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Effectiveness of NPK Fertilizer and Gibberellic Acid (GA_3) Plant Growth Regulator on the Growth and Yield of Long Bean *(Vigna sinensis* L.)

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Abstract

Long bean (*Vigna sinensis* L.) is a valuable vegetable commodity recognized for its high nutritional value; however, its production in Indonesia has declined. This decrease can be attributed to improper cultivation techniques. To enhance production, strategies such as NPK fertilization and the application of growth regulators, specifically gibberellic acid (GA_3), can be employed to improve yields. The combination of these two methods has the potential to improve both the growth and yield of long beans. This study employed a randomized complete block design (RCBD) with two factors, where each treatment combination was replicated three times. Data analysis was conducted using analysis of variance (ANOVA). This research aims to provide insights and recommendations regarding the most effective doses of NPK fertilizer and GA_3 concentrations to enhance growth and yield. Specifically, it seeks to determine the optimal concentration of GA_3 that promotes the growth and yield of long bean plants. The combination of NPK fertilizer and GA_3 had a significant influence on the growth and yield of long bean plants. The treatment of NPK at 15 g/plant combined with GA_3 at 100 ppm resulted in increased plant height, while NPK at 5 g/plant combined with GA3 at 100 ppm led to a higher number of fruits. Additionally, the combination of NPK at 15 g/plant and GA_3 at 150 ppm significantly increased pod weight. Furthermore, the individual treatments of NPK at 15 g/plant and GA_3 at concentrations ranging from 100 to 150 ppm also positively affected the growth and yield of long bean plants.

Keywords: Concentration, Dose, Growth Regulators, Long Bean, Repeated Treatment (RPT)

1. Introduction

Long beans *(Vigna sinensis* L.) are plants from the *Fabaceae family* originating from Southeast Asia and South Asia. They are widely cultivated in Indonesia due to their high nutritional value and health benefits (Armin et al., 2023). This plant is one of the most essential vegetable commodities, accounting for around 10% of total vegetable consumption, or approximately 763,200 tons per year. However, data from the Central Statistics Agency show a decrease in production from 360,871 tons in 2022 to 309,422 tons in 2023, representing a 14.2% decline (BPS, 2022 and 2023). This decrease in production is thought to be caused by inappropriate cultivation techniques, especially in terms of fertilization that does not meet plant needs, resulting in deficiencies in essential nutrients, as well as a lack of provision of plant growth regulators.

One of the efforts to increase long bean production is through fertilization and administration of Plant Growth Regulators (PGR). NPK fertilizers, which contain nitrogen (N), phosphorus (P), and potassium (K), play a crucial role in the vegetative and reproductive growth processes of plants. This point aligns with research (Amalia et al., 2024), which states that administering the correct dose of NPK has been shown to increase various yield components, such as plant length the number and weight of pods, and accelerate the emergence of flowers. PGRs, such as gibberellic acid (GA3), also play a role in stimulating stem elongation, flower formation, and cell growth, thereby supporting the development and quality of plant yields.

The administration of gibberellic acid has a real effect on long bean plants. This study contrasts with the two previous studies, as it examines the combination of NPK

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and GA3 fertilizers in a single treatment, allowing for the simultaneous determination of the interaction effect between the two factors on the growth and yield of long beans. The novelty of this study lies in the use of a two-factor factorial design, which allows for the identification of the most effective combination dose that has not been studied in previous studies. The combination of NPK and GA3 fertilizers is expected to significantly increase the productivity of long beans, as the combination can accelerate plant growth, enhance photosynthesis efficiency, and improve both the quantity and quality of the harvest. This point aligns with research (Alfiyadana et al., 2024), which suggests that the use of GA3 can have a positive impact on plant vegetative growth, providing a crucial foundation for increasing production yields.

Thus, the administration of a combination of NPK fertilizer doses and GA3 concentrations is expected to improve the quality and yield of long bean plants. The results of this study can provide recommendations for long bean cultivation. Therefore, this study was conducted to determine the optimal dose of NPK fertilizer and the optimal GA3 concentration for the growth and yield of long bean plants (*Vigna sinensis* L.).

2. Material and Methods

This research was conducted in the rice fields of Sawotratap Village, Gedangan District, Sidoarjo Regency, East Java, at coordinates 7°24'8.7"S and 112°42'2.3"E with an altitude of 4 meters above sea level, from December 2024 to February 2025. The tools and materials used in this study were meters, calipers, digital scales, hand sprayers, "U" shaped mulch plastic clamps, stakes, Pertiwi variety long bean seeds, goat manure, NPK 16-16-16 fertilizer, Gibracid ZPT with an active ingredient content of 20% gibberellic acid, KNO3 White fertilizer, Dangke 40 WP insecticide, Antracol fungicide, mulch.

This study was a factorial experiment arranged using a Split-Plot Design (RPT) with two factors. The primary factor in the main plot was GA3 concentration, with levels of 0 ppm (control), 100 ppm, 150 ppm, and 200 ppm. The subplot factor was the NPK fertilizer dose, including 0 g/plant (control), 5 g/plant, 10 g/plant, and 15 g/plant. Each treatment combination was repeated three times, yielding 48 experimental units. Each replication consisted of 8 plants, and the total number of experimental plants was 384. The parameters observed included plant length, number of leaves, fruit set, number of pods per plant, pod length, weight per pod, pod weight per plant, and soil analysis. Data analysis was carried out statistically using analysis of variance (ANOVA). If there was a real or very real effect on the treatment, then the BNJ (5% Honestly Significant Difference) test was carried out using Microsoft Excel. The data is also presented in graphical form and analyzed for regression using the data analysis feature in Microsoft Excel.

