

The Influence of POC Empty Bunch and NPK 17+17+17 Fertilizer on The Growth and Production of Long Bean Plants

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Abstract: The research was conducted from June to August 2023 in Nagori Sah Kuda Bayu Pasar Baru at an altitude of ± 136 m above sea level. The purpose of the research is to determine the effect of Empty Fruit Bunches (Janjang) and NPK fertilizer on the growth and production of long bean plants (*Vigna sinensis* L.). This research was conducted using a factorial randomized block design (RBD), consisting of two factors: The first factor is the application of Empty Bunches, which consists: T_0 =without the application of empty bunches, T_1 =2.4kg/plot, T_2 =4.8kg/plot, and T_3 =7.2kg/plot. The second factor is the addition of NPK fertilizer doses N_0 =without NPK fertilizer, N_1 =24g/plot, N_2 =48g/plot, N_3 =72g/plot. The parameters observed in this study include: Number of Leaves (Sheets) and Plant Height (cm) at 2, 4 and 6 WAP, Number of Fruits Per Sample Plant (Pods), Weight of Fruits Per Sample Plant (g), and Weight of Fruits Per Plot (kg). The research results indicate that the NPK 17+17+17 treatment significantly affected the Number of Leaves, Plant Height, Number of Fruits per Plant, Weight of Fruits per Plant, and Weight of Fruits per Plot. The best dose of NPK fertilizer 17+17+17 is 150 kg/ha (72 g/plot).

Keywords: Empty bunch; Leaf; Pods; Weight of fruit

Introduction

The long bean plant (*Vigna sinensis* L.) originates from India and Central Africa. This plant belongs to the papilionaceae family, grows and spreads in tropical climate regions of Asia, and has many varieties, adapted to its growing environment. In an effort to improve public nutrition, long beans are important as a source of vitamins and minerals. This vegetable is rich in vitamins A, B, and C, especially in the young pods. In its seeds, it contains a lot of protein, fat, and carbohydrates, making this commodity one of the quite potential sources of plant-based protein (Lubis, 2018).

Long beans are a type of vegetable with high nutritional content and are highly favored by the community. In recent years, there has been a high demand for long beans both domestically and internationally, which has not yet been met. However, the cultivation of long beans has not been carried out

intensively, even though the demand for this commodity is increasing and export opportunities are also opening up. Long beans are a vegetable that is widely known in Indonesia. Long beans contain a fairly complete range of nutrients, including 50 kcal, 3.40 g of protein, 0.40 g of fat, 8.50 mg of carbohydrates, 106 mg of calcium, 63 mg of phosphorus, 1.40 mg of iron, and 295 mg of vitamin A (Andrianto, 2018).

Based on data from the BPS (2017), the production of long beans continued to decline from 2017 to 2019. In 2017, the total reached 381,185 tons/ha, 370,202 tons/ha in 2018, and 352,700 tons/ha in 2019. Then it experienced an increase again in 2020 and 2021 with totals of 359,158 tons/ha and 383,685 tons/ha.

The decline in long bean production in Indonesia is caused by the decreasing cultivation land and climate factors such as rising temperatures in long bean cultivation. Empty fruit bunches (EFB) are solid waste produced by palm oil mills during the processing of

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palm fruit bunches into crude palm oil (CPO). In every processing of 6 tons of fruit bunches, 20-24% empty fruit bunches are produced. The benefits of empty fruit bunches as organic fertilizer include their ability to absorb and retain water, thereby maintaining soil moisture. Other benefits include their ability to prevent and reduce soil erosion caused by rainwater movement on steep land and to suppress weed growth (Wirayuda & Ningsih 2022).

Empty palm oil bunches also contain several nutrients needed by plants. The use of empty palm oil bunches can increase the organic matter content of the soil, which is necessary for improving the physical, chemical, and biological properties of the soil. The increase in organic matter in the soil leads to better soil structure and improved water retention capacity. The improvement in soil physical properties also positively impacts root growth and nutrient absorption in the soil. Empty Palm Fruit Bunches are very rich in organic matter, averaging 1.5% Nitrogen (N), 0.5% Phosphorus (P), 7.3% Potassium (K), 0.9% Magnesium (Mg), and micro-nutrients such as Calcium (Ca) (Haitami, 2019).

