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Increasing Red Onion Plant (*Allium ascalonicum* L) Growth and Production by Providing Cascing and NPK 16.16.16. Fertilizer

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ABSTRACT

Riau Province relies on other regions, such as North Sumatra, West Sumatra, and Java, for its needs. However, when natural disasters occur, or transportation disruptions happen from the sources of onion production, the price of shallots in the market increases. To reduce Riau companies' dependency on this raw material, it is necessary to develop shallot plants using optimal cultivation techniques to maximize growth and production. This research was conducted at the Experimental Garden of the Faculty of Agriculture, Pasir Pengaraian University, Rokan Hulu Regency, for three months from May 2022 to July 2022. The research utilized a completely randomized factorial design with two factors. The first factor involved the application of Vermicompost Fertilizer, with four treatment levels: 0. 200. 400. and 600 g/plot. The second factor involved the application of NPK 16.16.16 fertilizer with four treatment levels: 0. 10. 20. and 30 g/plot. The parameters observed included plant height, harvest age, number of tubers per cluster, tuber weight per bulb, wet tuber weight per cluster, dry tuber weight, and percentage of tuber weight loss. The research results indicated that the interaction between vermicompost fertilizer and NPK 16.16.16 fertilizer had a significant impact on plant height, harvest age, number of tubers per cluster, number of tubers per tuber, wet tuber weight per cluster, and dry tuber weight per cluster. The best treatment was a combination of Vermicompost 600 g/plot and NPK 16.16.16 30 g/plot. The main effect of the Vermicompost Fertilizer application was significant for all observation parameters, and the main effect of NPK 16.16.16 also had a significant impact on all observation parameters.

Keywords***:*** *Shallots, Vernucinoist, NPK 16. 16.16., Production, Growth*

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1. INTRODUCTION

Shallots, a staple in the daily lives of Indonesians, serve as a vital rural commodity. In addition to their culinary uses, shallots are also employed in traditional medicine. They are often utilized as a spice, following chilies. They can be sold or processed into various forms, such as spices, essential oils, fried onions, and even medicinal products, to reduce cholesterol levels in the blood and improve overall cardiovascular health (Suriani, 2012).

Irianto (2020) highlights the nutritional composition of shallots, stating that for every 100 grams, they consist of approximately 80-85% water, 1.5% protein, 0.3% fat, and 9.2% carbohydrates. Shallots also contain essential minerals like iron, potassium, phosphorus, ascorbate acid, nisin, Flavin essence, vitamin B, and vitamin C (Irianto, 2010).

Based on data provided by the National Statistics Agency in 2017. the production of shallots amounted to 964.221 tonnes. Subsequently 2018. there was an increase in shallot production, reaching 1.010.773 tonnes. The year 2019 witnessed a further rise in production, with 1.235.801 tonnes of shallots being produced. In 2020. the production slightly decreased to 1.229.184 tonnes, but in 2021. it rebounded significantly, reaching 1.446.860 tonnes. As the production of shallots continues to grow on small islands, Indonesia has become self-sufficient in meeting its domestic demand, eliminating the need for importing shallots from other countries (Badan Pusat Statistik, 2021).

In the province of Riau, one of the contributing factors to the variation in shallot production is the unfavorable soil conditions and inadequate nutrition resulting from continuous farming practices. Implementing suitable agricultural technologies becomes crucial to address this issue and enhance shallot yields. These technologies can be employed in shallot cultivation to compensate for the limited availability of nutrients through effective fertilization methods.

Organic fertilizer, in addition to artificial fertilizer, is considered the most effective and environmentally friendly method of enhancing soil quality. Generally, organic fertilizers have lower levels of long-term nutrients such as nitrogen (N), phosphorus (P), and potassium (K). Still, they contain limited other essential nutrients required for plant growth. One of the advantages of organic fertilizer is its ability to prevent erosion, soil surface movement, and soil cracks and maintain soil moisture levels (Sutanto, 2005).

Vermicompost, a type of organic fertilizer derived from the decomposition of organic matter by worms, is particularly beneficial for promoting plant growth and improving soil fertility. It contains various components necessary for plant development, including hormones like gibberellins, cytokinins, and auxins. Additionally, vermicompost contains essential nutrients such as nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg), and calcium (Ca). Furthermore, it also contains non-symbiotic nitrogen-fixing bacteria, such as Azobacter sp, which aids in enriching the soil with vital elements required by plants.