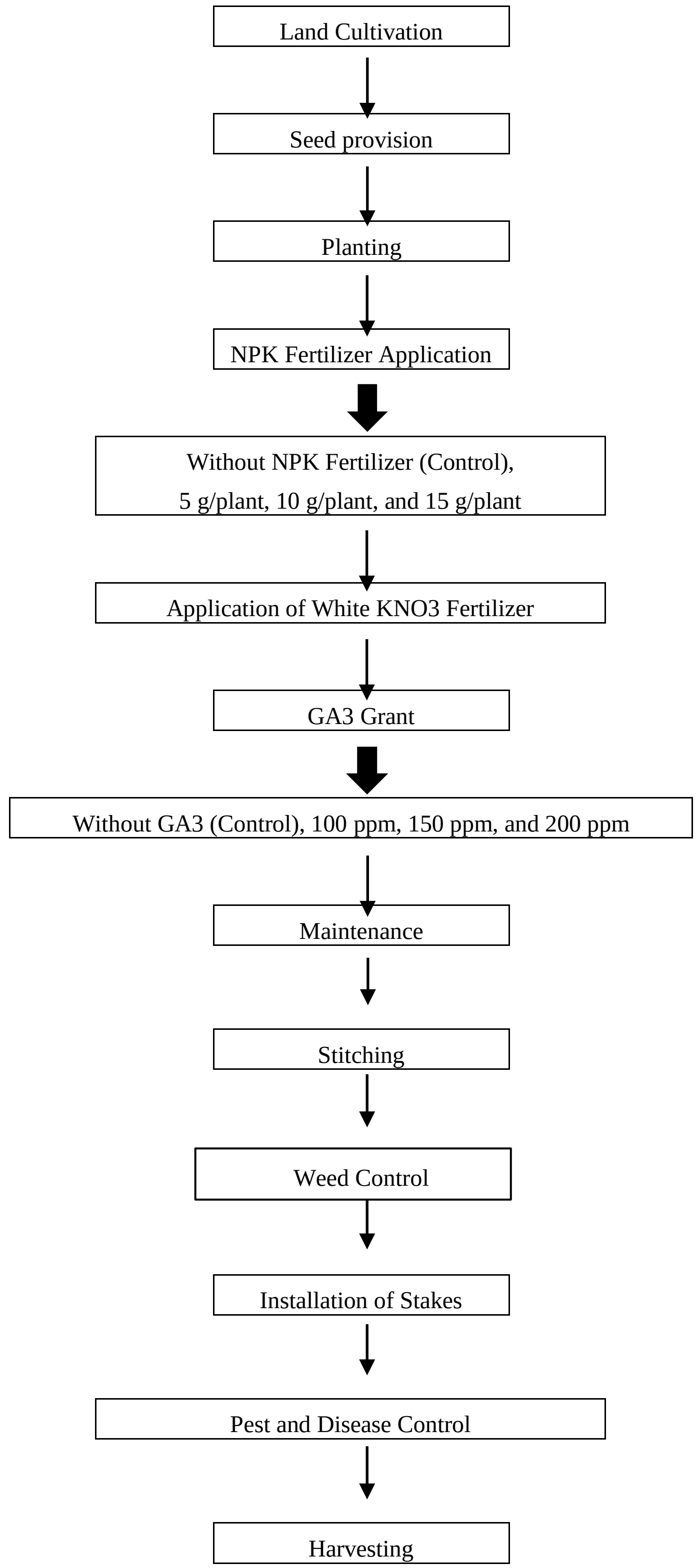

Figure 1. Research flow diagram

3. Results and Discussion

3.1. Plant Length

The results of the analysis of variance indicated a significant interaction between the combination of NPK fertilizer dose treatment and Gibberellic Acid (GA3) concentration on the length of long bean plants at 35 Days After Planting (DAP). Table 1 shows that the combination of NPK fertilizer doses and GA3 concentrations significantly affected the length of long bean plants at 35 days after sowing (DAP). The average length of the longest long bean plant with a combination of NPK fertilizer doses of 15 g/plant + GA3 concentration of 100 ppm (N3G1) was 258.44 cm. NPK fertilizer contains essential nutrients to support plant growth, while GA3 can stimulate stem elongation in plants. With sufficient nutrition and the help of hormones, plants grow faster, and this is evident in their higher stem lengths. Therefore, the combination of NPK fertilization and GA3 administration is the right choice to support the growth of long beans, especially in the early stages of development. These findings align with research (Sarwanidas and Setyowati, 2017), which indicates that the combination of optimal NPK fertilizer doses with moderate GA3 concentrations yields the best results in vegetative growth parameters, such as plant height.

Table 1. Average Length of Long Bean Plants Due to Combination of NPK Fertilizer Dose and GA3 Concentration Treatments at 35 DAP.