NPK fertilizer is a fertilizer that contains three essential macronutrients for plants, namely N, P₂O₅, and K₂O. In addition to these three important elements, there are also several added micronutrients such as chloride, iron, manganese, calcium, magnesium, sulfur, and others. The general benefit of NPK fertilizer is to help plant growth so that it develops optimally. Each nutrient in NPK fertilizer has a different role in aiding plant growth. The completeness of its contents makes the function of NPK fertilizer a very good choice for enhancing plant growth and productivity.

Based on the above description, the author is interested in conducting research on "The Effect of Empty Bunches (Janjang) and NPK Fertilizer on the Growth of Long Bean Plants (*Vigna sinensis* L.)".

Method

This research was conducted in Nagori Sah Kuda Bayu Pasar Baru, Gunung Malela District, Simalungun Regency, at an altitude of approximately 136 meters above sea level, from June to August 2023. The materials used in this research included certified long bean seeds with the trade name Cap Panah Merah, variety Parade Tavi, NPK fertilizer 17+17+17 (Kuda Sakti), empty palm oil fruit bunches (Tankos), chicken manure, bamboo, plastic rope/trellis rope, contact herbicide (Gramoxone), fungicide Antracol 70WP, insecticide Lannate 40 SP, and zinc plate. The tools used in this research include a hoe,

machete, measuring tape, rake, scale, writing materials, watering can, and other necessary tools.

The experimental design used in this study is a Factorial Randomized Block Design, which consists of 2 factors, where the first factor is the application of Empty Fruit Bunches of Oil Palm and the second factor is the application of NPK fertilizer 17+17+17, with 16 combinations and 3 replications. The first factor is T0: Without empty palm bunches, T1: Empty palm bunches 5 tons/ha (2.4 kg/plot), T2: Empty palm bunches 10 tons/ha (4.8 kg/plot), T3: Empty palm bunches 15 tons/ha (7.2 kg/plot). The second factor is NPK Fertilizer: N0: Without NPK fertilization, N1: NPK fertilizer 50 kg/ha (24 g/plot), N2: NPK fertilizer 100 kg/ha (48 g/plot), N3: NPK fertilizer 150 kg/ha (72 g/plot). The parameters observed in this study include: Number of Leaves at 2, 4, and 6 WAP, Plant Height (cm) at 2, 4, and 6 WAP, Number of Fruits Per Sample Plant (pods), Fruit Weight per Sample Plant (g), Fruit Weight Per Plot (kg).

Result and Discussion

Number of leaves

The results of the analysis of variance show that the application of empty fruit bunches, the interaction of empty fruit bunches and NPK fertilizer 17+17+17, did not significantly differ in the number of long bean leaves at 2, 4 and 6 WAP. The treatment with NPK fertilizer 17+17+17 significantly differed at 2, 4 and 6 WAP. Table 1 shows that the treatment with empty fruit bunches on the number of leaves at 2, 4 and 6 WAP was highest in treatment T3, which had (17.67 leaves), (30.90 leaves), and (57.88 leaves), and did not significantly differ from other treatments.

According to Aslamiah (2017), organic fertilizers generally contain relatively small amounts of nutrients and are usually slow to become available in the soil, resulting in a delayed release of nutrients. This slow release of nutrients causes the availability of nutrients in the soil to be insufficient to support plant growth.

Figure 1 shows that the highest number of leaves is found in T3 (17.67 leaves), (30.90 leaves), (57.88 leaves) and the lowest in T0 (15.96 leaves), (28.33 leaves), and (53.94 leaves). This indicates that the higher the dose of empty fruit bunches given, the more leaves of the long bean plants are produced. The results of this study indicate that the application of empty fruit bunches at 2, 4 and 6 WAP not significant because the empty fruit bunches were not yet able to provide nutrients to the plants maximally to meet their nutritional needs and had not yet affected the physical properties of the soil.