The utilization of organic fertilizer should be carefully balanced alongside the application of inorganic fertilizer. One notable example of the latter is NPK 16:16:16 fertilizer. NPK 16:16:16

Fertilizer assumes a significant role in numerous metabolic processes within plants. Nitrogen (N) serves the purpose of promoting overall plant growth. Phosphorus (P) facilitates the transfer of energy, such as ADP and ATP, within plant cells and encourages the development of young plant roots. On the other hand, potassium (K) fortifies plant tissue, preventing premature shedding of flowers and leaves and redirecting the synthesis of carbohydrate proteins to other plant organs (Hendri, 2015).

2. MATERIAL AND METHODS

This research was conducted at the Experimental Garden of the Faculty of Agriculture, Pasir Pengaraian University, Rokan Hulu Regency. This research was carried out for three months, from May 2022 to July 2022.
The materials used in this research were red onion seeds of the Bima variety, vermicompost fertilizer, NPK 16.16.16. and Dhitane M-45 manure. Meanwhile, the tools used are hoes, machetes, stainless knives, raffia rope, Gembor, a camera, measuring tape, a bucket, a hand sprayer, a zinc plate, and writing utensils.

The present study employed a factorial completely randomized design (CRD) comprising two factors. The first factor involved the application of vermicompost fertilizer (K) with four different levels, while the second factor consisted of NPK 16.16.16 (N) fertilizer with four different levels. This resulted in 16 treatment combinations replicated three times, leading to 48 experimental units. Each experimental unit comprised six plants per plot, which were utilized as observation samples. Consequently, the study encompassed a total of 288 plants.

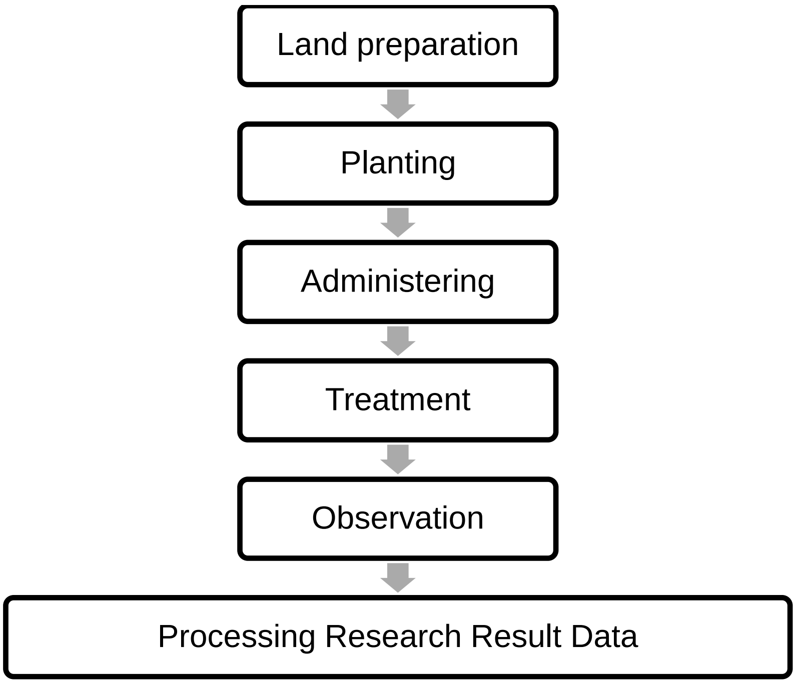

Figure 1. Research Flow Diagram

Data from observations of each treatment was analyzed statistically. If the F-count exceeds the F-table, proceed with the Honest Significant Difference Test (BNJ) at the 5% level.

3. RESULT AND DISCUSSION

3.1 Height of shallot plants

After analysis of variance, the observations of plant height showed that the main effect of applying vermicompost fertilizer and NPK 16:16:16 fertilizer had a real influence on shallot plant height. The results of the Honestly Significant Difference Test (BNJ) at the 5% level are shown in Table 1.

