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Effect of Vermicompost and NPK Nitrophonska 15:15:15 on the growth and yield of Mung Beans (Vigna Radiata L.)

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ABSTRACT

The aim of this research was to determine the effect of combining vermicompost and NPK Nitrophonska 15:15:15 fertilizer on the growth and yield of mung beans (Vigna radiata L.). The research was carried out in May - July 2024 in Pancalang Village, Pancalan District, Kuningan Regency, West Java Province. The research method used was an experimental method using a Randomized Group Design (RAK). The main observations included plant height, number of trifoliate leaves (three leaflets), root length, root volume, root nodules, numbers of pods per plant, and seed weight per plot. The results showed that the combination of VermiCompost fertilizer (K1N2) and Nitrophonka NPK (K2N2) had a significant effect on plant height at 21.28 DAP and 32 DAP, respectively. The K2N2 treatment produced the best plant height (45.87 cm). The number of plant leaves was positively correlated with the number of leaflets on green bean plants (r = 0.466, p 0.05). The K1N2 treatments had the best results from several observation parameters, especially in the weight of seeds per plot in the treatment (4 kg vermisp. and 40 gr NPK).

INTRODUCTION

Mung beans are a plant from the legume family that is widely cultivated in Indonesia and ranks third after peanuts. mung beans have a relatively shorter harvest time so the risk of interference from biotic and abiotic factors is relatively small and the cultivation techniques are easy, making the mung beans commodity very prospective for development (Elisabeth et al., 2021).

Various factors cause a decrease in productivity, including low soil fertility, land conversion, unfavorable climatic factors and inappropriate cultivation techniques (Hastuti et al., 2018). To increase the growth and yield of mung bean plants, various efforts can be made, one of which is intensification, namely increasing plant production per unit area of land, one of which is by applying fertilizer which aims to increase the availability of nutrients in the soil (Barłóg et al., 2022; Dincă et al., 2022; Havlin, 2020; Selim, 2020; Singh et al., 2020).

Efforts that can be made to increase production of mung bean plants are by improving cultivation techniques, for example by using organic fertilizer and inorganic fertilizer. Organic fertilizer is the result of the decomposition of organic materials which are broken down by microbes and the results can be used to provide nutrients needed by plants (Bhunia et al., 2021; Michael, 2021; Pahalvi et al., 2021; Shaji et al., 2021; Shang et al., 2020). Inorganic fertilizer is fertilizer resulting from a chemical, physical and/or biological engineering process, and is the product of an industry or fertilizer manufacturing factory (Jote, 2023; Karthik & Maheswari, 2020; Pajura et al., 2023; Rahman et al., 2021; Rashmi et al., 2020). The inorganic fertilizer formula is the compound content of the main nutrients or micro nutrients and microbes. Plants will grow well if the nutrients needed by the plant can be met.

One of the organic fertilizers that can be used is vermicompost organic fertilizer. Vermicompost contains various ingredients needed for plant growth, namely hormones such as gibberellin, cytokinin and auxin, contains nutrients (N, P, K, Mg and Ca) as well as Azotobacter sp, which are non-symbiotic N-fixing bacteria that will help enrich the N elements needed by plants. Thus vermicompost can increase soil fertility. Nitrophonska NPK is a type of compound fertilizer that contains at least 5 macro nutrients that plants really need. This fertilizer is in the form of faded blue granules which are usually packaged in plastic packaging.

Nitrophonska NPK is made by dissolving phosphate rock using nitric acid. NPK Nitrophonska contains 15% N (Nitrogen), 15% P2O5 (Phosphate), 15% K2O (Potassium), 0.5% MgO (Magnesium), and 6% CaO (Calcium). Because of this content, this fertilizer is also known as NPK Nitrophoska 15-15-15.

The aim of this research was to determine the effect of applying vermicompost and NPK Nitrophonska 15:15:15 on the growth and yield of mung beans. The research contribution in this study lies in evaluating the impact of combining vermicompost and NPK Nitrophonska 15:15:15 fertilizer on the growth and yield of mung beans. By investigating the effects of these two soil amendments, the study contributes to agricultural science by offering insights into sustainable farming practices, potentially enhancing crop productivity while reducing the reliance on synthetic fertilizers alone. The findings may also provide valuable information for optimizing nutrient management strategies for mung bean cultivation.