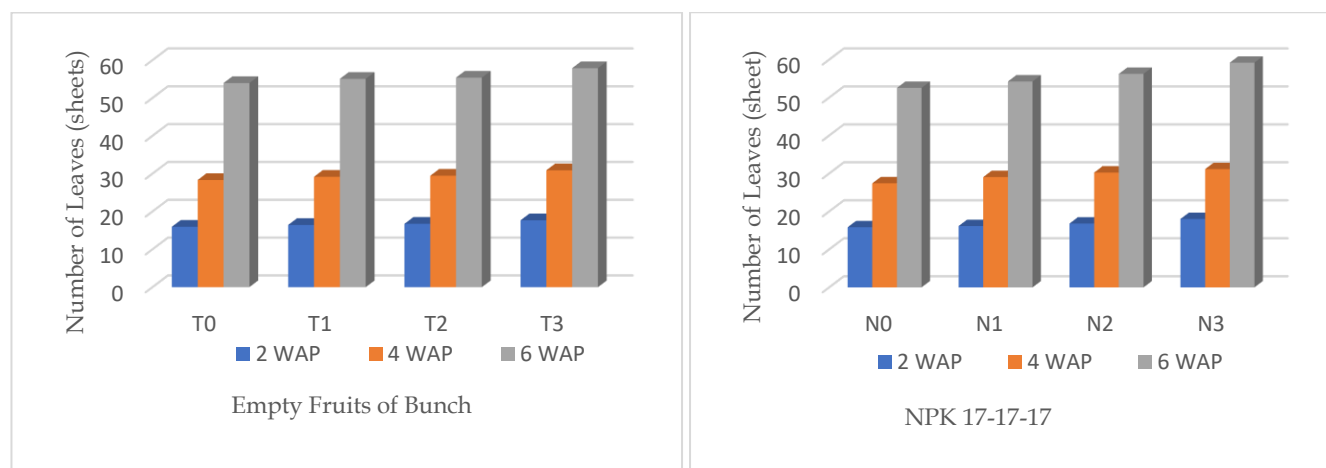


Figure 1. Histogram of Average Number of Leaves Due to the Application of Empty Bunches and NPK Fertilizer 17+17+17 at 2 WAP, 4 WAP, 6 WAP.

Figure 1 shows that the highest number of leaves is found in N₃ (18.02 leaves), (31.15 leaves), (59.19 leaves) and the lowest is found in N₀ (15.83 leaves), (27.42 leaves), and (52.56 leaves).

Table 1 shows that in the treatment with NPK 17+17+17 fertilizer, the highest number of leaves at 2, 4 and 6 WAP was found in the N₃ treatment (18.02 leaves),

(31.15 leaves), and (59.19 leaves), which were significantly different from the other treatments. According to Nariratih (2013), plants can grow well in soil that can provide nitrogen nutrients quickly at the beginning of growth, where nitrogen is needed from the early growth stage until the production period.

Table 1. Average Leaf Count Difference Test (Sheets) with the Application of Empty Bunches (Bunches) and NPK Fertilizer at 2 WAP, 4 WAP, and 6 WAP

Treatment	Number of Leaves			Plant Height		
	2 WAP	4 WAP	6 WAP	2 WAP	4 WAP	6 WAP
T0	15,96	28,33	53,94	23,48	125,42	173,65
T1	16,44	29,19	55,06	23,55	126,41	187,67
T2	16,75	29,46	55,38	23,59	128,06	191,51
T3	17,67	30,90	57,88	23,82	128,23	197,16
N0	15,83 b	27,42 b	52,56 b	21,99 b	124,52 b	172,65 c
N1	16,15 b	29,06 ab	54,25 b	23,21 b	126,11 ab	180,15 bc
N2	16,81 ab	30,25 a	56,25 ab	24,10 ab	128,24 a	193,78 ab
N3	18,02 a	31,15 a	59,19 a	25,13 a	129,25 a	203,40 a
BNT 5%	1,57	2,58	3,71	2,16	3,52	20,85
T0N0	15,08	26,58	50,50	22,46	122,47	160,58
T0N1	15,42	27,75	52,75	22,72	123,14	161,88
T0N2	16,67	29,08	54,50	23,33	127,43	185,44
T0N3	16,67	29,92	58,00	25,40	128,63	186,70
T1N0	15,50	25,83	51,50	21,33	123,76	168,31
T1N1	15,50	29,67	53,50	23,34	126,33	183,38
T1N2	15,58	30,17	56,25	24,07	127,43	192,78
T1N3	19,17	31,08	59,00	25,44	128,14	206,22
T2N0	15,92	27,67	52,50	22,02	126,09	170,23
T2N1	16,58	28,83	54,25	23,78	127,49	188,43
T2N2	16,67	30,25	56,00	24,13	128,75	197,83
T2N3	17,83	31,08	58,75	24,41	129,91	209,54
T3N0	16,83	29,58	55,75	22,13	125,75	191,49
T3N1	17,08	30,00	56,50	23,00	127,50	186,91
T3N2	18,33	31,50	58,25	24,88	129,34	199,08
T3N3	18,42	32,50	61,00	25,28	130,31	211,14

Note: Numbers followed by different notations in the same column are significantly different at the BNT 5% level.