Table 1. The average height of shallot plants treated with vermicompost and NPK fertilizer was 16.16.16 (cm)

Vermicompost (g/plot)	NPK 16.16.16 Fertilizer (g/plot)				Mean
	N0 (0)	N1 (10)	N2 (20)	N3 (30)	
K0 (0)	35,53 g	36,60 g	37,50fg	39,47ef	37,28 d
K1 (200)	40,10 de	40,60 cde	41,23be	41,57be	40,88 c
K2 (400)	41,67 be	42,17 bcd	42,60bc	42,97bc	42,35 b
K3 (600)	42,53 bcd	43,00 bc	4,70b	46,40a	43,91 a
Mean	39,96 b	40,59 b	41,93 a	41,93 a	
CV= 2,00 %		Tukey T & N =0,90		Tukey TN=2,4	

Numbers in columns followed by the same lowercase letters are not significantly different according to the BNJ follow-up test at the 5% level.

According to the data presented in Table 1. it is evident that the interaction between the application of vermicompost fertilizer and NPK 16.16.16 fertilizer had a notable impact on the height of shallot plants. The highest plant height was observed when the vermicompost treatment was administered at a rate of 600 g/plot, in conjunction with NPK 16.16.16 fertilizer at 30 g/plot (referred to as K3N3), measuring 46.40 cm. This height is significantly different from the heights observed in the other treatments.

On the other hand, the lowest plant height was recorded in the treatment where no vermicompost treatment was applied, and NPK 16.16.16 fertilizer (referred to as K0N0) was not used. The average plant height in this combination was 35.53 cm.

Sumarni (2010) stated that the metabolic process of photosynthesis plays a crucial role in the growth and development of plants by producing energy to support their life cycle. The amount of energy generated through photosynthesis directly impacts the overall growth and development of plant organs. A well-functioning photosynthesis process produces substantial energy, which in turn promotes optimal growth and development of plant organs.

In a study conducted by Napitupulu and Winarno (2009), it was found that applying nitrogen can significantly enhance plant growth. This is attributed to the stimulation of chlorophyll formation and the resulting greener color of leaves. Additionally, nitrogen application also leads to an increase in the shoot-to-root ratio. Consequently, the application of nitrogen can effectively expedite the growth of plants.

3.2 Harvest Age

The results of observations of harvest age after analysis of variance showed that the interaction and main effects of vermicompost fertilizer and NPK 16.16.16 were significant on shallot harvest age. The results of the Honestly Significant Difference Test (BNJ) at the 5% level are shown in Table 2.

Table 2. Average age of shallot harvest with vermicompost and NPK fertilizer treatment 16:16:16 (days).

Vermicompost (g/plot)	NPK 16.16.16 Fertilizer (g/plot)				Mean
	N0 (0)	N1 (10)	N2 (20)	N3 (30)	
K0 (0)	64,67 j	63,67 hij	63,67 ij	63,33 g-j	63,84 c
K1 (200)	63,00 f-j	63,00 f-j	62,67 e-j	62,33 e-i	62,75 bc
K2 (400)	61,00 c-f	61,33 d-g	62,67 e-j	60,67 b-e	61,25 ab
K3 (600)	59,67 bcd	59,33 bc	59,00 b	55,33 a	58,33 a
Mean	62,09 b	61,83 ab	60,92 a	61,33 a	
CV = 1.30 %		Tukey T & N = 0.81		Tukey TN = 2.1	

Numbers in columns followed by the same lowercase letters are not significantly different according to the BNJ follow-up test at the 5% level.

According to the information presented in Table 2. it is evident that the combination of vermicompost fertilizer and NPK 16.16.16 fertilizer has a substantial impact on the harvest age of shallots. The application of 600 g/plot of vermicompost fertilizer and 30 g of NPK 16.16.16 fertilizer (K3N3) resulted in the shortest harvest age of 55.33 cm, significantly different from the other treatments.

On the other hand, the longest harvest time was observed when no vermicompost treatment and NPK 16.16.16 (K0N0) fertilizer were applied, with a harvest age of 64.67 DAP.

Harvest Age Treatment (K3N2), given with a weekly dose of vermicompost fertilizer at the correct dose, improves the physical and chemical properties of the soil, resulting in more plants that encourage vegetative growth to enter the generation phase. The supply of NPK fertilizer can increase root growth and provide nutrients.

According to Masciandro et al. (2015), vermicompost contains microbes that are beneficial to plants. Microbial activity helps in forming a stable soil structure.