Age	Dose Fertilizer NPK (g/plant)	Plant Length (cm)			
		Concentration GA3 (ppm)			
		0	100	150	200
35 DAP	0	208.56±2.11 ab	221.78±2.11 ab	238.11±2.11 ab	216.78±2.11 ab
	5	242.67±2.50 defgh	242.11±1.85 defgh	238.11±2.50 cdef	247.78±4.89 defgh
	10	222.00±1.86 abc	252.11±5.14 fgh	256.67±4.67 gh	233.89 ±8.00 cde
	15	249.44 ± 1.18 efgh	258.44 ± 5.83 h	241.00 ± 5.50 defg	231.67 ±2.85 bcd
	BNJ 5%	16.44			

Note: The average numbers followed by the same letters show no significant difference in the 5% BNJ test.

Table 1 Average Length of Long Bean Plants Due to NPK Fertilizer Dose and GA3 Concentration Treatments

Treatment	Plant Length (cm) DAP 14	21	28
NPK Fertilizer Dosage (g/plant)			
0	36.86 ± 1.00	76.08 ± 3.74	172.72 ± 6.50
5	35.94 ± 0.61	75.97 ± 2.94	175.47 ± 3.99
10	36.30 ± 0.81	71.08 ± 4.01	179.69 ± 2.50
15	37.26 ± 0.66	79.05 ± 4.01	181.06 ± 3.58
BNJ 5%	tn	tn	tn
GA3 concentration (ppm)			
0	35.97 ± 1.00	79.47 ±3.67 ab	173.69 ±6.56
100	35.83 ± 0.53	69.19 ±2.08 ab	172.78 ±3.70
150	38.33 ± 0.75	86.22 ±3.30 b	182.42 ±2.28
200	36.22 ± 0.57	67.50 ±2.80 a	180.06 ±3.63
BNJ 5%	tn	17.78	tn

Description: The average number followed by the same letter in the same column and the same treatment shows no significant difference in the 5% BNJ test; tn=not significant.

Table 2 shows that the single NPK fertilizer dose treatment had no significant effect on the length of long bean plants at the ages of 14, 21, and 28 days after sowing (DAP). Meanwhile, the single GA3 concentration treatment had a significant effect on the length of long bean plants 21 days after planting (DAP) but did not show a substantial impact at 14 and 28 DAP. The provision of a GA3 concentration of 150 ppm significantly increased the growth of long bean plants in the vegetative phase compared to other treatments.

Based on the graph of the growth in length of long bean plants, it can be seen that all NPK fertilizer dose treatments at the age of 14 to 28 days after planting (DAP) experienced an increase in plant length, coinciding with the increasing age of the plant. The most significant increase was observed in the N3 treatment (15 g/plant), which resulted in a higher plant length compared to the other treatments. Plants without NPK fertilizer treatment (N0, 0 g/plant) still showed growth, albeit slower, as shown in Figure 2.

The graph in Figure 3 shows the effect of GA3 concentration on the length of long bean plants at the age of 14 to 28 DAP. In all GA3 concentration treatments, there was an increase in plant length as the plant age increased. The G3 treatment gave the highest plant length growth results compared to other treatments at each stage of observation age. The following best treatments were G2 and G1, while G0 showed the lowest growth. These findings align with research (Nazaruddin and Irmayanti, 2020), which demonstrated that the administration of gibberellic acid had a significant impact on plant growth, particularly in terms of plant height parameters.

3.2. Number of Leaves

The treatment with NPK fertilizer dose significantly affected the number of leaves of long bean plants at 35 days after planting (DAP) but did not have a significant effect at the ages of 14, 21, and 28 DAP. Meanwhile, the treatment of GA3 concentration alone significantly affected the number of leaves on long bean plants 35 days after planting (DAP). Still, it did not have a significant effect at the ages of 14, 21, and 28 days after planting (DAP).

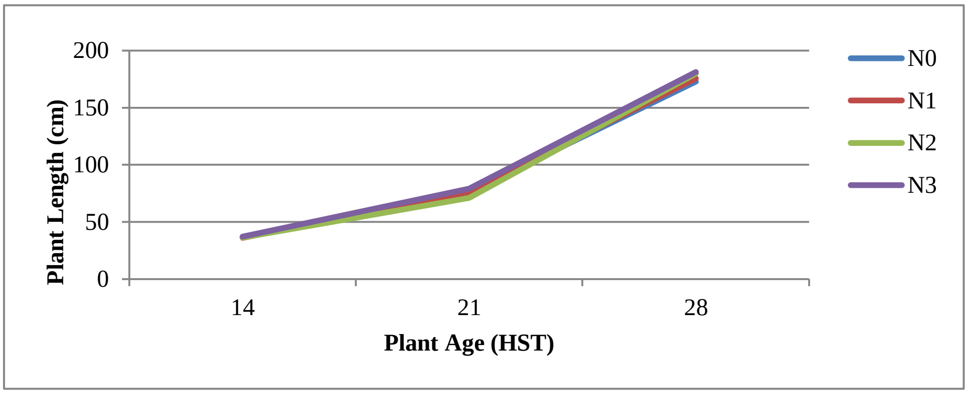

Figure 2. Graph of Plant Length in NPK Fertilizer Dose Treatment. N0: Control; N1: 5 g/plant; N2: 10 g/plant; N3: 15 g/plant