Plant Height

The results of the analysis of variance for the empty fruit bunch treatment and the interaction between the empty fruit bunch and NPK 17+17+17 fertilizer showed no significant difference in plant height at 2, 4 and 6 WAP. The NPK 17+17+17 fertilizer treatment showed a significant difference in plant height at 2, 4 and 6 WAP.

Table 1 shows that in the empty fruit bunch treatment, the highest plant heights at 2, 4 and 6 WAP were found in treatment T3, which were (23.82 cm), (128.23 cm), and (197.16 cm), respectively, and these were not significantly different from the other treatments. This is because empty fruit bunches cannot

be effectively absorbed by the soil and plants, thus they cannot contribute to the improvement of plant growth.

Table 1 shows that in the treatment with NPK 17+17+17 fertilizer, the highest plant heights at 2, 4 and 6 WAP were found in treatment N₃, which were (25.13 cm), (129.25 cm), and (203.40 cm), significantly different from other treatments. This is because the plants are able to optimally absorb the nutrients contained in the NPK 17+17+17 fertilizer, allowing the plants to meet the nutrient needs required by both the soil and the plants.

According to Afandi, (2015), the addition of organic materials containing N will affect the total N content and help activate plant cells and maintain the process of photosynthesis, which in turn can influence the height growth of the plants.

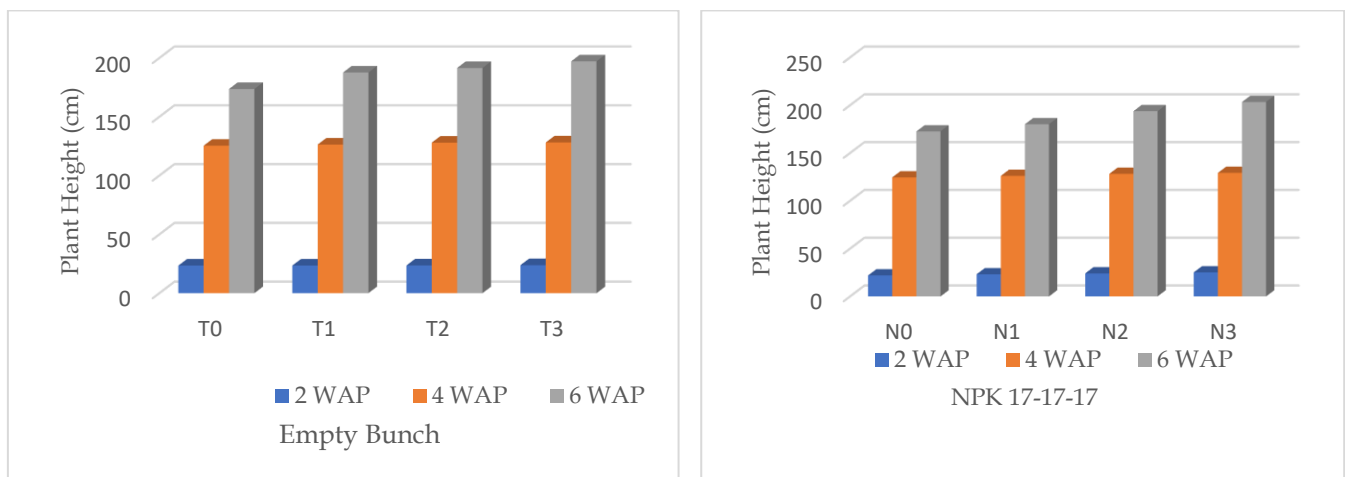


Figure 2. Histogram of Average Plant Height (cm) Due to the Application of Empty Bunches and NPK Fertilizer 17+17+17 at 2 WAP, 4 WAP, 6 WAP.

Figure 2 shows that the tallest plant height is found in T3 (23.82 cm), (128.23 cm), (197.16 cm), and the shortest is found in T0 (23.48 cm), (125.42 cm), and (173.65 cm).

The results of this study indicate that the treatment of empty fruit bunches at at 2, 4 and 6 WAP did not significant affect plant height because the empty fruit bunches had not yet reacted or provided the nutrients needed by the plants. According to Zubaidah, (2007) phosphorus nutrients are necessary for plant stem formation and stimulate vegetative growth in plants, such as stem girth, height, and an increase in the number of leaves.

Figure 2 shows that the tallest plants are found in N3 (25.13 cm), (129.25 cm), and (203.40 cm), while the shortest are in N0 (21.99 cm), (124.52 cm), and (172.65 cm).

