00	20.27
36 g/polybag (k1)	20.80	25.60	32.20	26.20
72 g/polybag (k2)	25.40	28.20	32.60	28.73
108 g/polybag (k3)	31.00	23.60	30.80	28.47
Average Treatment (T)	23.65	23.95	30.15	25.92

Table 8. Average fruit weight per plant in response to TSP fertilizer (T), Kascing fertilizer (K), and their interaction (T × K) on the growth and yield of long bean (Vigna sinensis L.) variety Pertiwi F1 (grams)

Kascing Fertilizer (K)	TPS Fertilizer (T)			Average Treatment (K)
	Control (t0)	5.4 g/polybag (t1)	10.8 g/polybag (t2)	
Control (k0)	305.40	362.00	353.80	340.40
36 g/polybag (k1)	366.40	364.60	337.40	356.13
72 g/polybag (k2)	351.60	362.40	366.60	360.20
108 g/polybag (k3)	359.60	366.60	363.60	363.27
Average Treatment (T)	345.75^{bc}	363.90^{a}	355.35^{ab}	355.00

Note: Means followed by the same letter in the same row are not significantly different based on LSD test at 5% level ($LSD_{0.05}$ = 5.69).

Table 9. Average fruit length per plant in response to TSP fertilizer (T), Kascing fertilizer (K), and their interaction (T × K) on the growth and yield of long bean (Vigna sinensis L.) variety Pertiwi F1 (cm).

Kascing Fertilizer (K)	TPS Fertilizer (T)			Average Treatment (K)
	Control (t0)	5.4 g/polybag (t1)	10.8 g/polybag (t2)	
Control (k0)	69.80	72.14	71.92	71.29
36 g/polybag (k1)	71.88	73.72	70.32	71.97
72 g/polybag (k2)	72.64	71.16	74.08	72.63
108 g/polybag (k3)	71.76	70.44	74.16	72.12
Average Treatment (T)	71.52	71.87	72.62	72.00

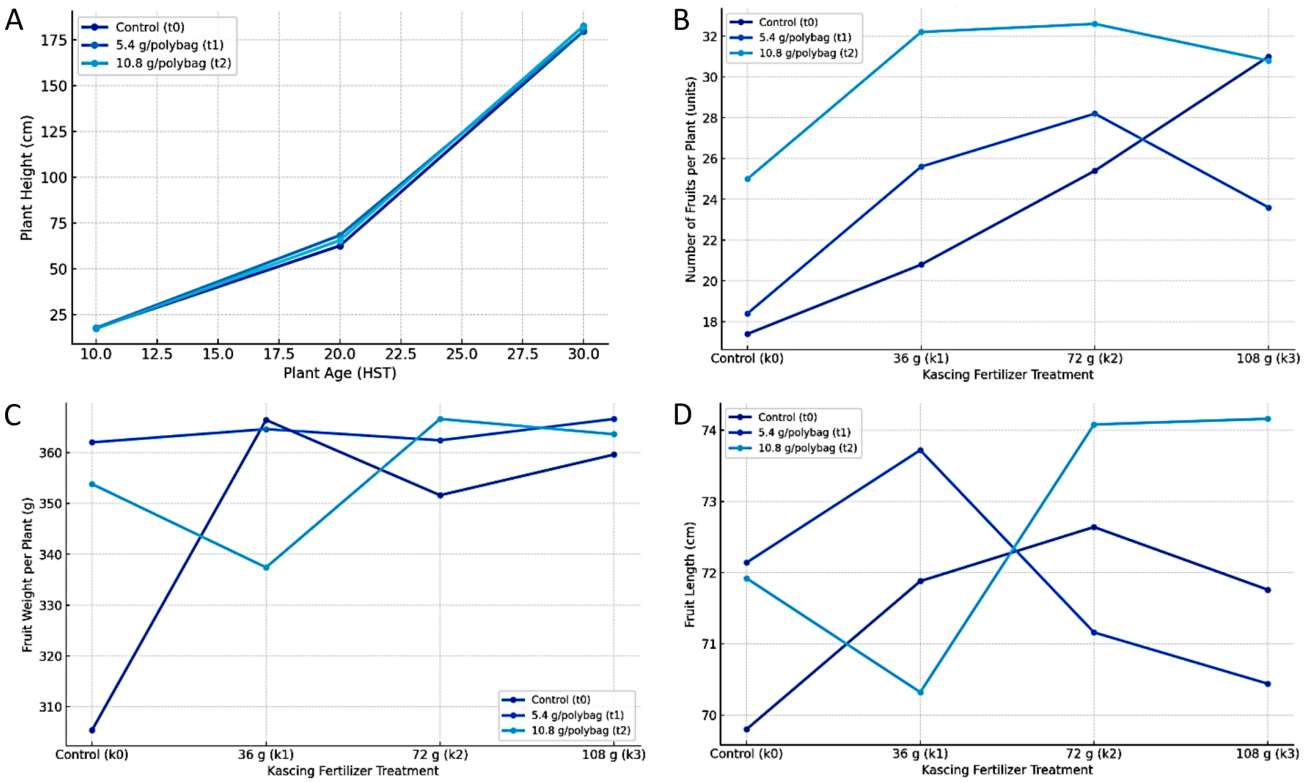

Figure 1. Effect of TSP fertilizer treatments on plant height over time (A), and effect of TSP and Kascing fertilizer interaction on fruit count (B), fruit weight (C), and fruit length per plant (D).

significant response is likely due to the composition of TSP fertilizer, which contains a high concentration of phosphorus pentoxide (46% P_2O_5), moderate calcium (15% Ca), and no nitrogen (N). While phosphorus is essential for root development, photosynthesis, respiration, flower formation, and seed maturation, the absence of nitrogen, an element crucial for vegetative growth such as leaf and stem development, may have limited its effectiveness in promoting early plant growth (23).