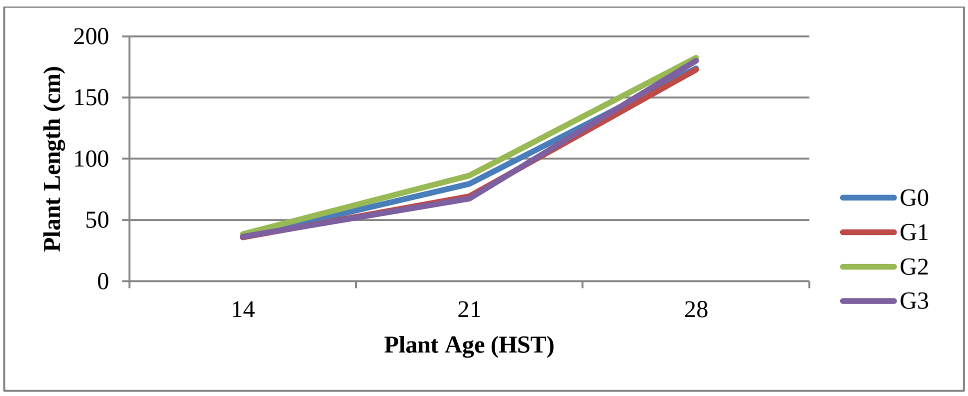

Figure 3. Graph of Plant Length in GA3 Concentration Treatment. G0: Control; G1: 100ppm; G2: 150ppm; G3: 200 ppm

Table 2 Average Number of Leaves of Long Bean Plants Due to NPK Fertilizer Dose and GA3 Concentration Treatments

Treatment	Amount Leaf (strand)			
	DAP			
	14	21	28	35
NPK Fertilizer Dosage (g/plant)				
0	2.08 ± 0.04	4.19 ± 0.14	10.29 ±0.38	21.95 ± 0.72 a
5	2.03 ± 0.06	4.23 ± 0.08	10.42 ± 0.37	27.05 ± 1.08 b
10	2.08 ± 0.08	4.06 ± 0.12	9.98 ± 0.63	28.42 ± 1.13 b
15	2.03 ± 0.03	4.10 ± 0.15	10.45 ± 0.58	29.51 ± 1.48 b
BNJ 5%	tn	tn	tn	2.59
GA3 concentration (ppm)				
0	2.08 ± 0.08	4.23 ± 0.12	10.60 ± 0.48	25.08 ± 0.58 a
100	2.06 ± 0.04	4.23 ± 0.10	10.23 ± 0.54	31.59 ± 1.42 b
150	2.06 ± 0.07	4.19 ± 0.15	10.38 ± 0.48	25.08 ± 1.32 a
200	2.03 ± 0.03	3.94 ± 0.12	9.93 ± 0.49	25.17 ± 0.90 a
BNJ 5%	tn	tn	tn	4.86

Description: The average number followed by the same letter in the same column and the same treatment shows no significant difference in the 5% BNJ test; tn=not significant

Table 3 shows that the best number of leaves on long bean plants at 35 DAP was in the NPK N3 treatment (15 g/plant), with an average of 29.51 leaves. This value is significantly different from N0 (without NPK fertilizer), which produced 21.95 strands. The results of vegetative phase growth in the NPK fertilizer dose treatment of 15 g/plant showed the best growth, particularly in terms of leaf number. NPK fertilizer can increase vegetative plant growth by providing a balanced supply of Nitrogen (N), Phosphorus (P), and Potassium (K). Nitrogen encourages leaf and stem formation, phosphorus supports root development, and potassium strengthens plant tissue (Fauzan et al., 2024).

The graph in Figure 4 illustrates the effect of NPK fertilizer dosage on the number of leaves at various stages of plant development. It can be observed that the higher the NPK dosage (N0, N1, and N2), the more leaves are produced compared to the no-treatment control (N0). The most significant increase was observed at 35 DAP, where the N3 treatment yielded the highest number of leaves compared to the other treatments. These findings align with research conducted by Ariani et al. (2025), which shows that the use of NPK fertilizer can increase plant growth parameters, particularly the number of leaves, which is higher compared to plants that do not receive fertilizer.

The graph shows each treatment at several age stages, specifically 14, 21, 28, and 35 days after planting (DAP). In general, it can be observed that the number of leaves increases with increasing plant age in all treatments, both with and without GA3 application. However, plants treated with GA3 (G1, G2, and G3) showed a significantly higher number of leaves compared to those without GA3 treatment (G0), especially at the final observation, namely at 35 DAP. These findings align with research (Sunarya, 2024), which indicates that the administration of gibberellic acid has the most significant effect on vegetative growth, as evidenced by an increase in the number of leaves in long bean plants.