The results of the study in Table 1 show that the interaction treatment of empty fruit bunches and NPK fertilizer 17+17+17 at the ages of 2, 4 and 6 WAP did not significant in plant height. This is because the doses of

both fertilizers could not promote plant height growth due to the application of lower dosage levels, or the available nutrients could not be fully absorbed by the plant roots, resulting in both treatments having the same effect.

Number of Fruits Per Plant (Pods)

The results of the analysis of variance on the number of fruits per sample plant showed no significant difference due to the application of empty fruit bunches and the interaction between empty fruit bunches and NPK fertilizer 17+17+17. The treatment with NPK fertilizer 17+17+17 showed a significant difference in the number of fruits per sample plant.

According to Panjaitan, (2015), the proper dosage application on plants can encourage plant growth and enhance plant metabolism. This is in accordance with Fathin, (2019) opinion, which states that the plant's response to fertilization will increase if the application of fertilizer is in accordance with the appropriate dosage, timing, and method.

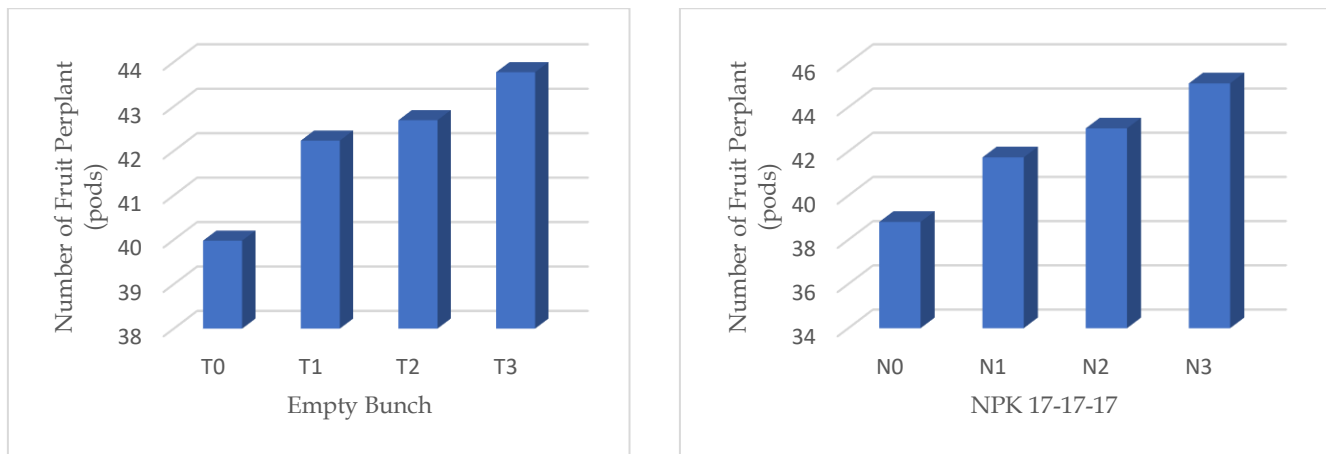


Figure 3. Histogram of Average Number of Fruits Per Plant (Pod) Due to the Application of Empty Bunches and NPK Fertilizer

Figure 3 shows that the highest number of fruits per sample plant is found in T3 (43.77) and the lowest in T0 (39.98). This indicates that the higher the dose of empty fruit bunches given, the more fruit is produced. The results of this study indicate that higher doses of NPK 17+17+17 fertilizer can be effectively utilized and absorbed by the plants, thereby increasing the number of fruits on the plants. NPK 17+17+17 fertilizer contains a complete set of nutrients that function in the processes of flower, fruit, and seed formation. The more fruits produced, the heavier the fruits of the plants will be.

In accordance with the statement by Munir & Swasono, (2012), the N element plays an important role in the formation of green leaves and is very useful in the process of photosynthesis, forming proteins, fats, and other organic compounds. The P element also plays an important role in the formation of fruits and seeds and is equally important as the K element, which plays a significant role in the formation of carbohydrates and proteins. Therefore, it can be concluded that the N, P, and K nutrients are interconnected in fulfilling the nutrients needed by the plants, thereby improving the quality and production, including the number of pods on the plants.

Figure 3 shows that the highest number of fruits per sample plant is found in N3 (45.08) and the lowest in N0 (38.81). This indicates that the higher the dose of NPK 17+17+17 fertilizer given, the more fruit per plant is produced.