3.3 Number of Tubers Per Clump (bulbs)

The results of observing the number of tubers per hill after analysis of variance showed that the interaction and main effects of vermicompost fertilizer and NPK 16.16.16 were significant on the number of tubers per hill. The results of the Honestly Significant Difference Test (BNJ) at the 5% level are shown in Table 3.

Table 3. Average number of bulbs per cluster of shallots treated with vermicompost and NPK fertilizer 16:16:16 (bulbs).

Vermicompost (g/plot)	NPK 16.16.16 Fertilizer (g/plot)				Mean
	N0 (0)	N1 (10)	N2 (20)	N3 (30)	
K0 (0)	5,10 l	5,40 kl	5,57 jkl	5,83 ijkl	5,48 d
K1 (200)	6,10 ijk	6,33 hijk	6,53 ghi	6,50 hij	6,37 c
K2 (400)	6,97 gh	7,33 g	8,93 f	10,20 e	8,36 b
K3 (600)	10,97 d	12,03 c	14,13 ab	14,23 a	12,84 a
Mean	7,29c	7,77b	8,82a	9,17b	
CV= 3,20 %		Tukey T & N =0,36		Tukey TN=1,0	

Numbers in columns followed by the same lowercase letters are not significantly different according to the BNJ follow-up test at the 5% level.

Based on the data in Table 3 shows that the interaction between the vermicompost fertilizer treatment and NPK 16.16.16 had a real influence on the number of bulbs per cluster of shallots, where the highest number of tubers per cluster was found in the treatment of vermicompost 600 g/plot and NPK 16.16.16 fertilizer 30 g / plot (K3N3), namely: 14.23 tubers, this treatment was not significantly different from the K3N2 treatment. Still, it was significantly different from the other treatments.

The lowest number of tubers was produced by a combination of treatment without vermicompost and NPK 16.16.16 (K0N0) with several tubers 5.10.

Munawar's opinion (2011). Nutrient availability and improved soil properties are critical for taller plants' clump and root growth. This is because bulbs produce onions that undergo differentiation and enlargement as a reservoir for photosynthetic carbohydrates. Shallots are made from the roots of the lumps that appear because, generally, each lump produces a bulb with 3-5 shallots.

Vermicompost is composed of various essential components for plant growth. These include hormones like gibberellin, cytokinin, and auxin, as well as nutrients such as nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg), and calcium (Ca). Additionally, it contains Azotobacter sp, a non-symbiotic nitrogen-fixing bacteria that aids in enriching the necessary nitrogen elements required by plants (Krishnawati, 2013).

According to Mulyadi (2007), macro elements, particularly nitrogen (N), contribute to the growth of plants. Phosphorus (P) plays a crucial role in root formation, strengthening plant stems, and increasing crop yields. Furthermore, potassium (K) is beneficial in fortifying the overall plant structure preventing premature leaf, flower, and fruit drop.

3.4 Tuber Weight Per Bulb (grams)

The results of observing the weight of tubers per tuber after carrying out an analysis of variance showed that the interaction and main effects of vermicompost fertilizer and NPK 16.16.16 were significant on the weight of tubers per tuber. The results of the Honestly Significant Difference Test (BNJ) at the 5% level are shown in Table 4.

Table 4. Average bulb weight per shallot bulb treated with vermicompost and NPK fertilizer 16:16:16 (g).

Vermicompost (g/plot)	NPK 16.16.16 Fertilizer (g/plot)				Mean
	N0 (0)	N1 (10)	N2 (20)	N3 (30)	
K0 (0)	3,03 f	3,38 cde	3,50 abcd	3,28 def	3,45 b
K1 (200)	3,35 cde	3,14 ef	3,28 def	3,65 abc	3,20 c
K2 (400)	3,42 bcde	3,62 abc	3,77 a	3,75 a	3,64 a
K3 (600)	3,51 abcd	3,52 abcd	3,70 ab	3,78 a	3,63 a
Mean	3,45 ab	3,42 b	3,53 ab	3,53a	
CV = 15,60 %		Tukey T & N = 0,54		Tukey TN= 1,48	

Numbers in columns followed by the same lowercase letters are not significantly different according to the BNJ follow-up test at the 5% level.