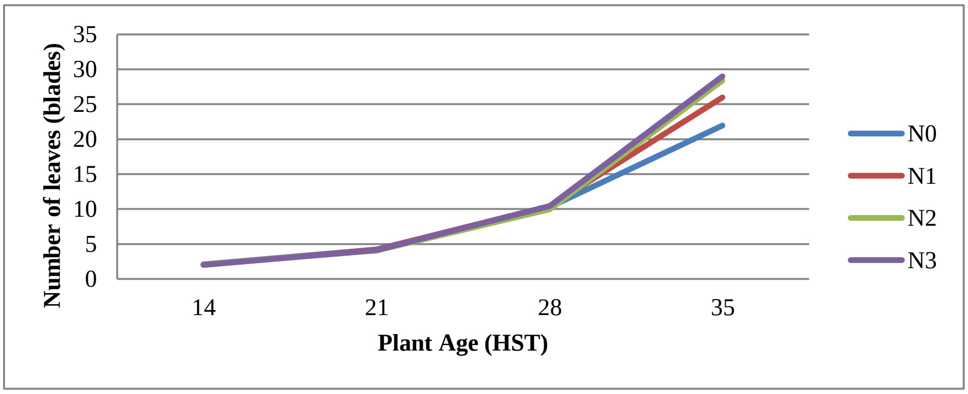

Figure 4. Graph of Number of Leaves in NPK Fertilizer Dose Treatment. N0: Control; N1: 5 g/plant; N2: 10 g/plant; N3: 15 g/plant

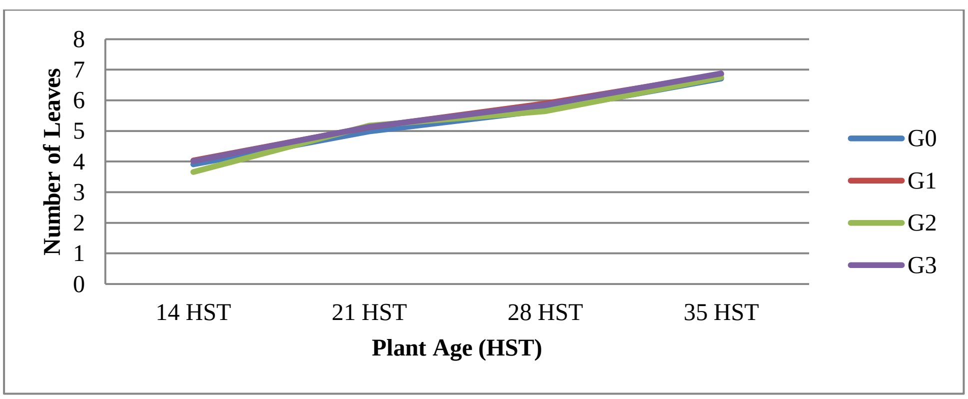

Figure 5. Graph of Number of Leaves in GA3 Concentration Treatment. G0: Control; G1: 100ppm; G2: 150ppm; G3: 200 ppm

3.3. Fruit Set

The results of the analysis of variance show that there is a significant interaction between the combinations of NPK fertilizer doses and Gibberellic Acid (GA3) concentrations on the percentage of flowers that become pods *(fruit set)* in long bean plants.

Table 4 shows that the combination of NPK fertilizer doses and GA3 concentrations significantly affected the fruit set of long bean plants. The best average fruit set results for long bean plants were obtained from the combination of NPK fertilizer doses of 5 g/plant and a GA3 concentration of 100 ppm (N1G1), which achieved a 96.81% success rate. GA3 can stimulate flower formation, while NPK fertilizer provides the necessary nutrients for the development of flowers into fruit. The combination of these two treatments can produce higher-quality fruit, resulting in a significantly increased overall harvest (Ullah et al., 2017).

3.4. Number of Pods per Plant

The results of the analysis of variance showed that there was no significant interaction between the combination of NPK fertilizer dose and GA3 concentration treatments on the number of pods per long bean plant. Singly, the NPK fertilizer dose treatment did not significantly affect the number of pods per long bean plant. However, the GA3 concentration treatment had a significant effect on the number of pods per long bean plant when applied singly.

Table 4. Average *Fruit Set* of Long Bean Plants Due to Combination of NPK Fertilizer Dose and GA3 Concentration Treatments

NPK Fertilizer Dosage (g/plant)	*Fruit Set* (%) GA3 concentration (ppm) 0	100	150	200
0	81.47 ± 10.31 ab	94.98 ± 1.49 b	81.72 ± 4.40 ab	93.57 ± 5.68 b
5	78.85 ± 5.82 ab	96.81 ± 5.75 b	85.83 ± 2.63 ab	91.15 ± 1.87 b
10	75.33 ± 9.91 ab	52.64 ± 21.99 a	96.06 ± 8.62 b	94.66 ± 6.46 b
15	76.24 ± 5.40 ab	88.04 ± 5.18 ab	86.90 ± 5.38 ab	87.00 ± 5.18 ab
BNJ 5%	38.09			

Description = The average number followed by the same letter shows no significant difference in the 5% BNJ test.

Table 5. Average Number of Pods per Long Bean Plant Due to NPK Fertilizer Dose and GA3 Concentration Treatment at Week 1 to Week 3 Harvest

Treatment	Number of Pods per Plant (fruit)
NPK Fertilizer Dosage (g/plant)	
0	8.82 ± 0.31
5	9.25 ± 0.23
10	9.38 ± 0.39
15	9.52 ± 0.27
BNJ 5%	tn
Gibberellin Concentration (ppm)	
0	8.03 a ± 0.20
100	9.85 c ± 0.29
150	9.33 b ± 0.24
200	9.76 c ± 0.13
BNJ 5%	0.32

Description: The average number followed by the same letter in the same column and the same treatment shows no significant difference in the 5% BNJ test; tn=not significant

Table 5 shows that the single treatment of NPK fertilizer dose did not significantly affect the number of pods per long bean plant. However, the best NPK fertilizer treatment at N3 (15 g/plant) was 9.52 pods, while the lowest treatment at N0 (0 g/plant) was 8.82 pods. Meanwhile, the single treatment of GA3 concentration significantly affected the number of pods per plant. The best GA3 concentration was achieved at the G1 treatment (100 ppm), yielding 9.85 fruits, while the lowest number of pods per plant was observed in G0 (0 ppm), which was 8.03 fruits. Administering GA3 at the correct concentration not only affects the vegetative phase but also impacts the generative results of plants, including flower and fruit formation. Additionally, GA3 can stimulate the emergence of flowers and enhance pollination efficiency, which in turn can influence the number of flowers and pods produced (Pratiwi, 2018).