The results of this study show that the interaction of the number of fruits per sample planting is not significant. This is because the long bean plants have not yet been able to optimally absorb nutrients from both treatments to influence each other (Table 1)

Weight of Fruit Per Plant (g)

The results of the analysis of variance for fruit weight per plant show that the treatment with empty bunches did not significantly differ from the sample's

fruit weight per plant. The treatment with NPK fertilizer 17+17+17 significantly differed from the sample's fruit weight per plant. The interaction treatment of empty bunches and NPK fertilizer 17+17+17 did not significantly differ from the sample's fruit weight per plant.

Table 2. Results of the Average Difference Test for the Number of Fruits Per Plant (pods), Weight of Fruits Per Plant (g), and Weight of Fruits Per Plot with the Application of Empty Bunches (EFB) and NPK Fertilizer.

Treatment	Number of Fruit Perplant	Weight of Fruit Perplant	Weight of Fruit Perplot
T0	39,98	706,63	11,66
T1	42,23	715,75	11,81
T2	42,69	729,04	12,03
T3	43,77	752,63	12,52
N0	38,81 c	673,88 c	11,06 c
N1	41,73 b	708,33 b	11,50 b
N2	43,04 ab	732,17 ab	12,12 ab
N3	45,08 a	789,67 a	13,34 a
BNT 5%	4,23	80,33	1,36
T0N0	37,17	644,17	11,00
T0N1	38,67	703,83	11,27
T0N2	39,92	729,83	11,84
T0N3	44,17	748,67	12,54
T1N0	38,50	661,00	11,01
T1N1	41,83	698,33	11,38
T1N2	43,83	727,33	12,08
T1N3	44,75	776,33	12,76
T2N0	39,00	689,67	11,04
T2N1	42,92	709,00	11,67
T2N2	44,00	731,17	12,10
T2N3	44,83	786,33	13,31
T3N0	40,58	700,67	11,17
T3N1	43,50	722,17	11,69
T3N2	44,42	740,33	12,45
T3N3	46,58	847,33	14,75

Note: Numbers followed by different notations in the same column are significantly different at the BNT 5% level

Table 2 shows that the treatment of empty fruit bunches on the weight of fruit per plant sample of long beans was not significantly different. The treatment of NPK fertilizer 17+17+17 was significantly different from the weight of fruit per plant sample of long beans. The interaction between the treatment of empty fruit bunches and NPK 17+17+17 was not significantly different from the weight of fruit per plant sample of long beans.

Table 2 shows that the treatment of empty fruit bunches with the highest weight of fruit per plant sample was found in treatment T3, which was (752.63 g) and was not significant from other treatments. This is because empty fruit bunches cannot be effectively absorbed by the soil and plants, thus they cannot

contribute to the increase in fruit weight per sample plant. Therefore, this research ensures that the plants can receive the required amount of nutrients.

The results of this study indicate that increasing the dosage of empty fruit bunches can enhance fruit weight during plant growth. The more nutrient availability in the soil, the more it can fertilize the soil and not leave significant residues for the plants themselves, also enhancing growth, which can affect the fruit weight production in long bean plants.

Al Amin et al., (2017) state that if the availability of nutrients is sufficient, the photosynthesis process will run smoothly, allowing assimilation to be translocated to all parts of the plant, ultimately resulting in an increase in the weight of the plant.