METHOD

This research was carried out in May – July 2024 in Pancalang Village, Pancalang District, Kuningan Regency, West Java Province. This location has an altitude of 337 – 350 meters above sea level with a temperature of 18^{O}C – 32OC with rainfall ranging from 2,000 mm – 3,000 mm per year. The materials used in the experiment included mung beans seeds of the Vimil 2 variety, inoculant (soil used to plant mung beans), vermicompost, NPK Nitrophonska 15:15:15, herbicide. Meanwhile, the tools used include meters, rulers, measuring cups, analytical scales, spray tanks, hoes, nameplates and writing tools.

The research method used was an experimental method using a Randomized Group Design (RAK). The treatment combination consisted of 9 treatment combinations and was repeated 3 times: K1NI (3 kg Vermicompost, 30 gr NPK Nitrophonska), K1N2 (3 kg Vermicompost, 40 gr NPK Nitrophonska), K1N3 (3 kg Vermicompost, 50 gr NPK Nitrophonska), K2NI (4 kg Vermicompost, 30 gr NPK Nitrophonska), K2N2 (4 kg Vermicompost, 40 gr NPK Nitrophonska), K2N3 (4 kg Vermicompost, 50 gr NPK Nitrophonska), K3NI (5 kg Vermicompost, 30 gr NPK Nitrophonska), K3N2 (5 kg Vermicompost, 40 gr NPK Nitrophonska), K3N3 (5 kg Vermicompost, 50 gr NPK Nitrophonska). If the observation data shows a real effect, it is continued with the 5% BNT Test for single effects and the 5% Duncan Multiple Distance Test (DMRT) for interaction effects.

Land processing was carried out twice, 7 and 14 days before planting. After that, maps are made according to a predetermined layout. 27 plots were made, each replication consisted of 9 plots with a size of 2 m x 1 m, the distance between treatment plots was 40 cm and the distance between replications was 60 cm which functioned for water drainage and plant control. Planting is done by digging to a depth of 3 cm with a planting distance of 30 cm x 20 cm, each planting hole is filled with 1 seed. Vermicompost fertilizer is applied during the second tillage or 7 days before planting, and NPK Nitrophonska is applied 7 days after planting.

Plant maintenance includes thinning, replanting, watering, hilling, weeding, and controlling pests and diseases. Green beans are harvested when the plants are 52 HST and harvesting is done 4 times. The characteristics of pods that can be harvested are that the color of the pods is blackish brown and the pod skin is dry. The observations made include supporting observations and main observations. Supporting observations include analysis of soil fertility before the experiment at the Lembang Vegetable Plant Research Institute (Balitsa), rainfall during the research, and attacks by plant pests (OPT). The main observations included plant height, number of trifoliate leaves (three leaflets), root length, root volume, number of root nodules, number of pods per plant, seed weight per plant, and seed weight per plot. Plant growth observations were carried out at the ages of 14, 21, 28 and 35 DAP.

RESULTS AND DISCUSSION

Plant Height

Plant height measurements started at 14 DAP and continued until the plants were 32 DAP. Measuring the height of green bean plants starts from the base of the stem to the highest shoot of the plant.

Table 1. Effect of vermicompost fertilizer and Nitrophonska NPK on mung bean plant height

Code	Treatment	Plant Height (cm)							
		14 DAP		***21 DAP***		***28 DAP***		***32 DAP***	
A	K1N1 (kascing 3kg, NPK 30 gr)	15,30	A	23,10	A	34,07	A	42,07	A
B	K1N2 (kascing 3kg, NPK 40 gr)	14,77	A	21,67	B	**37,93**	**A**	**45,87**	**A**
C	K1N3 (kascing 3kg, NPK 50 gr)	15,00	A	22,90	AB	35,27	A	41,53	A
D	K2N1 (kascing 4kg, NPK 30 gr)	14,73	A	23,10	A	32,00	B	45,53	A
E	K2N2 (kascing 4kg, NPK 40 gr)	15,33	A	**24,60**	**A**	27,27	B	42,27	A
F	K2N3 (kascing 4kg, NPK 50 gr)	15,30	A	21,87	B	33,07	Ab	40,53	A
G	K3N1 (kascing 5kg, NPK 30 gr)	15,67	A	24,00	A	31,27	B	41,20	A
H	K3N2 (kascing 5kg, NPK 40 gr)	15.10	A	21,83	B	29,33	B	37,00	B