3.5. Pod Length

The results of the analysis of variance showed that there was no significant interaction between the combination of NPK fertilizer dose treatment and GA3 concentration on the length of pods in long bean plants. Singly, the NPK fertilizer dose treatment had a significant effect on the length of pods in long bean plants, but the GA3 concentration treatment alone had no significant impact.

Table 6 shows that the single treatment due to the administration of NPK fertilizer doses significantly affected the length of long bean pods. The best average pod length results were obtained from the NPK fertilizer doses administered in the N2 treatment (10 g/plant), which was 68.46 cm. In contrast, the lowest average pod length was observed in the N0 treatment (0 g/plant) at 63.85 cm. The single treatment of GA3 concentration did not significantly affect the length of the pods. However, the best pod length was obtained in the G1 treatment (100 ppm), which was 66.87 cm, while the lowest pod length was observed in G0

(0 ppm), at 66.65 cm. These findings are in line with research conducted by Oktavianti et al. (2017), which showed that NPK fertilizer was proven to increase pod length. This point demonstrates the consistency of the results, showing that the macronutrients available in NPK, especially Nitrogen (N) and Potassium (K), play a crucial role in the formation and elongation of pods.

Table 6. Average Length of Long Bean Pods Due to NPK Fertilizer Dose and GA3 Concentration Treatments

Treatment	Pod Length (cm)
NPK Fertilizer Dosage (g/plant)	
0	63.85 ± 1.42 a
5	67.27 ± 1.48 b
10	68.46 ± 1.57 b
15	67.49 ± 1.26 b
BNJ 5%	3.16
GA3 Concentration (ppm)	
0	66.65 ± 1.97
100	66.87 ± 1.46
150	66.81 ± 1.45
200	66.74 ± 1.10
BNJ 5%	tn

Description: The average number followed by the same letter in the same column and the same treatment shows no significant difference in the 5% BNJ test; tn=not significant

3.6. Weight per Pod

The results of the analysis of variance showed a significant interaction between the combination of NPK fertilizer dose and GA3 concentration on the weight per pod in long bean plants. Table 7 shows that the combination of NPK fertilizer doses and GA3 concentrations significantly affected the weight per pod of long bean plants. The best average weight per pod of long bean plants was obtained from the combination of NPK fertilizer doses of 15 g/plant and a GA3 concentration of 150 ppm (N3G2), which yielded 27.83 g. These findings align with research (Purwanto et al., 2019), which suggests that the provision of GA3 can enhance cell elongation and division. GA3 can also play a role in stimulating the formation of more flowers, a crucial initial step in the fruit formation process. Meanwhile, the provision of NPK fertilizer can serve as the primary source of macronutrients, including nitrogen (N), phosphorus (P), and potassium (K), which are essential for plant physiological processes, such as optimal fruit formation.

Table 7. Weight per Pod of Long Bean Plants Due to the Combination of NPK Fertilizer Dose and GA3 Concentration Treatments at the 1st to 3rd Week of Harvest

Weight per pod (g)				
NPK Fertilizer Dosage (g/plant)	**GA3 concentration (ppm)**			
	0	**100**	**150**	**200**
0	24.15 ± 2.74 ab	22.64 ± 1.88a	22.33 ± 1.88a	24.00 ± 2.30ab
5	22.20 ± 1.78a	24.90 ± 2.46ab	24.14 ± 2.42ab	25.06 ± 2.69ab
10	23.96 ± 2.81 ab	23.52 ± 2.54ab	22.47 ± 2.19a	24.93 ± 2.49ab
15	25.74 ± 2.91 ab	24.31 ± 3.37ab	27.83 ± 0.31b	24.70 ± 1.90ab
BNJ 5%	4.68			

Note: The average numbers followed by the same letters show no significant difference in the 5% BNJ test.

3.7. Pod Weight per Plant

The results of the analysis of variance showed that there was no significant interaction between the combination of NPK fertilizer dose treatment and GA3 concentration on the weight of pods per long bean plant. Singly, the NPK fertilizer dose treatment had a significant effect on the weight of pods per plant in long bean plants. Meanwhile, the GA3 concentration treatment alone did not have a considerable impact on the weight of pods per plant in long bean plants.

Table 8 shows that the single treatment of NPK fertilizer dose had a significant effect on the weight of pods per long bean plant. The average yield of the best pod weight per plant in the N3 treatment (15 g/plant) was 495.19 g, while the lowest pod weight per plant was N0 (0 g/plant), which was 319.94 g. However, the single treatment of GA3 concentration had no significant effect on the weight of pods per plant. The average yield of the best pod weight per plant in the G1 treatment (100 ppm) was 481.69 g, while the lowest pod weight per plant in G0 (0 ppm) was 412.75 g. These findings align with research (Pobela et al., 2022), which states that the provision of

NPK fertilizer can support the flowering and fruit formation process through the roles of Phosphorus (P) and Potassium (K) in stimulating the generative phase of plants. The Nitrogen (N) element contained in NPK fertilizer plays a role in supporting the vegetative growth of plants. The phosphorus (P) element plays a role in the process of forming reproductive organs, such as flowers and fruit. In contrast, the Potassium (K) element can help improve the quality of fruit yields in plants.