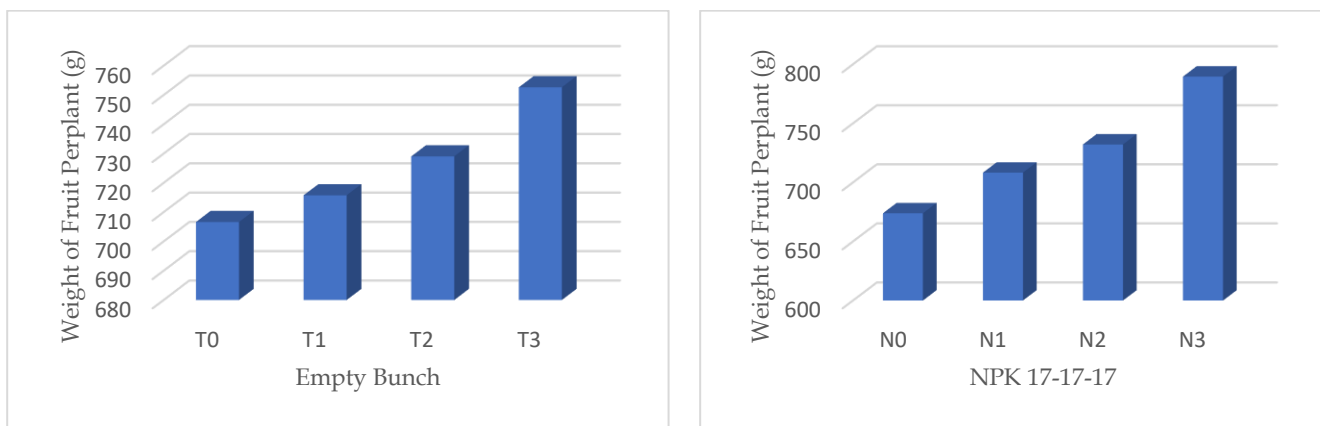


Figure 4. Histogram of Average Weight of Fruits Per Plant (g) Due to the Application of Empty Bunches and NPK Fertilizer

Figure 4 shows that the highest fruit weight per sample plant is found in treatment T3 (752.63 g) and the lowest in treatment T0 (706.63 g). The results of this study indicate that higher doses of NPK 17+17+17 fertilizer are utilized and absorbed well by the plants, thereby increasing the weight of fruit. NPK 17+17+17 fertilizer contains a complete set of nutrients essential for the formation of flowers and pods. The function of several of these nutrients plays an important role in plant growth, facilitating the photosynthesis process and the formation of carbohydrates and proteins, which are then transferred to the plant pods, resulting in an increased number of pods and heavier pod weight.

Munir & Swasono, (2012) state that the N element plays an important role in the formation of green leaves and is very useful in the photosynthesis process, forming proteins, fats, and other organic compounds. Element P also plays an important role in the formation of fruits and seeds and is no less important than the element K, which has a significant role in the formation of carbohydrates and proteins. Therefore, it can be concluded that the nutrients N, P, and K are interconnected in fulfilling the nutrients needed by

plants, thereby improving quality and production, including fruit weight in plants.

Figure 4 shows that the highest fruit weight per plant was found in the N3 treatment (789.67 g) and the lowest in the N0 treatment (673.88 g). This indicates that the higher the dose of NPK 17+17+17 given, the heavier the fruit per sample plant produced.

The treatment with empty bunches and NPK 17+17+17 did not show a significant difference in fruit weight per plant. This is because the doses of both fertilizers could not promote the growth of fruit weight per sample plant due to the application of lower dosage levels, or the available nutrients could not be absorbed by the plant roots perfectly, resulting in both treatments having the same effect.

Weight of Fruits Per Plot

The results of the analysis show that the treatment with empty bunches did not significantly differ in terms of fruit weight per plot, whereas the treatment with NPK fertilizer 17+17+17 significantly differed in terms of fruit weight per plot. The interaction treatment between empty bunches and NPK fertilizer 17+17+17 did not

significantly differ in terms of fruit weight per plot produced by the long bean plants.

Table 2 shows that the treatment with empty fruit bunches for the highest fruit weight per plot was found in treatment T3, which was (12.52 kg) and did not significantly differ from other treatments. It also shows that the highest conversion of fruit weight per plot was produced by treatment T3 (26.08 tons/ha) with a dose of 7.2 kg/plot.

The results of this study indicate that the increasing application of empty fruit bunches can enhance the weight of fruit per plot in long bean plants. This is because empty fruit bunches can enhance growth and production, as they contain nutrients that are beneficial for the soil, which play a crucial role in the plant growth process. According to Munir & Swasono, (2012) if the plants lack nitrogen (N), their growth will be hindered, the plants will appear thin, protein production in the formation of new cells will be inhibited, and growth will proceed slowly due to the inhibited formation of chlorophyll caused by nitrogen deficiency.

The results of this study indicate that the application of higher doses of NPK 17+17+17 fertilizer can increase the weight of long bean fruits. NPK 17+17+17 contains a complete set of nutrients such as N, P, and K, which play a role in the formation of flowers, fruits, and seeds, being one of the main factors in the fruit weight of the plant.

The N element plays an important role in the formation of green leaves and is very useful in the

process of photosynthesis, forming proteins, fats, and other organic compounds. According to Zubaidah, (2007), the nutrient element P plays an important role in stimulating root growth, flower formation, fruit, and seed development. The K element plays a significant role in the formation of carbohydrates and proteins.