Based on the information presented in Table 4. it is evident that the combination of vermicompost fertilizer treatment and NPK 16.16.16 significantly impacted the weight of tubers per shallot bulb. The treatment with the highest tuber weight per tuber was observed in the vermicompost 600 g/plot and NPK 16.16.16 30 g/plot (K3N3) treatment, weighing 3.7 g. This treatment did not show a significant difference compared to the K3N2. K2N3. K2N2. K2N1. and K1N3 treatments, but it differed from the other treatments.

On the other hand, the lowest tuber weight per tuber was obtained from the treatment without vermicompost fertilizer and NPK 16.16.16 (K0N0), with a tuber weight of 3.03 tubers.

According to Masnur (2011), vermicompost offers the advantage of providing essential nutrients for plants, including N, P, K, Ca, Mg, S, Fe, Mn, AL, Na, Cu, Zn, Bo, and Mo, depending on the materials used. Additionally, vermicompost acts as a nutrient source for soil microbes, promoting their growth and enhancing the decomposition of organic matter.

According to Lactin (2011), the element potassium plays a role in increasing photosynthetic activity, which allows the collection of photosynthesis to be transferred to productive organs, especially for the formation of cilia. Rosema and Narshi (2005) suggested that root potassium plays a role in absorbing nutrients and water, which increases metabolism. Indrani (2007) suggested good N, P, and K nutrition, increasing fresh onions' weight.

3.5 Wet Tuber Weight Per Clump (g)

Observing the wet tuber weight per household after analysis of variance showed that the interaction and main effect of vermicompost fertilizer and NPK 16.16.16 was significant on the wet tuber weight per cluster. The results of the Honestly Significant Difference Test (BNJ) at the 5% level are shown in Table 5.

Table 5. Average wet tuber weight per cluster of shallot plants treated with vermicompost and NPK fertilizer 16:16:16 (g).

Vermicompost	NPK 16.16.16 Fertilizer (g/plot)				Mean
(g/plot)	N0 (0)	N1 (10)	N2 (20)	N3 (30)	
K0 (0)	33,49 h	36,36 h	38,44 gh	39,16 fgh	36,86 d
K1 (200)	38,28 fgh	41,75 fgh	44,99 efg	47,33 ef	43,09 c
K2 (400)	42,58 efg	46,71 efg	53,27 de	58,39 d	50,24 b
K3 (600)	70,00 c	86,28 b	94,24 ab	96,75 a	86,82 a
Mean	46,09 c	54,278 b	58,36 a	59,78 a	
CV= 5,20 %		Tukey T & N = 3.12		Tukey TN=8.61	

Numbers in columns followed by the same lowercase letters are not significantly different according to the BNJ follow-up test at the 5% level.

According to the data presented in Table 5. it is evident that the interaction between vermicompost and NPK 16.16.16 fertilizer treatments had a significant impact on the wet bulb weight per cluster of shallots. The highest weight per tuber was observed in the 600 g/plot vermicompost fertilizer and NPK 16.16.16 fertilizer. 30 g/plot (K3N3) treatment, explicitly measuring 96.75 g. This treatment did not show a significant difference compared to the K3N2 treatment but did differ from the other treatments.

On the other hand, the lowest tuber weight per tuber was recorded in the combination of treatment without vermicompost and NPK 16.16.16 (K0N0), with a wet tuber weight per cluster of 33.49 g.

According to Lingga (2010), the metabolic processes of plants are greatly influenced by the availability of essential elements, particularly nitrogen, phosphorus, and potassium, during both the vegetative and generative growth phases.

In addition, vermicompost can potentially enhance soil's chemical characteristics. It can enhance the soil's capacity to absorb cations, serving as a valuable source of macro and micronutrients. Furthermore, it can also elevate the pH levels in acidic soil. The utilization of vermicompost is anticipated to decrease the reliance on chemical fertilizers while promoting organic fertilizers. This, in turn, will contribute to reducing environmental pollution (Luh, 2015).

Adequate nitrogen content plays a crucial role in stimulating plant growth, producing a more significant number of tubers. This is because the fertility of plants directly impacts the quantity of tubers they yield (Wahyu, 2013).