Table 8. Average Weight of Pods per Long Bean Plant Due to NPK Fertilizer Dose and GA3 Concentration Treatment at Harvest Week 1 to Week 3

Treatment	Pod Weight per Plant (g)
NPK Fertilizer Dosage (g/plant)	
0	319.94 ± 29.55 a
5	440.06 ± 36.02 ab
10	432.86 ± 46.79 ab
15	495.19 ± 37.68 b
BNJ 5%	64.06
GA3 Concentration (ppm)	
0	412.75 ± 29.50
100	481.69 ± 45.07
150	426.33 ± 44.57
200	439.28 ± 33.79
BNJ 5%	tn

Description: The average number followed by the same letter in the same column and the same treatment shows no significant difference in the 5% BNJ test; tn=not significant

3.8. Correlation of Weight with Length and Number of Pods

The results of the analysis of variance showed that there was no significant interaction between the combination of NPK fertilizer dose treatment and GA3 concentration on pod length and pod weight in long bean plants. However, the graph shows a positive relationship between pod weight and pod length, as indicated by the regression equation. The equation shows that the longer the pod, the heavier the pod size. However, based on the graph, the coefficient of determination value indicates that the relationship is relatively weak, as the value is only around 18.71%, as shown in Figure 6.

The results of the analysis of variance showed that there was no significant interaction between the combination of NPK fertilizer dose treatment and GA3 concentration on the number of pods per long bean plant; however, a significant interaction was observed on the weight of pods per long bean plant. Based on the results of the regression graph it shows that there is a positive relationship between the number of pods and the weight of pods per plant. The results of the regression equation and the coefficient of determination value indicate that the heavier the pods per plant, the greater the number of pods also increases. However, this relationship is low, at only around 36.9%, as shown in Figure 7.