I	K3N3 (kascing 5kg, NPK 50 gr)	**15,97**	**A**	23,07	A	27,80	B	39,13	A

Note: The average values marked with the same letter in the same column are not significantly different at the 5% level according to the Duncan Test. DAP = Days After Planting

Table 1 shows that the combination of vermicompost and NPK Nitrophonska fertilizer treatments had a significant effect on plant height at 21.28 and 32 DAP. Providing 3 kg vermicompost fertilizer and 40 gr NPK Nitrophonska (K1N2) produced the best plant height, namely 45.87 cm. Providing vermicompost fertilizer and NPK nitrophonska according to plant needs can increase nutrient uptake by plants and can then improve plant growth, especially plant height.

Number of Trifoliate Leaves

Leaves are a very influential plant organ because they function as a site for photosynthesis. The number of green bean leaves is done by counting the number of leaves that have opened completely each week.

Table 2. Effect of vermicompost fertilizer and Nitrophonska NPK on the number of plant leaves on mung beans

Code	Treatment	Plant Leaves							
		14 DAP		***21 DAP***		***28 DAP***		***32 DAP***	
A	K1N1(vermicompost 3kg, NPK 30 gr)	0.87	A	2.87	A	6.93	A	8.27	A
B	K1N2(vermicompost 3kg, NPK 40 gr)	0.87	A	2.53	B	**7.07**	**A**	**8.87**	**A**
C	K1N3(vermicompost 3kg, NPK 50 gr)	0.87	A	2.87	A	5.80	B	7.80	A
D	K2N1(vermicompost 4kg, NPK 30 gr)	0.87	A	2.80	A	5.73	B	8.67	A
E	K2N2(vermicompost 4kg, NPK 40 gr)	0.67	B	**3.00**	**A**	6.00	A	8.73	A
F	K2N3(vermicompost 4kg, NPK 50 gr)	0.80	A	2.80	A	6.53	B	8.13	A
G	K3N1(vermicompost 5kg, NPK 30 gr)	**0.93**	**A**	**3.00**	**A**	6.53	B	7.67	A
H	K3N2(vermicompost 5kg, NPK 40 gr)	0.73	A	2.80	A	5.27	B	6.87	A
I	K3N3(vermicompost 5kg, NPK 50 gr)	0.80	A	2.80	A	6.40	A	7.07	A

Note: The average values marked with the same letter in the same column are not significantly different at the 5% level according to the Duncan Test. DAP= Days After Planting

Based on the data in table 2, it shows that the treatment of vermicompost fertilizer and Nitrophonska NPK on the number of leaves showed a significant difference at the age of 28 DAP. The amount of water available and proper fertilization during the growth phase can increase the number of leaves further. Providing 3 kg vermicompost fertilizer and 40 gr NPK Nitrophonska (K1N2) produced the highest number of plant leaves, namely 8.87.

Root Length, Root Volume and Root Nodules

Table 3. Effect of vermicompost fertilizer and Nitrophonska NPK on root length, root volume and root nodules on mung bean plants

Code	Treatment	Root Length (cm)		Root Volume (ml)		Root nodules	
A	K1N1 (kascing 3kg, NPK 30 gr)	15,83	A	4,00	A	**59,00**	**A**
B	K1N2 (kascing 3kg, NPK 40 gr)	15,00	AB	4,00	A	44,00	B
C	K1N3 (kascing 3kg, NPK 50 gr)	15,83	A	4,00	A	24,00	C
D	K2N1 (kascing 4kg, NPK 30 gr)	14,00	B	4,33	AB	55,33	A
E	K2N2 (kascing 4kg, NPK 40 gr)	15,67	A	4,00	A	40,33	B
F	K2N3 (kascing 4kg, NPK 50 gr)	14,33	B	**4,67**	**A**	30,00	C
G	K3N1 (kascing 5kg, NPK 30 gr)	11,83	B	4,33	B	32,33	B
H	K3N2 (kascing 5kg, NPK 40 gr)	**17,67**	**A**	**4,67**	**A**	36,33	B
I	K3N3 (kascing 5kg, NPK 50 gr)	16,00	A	4,00	B	32,33	BC