3. 6 Dry Tuber Weight Per Clump (g)

Observing the weight of dry tubers per house after carrying out an analysis of variance showed that the interaction and primary effect of vermicompost fertilizer and NPK 16.16.16 was significant on the weight of dry tubers per house. The results of the Honestly Significant Difference Test (BNJ) at the 5% level are shown in Table 6.

Table 6. Average dry tuber weight per cluster of shallot plants with the influence of vermicompost fertilizer and NPK fertilizer 16:16:16 (g).

Vermicompost (g/plot)	NPK 16.16.16 Fertilizer (g/plot)				Mean
	N0 (0)	N1 (10)	N2 (20)	N3 (30)	
K0 (0)	26,28 i	26,50 gh	29,17 hi	32,24 hi	28,55 d
K1 (200)	34,69 hi	37,07 gh	42,33 fg	44,98 ef	39,77 c
K2 (400)	47,80 ef	52,93 de	62,87 bc	63,50 ab	56,78 b
K3 (600)	67,13 cd	67,91 bc	73,34 a	77,76 a	71,54 a
Mean	43,98 d	46,10 c	53,03 b	53,52 a	
CV= 6.60 %		Tukey T & N = 2.93		Tukey TN=8.03	

Numbers in columns followed by the same lowercase letters are not significantly different according to the BNJ follow-up test at the 5% level.

Based on the data in Table 6. it shows that the interaction between the vermicompost fertilizer treatment and NPK 16.16.16 had a real influence on the dry tuber weight per cluster of shallots, where the highest tuber weight per tuber was found in the 600 g vermicompost/plot and NPK 16.16.16 fertilizer treatment. 30 g/plot (K3N3), namely: 77.76 g. This treatment is not significantly different from the K3N2 and K2N2 treatments but differs from other treatments.

The lowest dry bulb weight per cluster of shallots was produced by a combination of treatment without vermicompost and NPK 16.16.16 (K0N0) with a wet bulb weight per cluster of 26.28.

The combination of vermicompost fertilizer and NPK 16.16.16 fertilizer can improve the soil, and potassium elements make dry material filler so that the tubers produced are high enough.

Vermicompost contains macro and micronutrients. Vermicompost usually contains nitrogen (N) 0.63%, phosphorus (P) 0.35%, potassium (K) 0.2%, calcium (Ca) 0.23%, manganese (Mn) 0.003%, magnesium (Mg) 0.26%, copper (Cu) 17 .58%, zinc (Zn) 0.007%, iron (Fe) 0.79%, molybdenum (Mo) 14.48%, organic matter 0.21%, CEC 35.80 me%, water holding capacity 41.23% and humic acid 13.88% (Mulat, 2016).

When converted to an area of 1 ha, the research results show that the weight of dry tubers obtained from treatment with K3N3 is approximately equivalent to the description of 21 tons/ha. In contrast, the average yield of the shallot variety of 9.7 tons/ha

Bima Brebes exceeds the production in the same way because rich compost and NPK 16.16.16 fertilizer can meet the nutritional needs of shallots during their growth. As demonstrated by Sudrajat et al. (2010), the dry tuber weight represents the quantity of dry substance accumulated during the growth process. It is worth noting that approximately 90% of the plant's dry matter is attributed to photosynthesis. By evaluating the growth analysis regarding dry tuber weight, one can assess the plant's ability to perform photosynthesis. Moreover, plant dry weight serves as a reliable indicator to determine the growth of seeds, as it effectively describes the efficiency of plant physiological processes.

4. CONCLUSION

1. The application of vermicompost fertilizer in combination with NPK 16.16.16 fertilizer has a notable impact on various aspects of plant growth and tuber production. These include plant height, harvest age, the number of tubers per cluster, the number of tubers per tuber, and the wet and dry tuber weights per cluster. The most effective treatment involves using 600 g/plot of vermicompost fertilizer and 30 g/plot of NPK fertilizer (K3N3).
2. The utilization of vermicompost fertilizer significantly influences plant height, harvest age, the number of tubers per hill, the number of tubers per tuber, and the wet and dry tuber weights per cluster. The optimal treatment involves applying 600 g/plot of vermicompost fertilizer (K3).
3. The application of NPK 16.16.16 fertilizer has a notable impact on plant height, harvest age, the number of tubers per hill, the number of tubers per tuber, and the wet and dry tuber weights per cluster. The most effective treatment involves 30 g/plot of NPK fertilizer (N3).

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