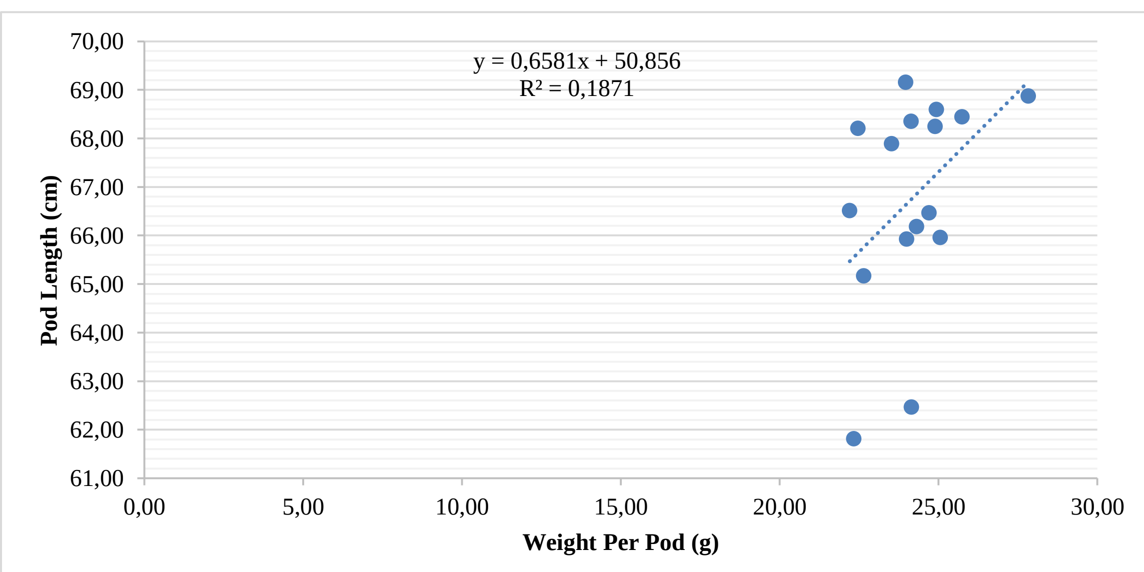

Figure 6. Regression Graph of Pod Length and Weight Per Pod

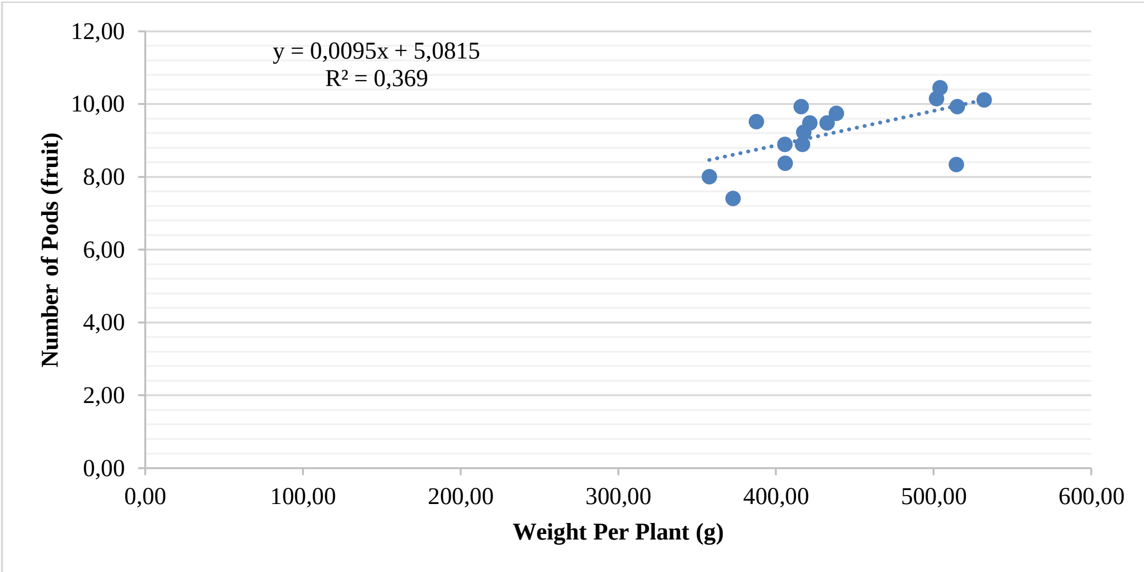

Figure 7. Regression Graph of Number of Pods and Pod Weight per Plant

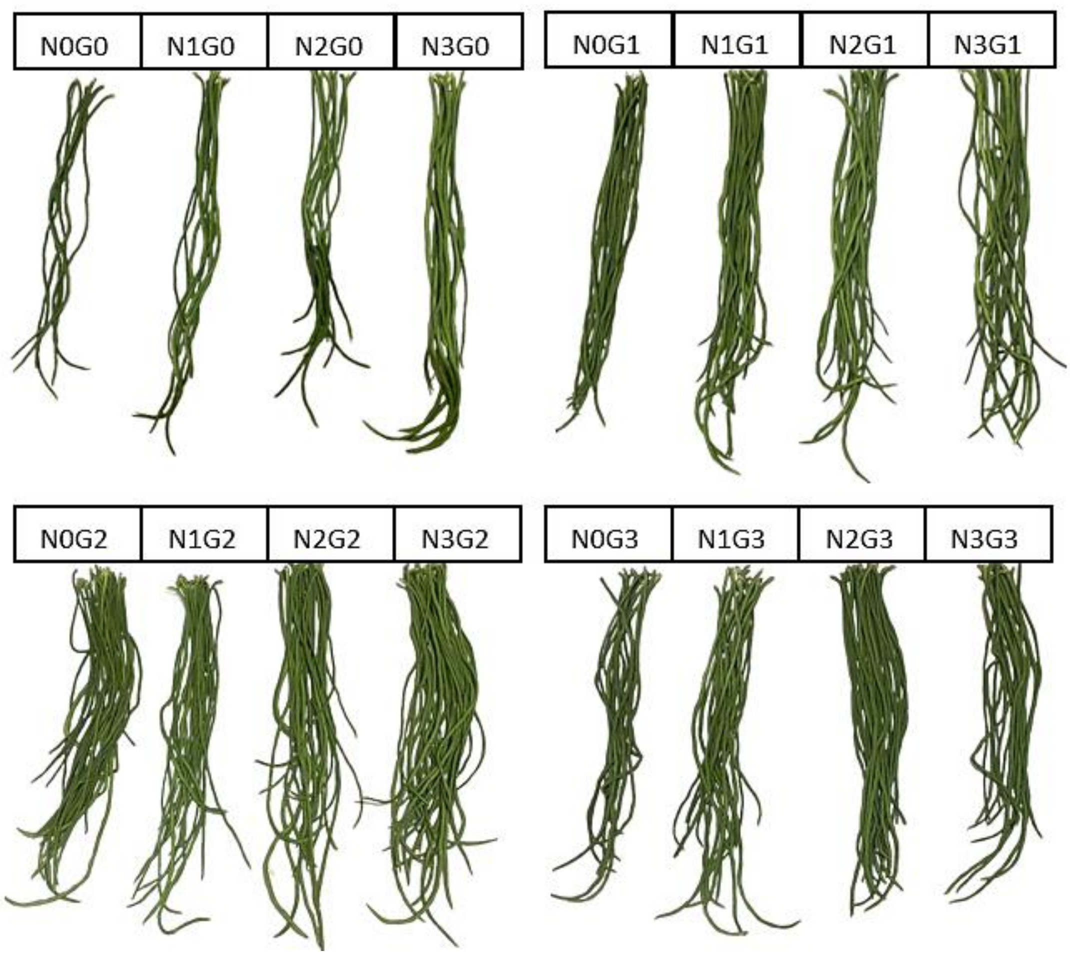

Figure 8. Long Bean Samples Between Treatments

4. Conclusion

The combination of NPK and GA3 fertilizers significantly affected the growth and yield of long beans, as indicated by changes in plant length at 35 DAP, fruit set, and weight per pod. A single treatment of NPK 15 g/plant and GA3 at 100 -150 ppm also affected the growth and yield of long beans. The results of this study can provide an alternative combination of effective treatments, which can serve as a recommendation for farmers to increase long bean productivity efficiently.

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