Note: The average values marked with the same letter in the same column are not significantly different at the 5% level according to the Duncan Test. DAP = Days After Planting

Root length, root volume and root nodules were measured at harvest. Measurement of root length starts from the base of the root to the tip of the root. Based on existing data on root length, the best treatment is K3N2

(5 kg Vermicompost and 40 gr NPK Nitrophonska). The best root volume was in K2N3 and K3N2 with 4.67 ml, the root length and root volume treatments did not show significant data, while the root nodules showed a significant difference with the best treatment in K1N1 (3 kg Vermicompost and 30 gr Nitrophonska NPK) The addition of organic fertilizer to the planting medium should be able to improve the physical properties of the soil and soil porosity so that it can improve root growth in plants (Ramadhani et al., 2019).

Yield Components and Yield of Mung Beans

Mung beans are a type of grain plant. The pods or seeds produced from mung bean plants come from the assimilation of photosynthate produced from the leaf organs. Seed weight per plot is positively correlated with the number of trifoliate leaves on green bean plants ($r = 0.466$, $p < 0.05$). This illustrates that an increase in the number of leaves is followed by an increase in seed weight per plot.

Table 3. The effect of vermicompost fertilizer and Nitrophonska NPK on the number of pods planted, seed weight per plant, and seed weight per plot in mung bean plants

Code	Treatment	Number of Pods Planted		Planting Seed Weight (g)		Weight of Seeds Per Plot (g)	
A	K1N1(vermicompost 3kg, NPK 30 gr)	13.53	B	8.39	A	209.70	B
B	K1N2(vermicompost 3kg, NPK 40 gr)	17.76	A	11.01	A	275.24	A
C	K1N3(vermicompost 3kg, NPK 50 gr)	18.22	A	12.15	A	303.76	A
D	K2N1(vermicompost 4kg, NPK 30 gr)	20.71	A	11.09	A	321.00	A
E	K2N2(vermicompost 4kg, NPK 40 gr)	**21.45**	**A**	12.84	A	**353.86**	A
F	K2N3(vermicompost 4kg, NPK 50 gr)	17.8,9	A	**14,15**	**A**	277.36	A
G	K3N1(vermicompost 5kg, NPK 30 gr)	17.46	AB	10.83	A	270.67	AB
H	K3N2(vermicompost 5kg, NPK 40 gr)	13.66	B	8.47	A	211.70	B
I	K3N3(vermicompost 5kg, NPK 50 gr)	15.12	B	9.37	A	234.32	B

Note: The average values marked with the same letter in the same column are not significantly different at the 5% level according to the Duncan Test. DAP = Days After Planting

The seed weight of the green bean plots in the treatments did not show a significant difference. Likewise, other treatments did not show significant differences. The seed weight per plot with the best results was in the K2N3 treatment, namely 353.86 gr/plot. This is thought to be due to the adequate nutrition available from Nitrophonska NPK fertilizer and supported by vermicompost fertilizer which has the property of improving the chemical and physical properties of the soil.

CONCLUSION

The study reveals that vermicompost and NPK Nitrophonska 15:15:15 can significantly increase the growth and yield of mung bean plants, particularly in terms of seed weight per plot. The K2N2 treatment (4 kg vermicompost and 40 gr NPK Nitrophonska) showed the best results. Future research should explore the long-term effects of varying doses of these fertilizers on mung bean growth across multiple growing seasons to assess sustainability and consistency. Additionally, studies could investigate the application of these fertilizers in combination with other organic or biofertilizers to improve soil health, nutrient availability, and crop yield. Expanding the research to other legume species or soil types could provide broader insights.

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