Therefore, it can be concluded that the nutrients N, P, and K are interconnected in fulfilling the nutrient requirements of plants, thereby enhancing the quality and production of the plants. High production is suspected because the plants can utilize the available N, P, and K nutrients in the soil.

Figure 5 shows that the highest fruit weight per plot is found in the N3 treatment (13.34 kg) and the lowest in the N0 treatment (11.06 kg).

The results of this study indicate that the influence of empty fruit bunches and NPK fertilizer 17+17+17 has not yet been able to interact well with each other because the nutrient content available in the empty fruit bunches and NPK fertilizer 17+17+17 is not sufficient and cannot be effectively utilized by the plants.

Mulyani & Syukri, (2017) says that plants will grow well if the nutrients needed are sufficiently available and balanced. The high generative growth in plants is closely related to the availability of microbial elements in the soil as well as nutrient elements in the soil, which determine the plant's weight production resulting from the accumulation of assimilates thru the processes of photosynthesis, respiration, and the accumulation of organic compounds (Safitri, 2020).

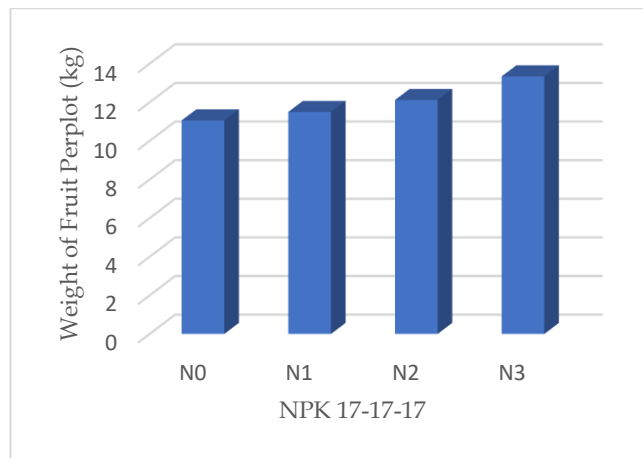
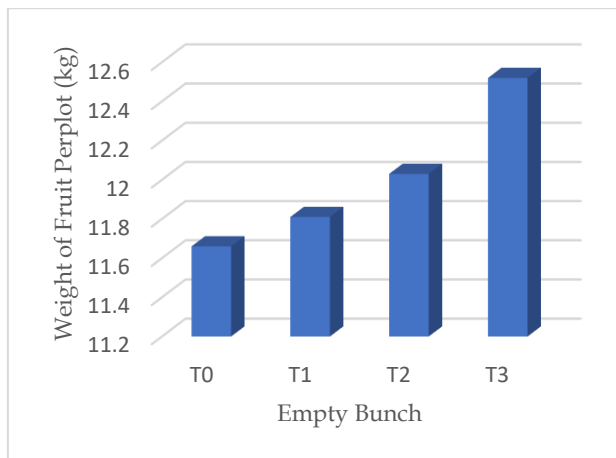


Figure 5. Histogram of Average Weight of Fruits Per Plant (kg) Due to the Application of Empty Bunches and NPK Fertilizer

According to Panjaitan, (2015) the application of nutrients thru fertilizers within certain limits has a significant effect, but too little application has no effect, while excessive application can cause toxicity. Figure 5 shows that the highest fruit weight per plot is in the T3N3 treatment (14.75 kg) and the lowest is in the T0N0 treatment (11.00 kg).

Conclusion

The application of empty fruit bunches (EFB) did not significantly affect the number of leaves, plant height, number of fruits per sample plant, fruit weight per plant, or fruit weight per plot. However, the best dose of empty fruit bunches (EFB) was obtained at 15 tons/ha (7.2 kg/plot). In contrast, the application of

NPK fertilizer 17+17+17 significantly affected the number of leaves, plant height, number of fruits per sample plant, fruit weight per plant, and fruit weight per plot, with the best dose achieved at 150 kg/ha (72 g/plot). Furthermore, the interaction between empty fruit bunches (EFB) and NPK fertilizer 17+17+17 did not significantly affect all observed parameters. Nevertheless, the best treatment combination was obtained from the application of empty fruit bunches at 15 tons/ha (7.2 kg/plot) combined with NPK fertilizer 17+17+17 at 150 kg/ha (72 g/plot).

Author Contributions

The author have made a major contribution to the completion of this manuscript.

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Conflicts of Interest

Declare conflicts of interest or state "The authors declare no conflict of interest."

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