Nevertheless, the analysis revealed that TSP fertilizer had a significant effect on fruit weight per plant. This response is likely due to the application of TSP at a dosage of 5.4 g/plant (t1), which supplied an optimal amount of phosphorus that was efficiently absorbed by the plants during the fruit development stage, thereby increasing the fruit weight (24). In contrast, TSP fertilizer did not influence pod length, as no notable differences were observed across treatments, regardless of whether a low or high dosage was applied. This suggests that TSP alone may not be sufficient to stimulate pod elongation in long bean (25).

Overall, the highest pod production was observed in the treatment with 10.8 g TSP/polybag (t2), resulting in 72.62 g/plant, while the lowest was recorded in the control treatment without TSP (t0), at 71.52 g/plant. Although the difference was relatively small, these findings indicate that TSP fertilizer contributes to increasing yield, particularly in terms of fruit weight, even if it does not significantly affect other vegetative growth parameters.

Response to Kascing Fertilizer (K) Application on the Growth and Yield of Long Bean Plants

The analysis of variance results showed that the application of Kascing fertilizer (K) did not produce a significant response across all observed growth and yield parameters. These parameters included plant height at 10, 20, and 30 days after planting, days to flowering, days to first harvest, number of pods per plant, pod weight per plant, and pod length. It is suspected that the lack of response is due to the relatively low concentration of Kascing fertilizer applied, which may not have been sufficient to significantly impact the long bean plants.

According to literature, the nutrient content of Kascing includes 1.79% Nitrogen, 1.79% Potassium, 0.85% Phosphate, 30.52% Calcium, and 27.13% Carbon. For optimal growth, plants require high levels of Nitrogen, and for fruit development, sufficient levels of Potassium (K) and Phosphorus (P) are essential. The levels of N, K, and P in Kascing may be inadequate or not readily available to the plants. Another limitation of organic fertilizers like Kascing is that they must be applied in large quantities, plants respond more slowly, and they can potentially become sources of pests and diseases (26). The nutrients in organic fertilizers are slow-release, meaning they become available over an extended period (27).

In this study, Kascing fertilizer was applied one week prior to planting, which may not have allowed enough time for the organic matter to decompose and release mineral nutrients that the plant roots could absorb. Nonetheless, the highest pod production was recorded at the Kascing fertilizer treatment with a dose of 20 tons/ha or 72 g/polybag (k2), yielding 76.63 g/plant, while the lowest production occurred in the control treatment without Kascing fertilizer (k0), with a yield of 71.29 g/plant.

Effect of Interaction Between Treatments (TxK) on the Growth and Yield Response of Long Bean Plants

The analysis of variance showed that the interaction

between TSP fertilizer and Kascing fertilizer (TxK) did not result in a significant response across all observed parameters. These parameters included plant height at 10, 20, and 30 days after planting, days to flowering, days to harvest, number of pods per plant, pod weight per plant, and pod length. This lack of interaction is likely due to the independent nature of each treatment factor. TSP fertilizer, with its high phosphorus content, tends to act quickly, while Kascing, being organic, has a slower release and effect, resulting in no synergistic interaction when applied together. Therefore, it can be concluded that TSP and Kascing acted independently in this study, with neither influencing the effectiveness of the other. Nonetheless, the highest pod yield from the interaction treatment was recorded in the t2k3 combination (TSP 10.8 g/polybag and Kascing 108 g/polybag), yielding 70.16 g/plant. In contrast, the lowest yield was observed in the control treatment t0k0 (without TSP and Kascing), which yielded 69.80 g/plant.

In summary, the findings highlight that TSP fertilizer is effective in increasing fruit weight per plant at a dose of 10.8 g/polybag, although it did not significantly affect other growth or yield parameters. Kascing fertilizer showed the highest yield at 72 g/polybag, but similarly did not significantly influence other growth or yield aspects. The interaction between TSP and Kascing fertilizers had no significant effect on any of the observed parameters.

Conclusion

The application of TSP fertilizer (T) demonstrated a significant response in one yield parameter, namely the fruit weight per plant. However, TSP treatment did not show any noticeable effect on other growth and yield parameters such as plant height at 10, 20, and 30 days after planting, days to flowering, days to harvest, number of pods per plant, and pod length. Among the tested dosages, the most effective was t2, equivalent to 300 kg/ha or 10.8 g/polybag, which optimally increased fruit weight. In contrast, the application of Kascing fertilizer (K) did not produce a significant response in any of the observed parameters, which included plant height, flowering time, harvesting time, pod number, pod weight, and pod length. Nevertheless, the best-performing dose of Kascing was k2, equivalent to 20 tons/ha or 72 g/polybag. Furthermore, the interaction between TSP and Kascing fertilizers (TxK) showed no significant effect on any of the observed growth and yield parameters. All measurements taken revealed that the combination of both fertilizers did not result in any notable improvement. In summary, TSP fertilizer was effective in increasing the fruit weight of long bean plants, while Kascing fertilizer and the interaction between the two fertilizers had no significant influence on the observed growth and yield parameters in this study.

Declarations

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Contribution: Data Curation, Formal analysis, Visualization, Writing - Original Draft, Writing - Review & Editing.

Conflict of Interest

The authors declare no conflicting interest.

Data Availability

The unpublished data is available upon request to the corresponding author.

Ethics Statement

Not applicable.

Funding Information

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Supplemental Material

The supplementary materials can be found at the link: https://etflin.com/file/document/20250530072736141788366 4.docx

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Additional Information

How to Cite

Veronika Vellin. Long Bean Response to Triple Super Phosphate and Kascing Fertilizer. *Crop Life*. 2025;1(1):18-25

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