

The Effect of Various Types of Fertilizer on the Growth and Yield of Long Bean Plants (*Vigna Sinensis L.*)

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Abstract

Long beans are one type of vegetable horticultural plant that is popular throughout the world which is widely used as food or daily consumption, produced to be used as seeds and used as medicines in the world of health. This study aims to determine the effect of applying various fertilizers on the growth and production of string bean plants. This research was conducted in Lembang Village, Banggae Timur District, Majene Regency, Sulawesi Barat Province. The treatment in this study was designed with a simple Group Randomized Design with 4 treatments and 4 repetitions, namely P0 = No Fertilizer (control), P1 = Leachate 5 ml, P2 = MOL 5 ml, P3 = NPK Fertilizer 5 ml. Leachate and MOL as liquid organic fertilizers dissolved in water and applied per week after planting. NPK fertilizer as an inorganic fertilizer that is thawed with water and applied per week after planting. The results showed that the treatment of various fertilizers (P0, P1, P2, and P3) did not have a real effect on the growth and production of string bean tama, especially on the number of fruits. while the application of leachate water fertilizer dose of 5 ml (P1) gave higher results on the height and number of leaves of long bean plants compared to without fertilizer (P0) and the application of MOL 5 ml (P2) and NPK dose 5 ml (P3). The effect of applying NPK 5 ml (P3) fertilizer on the growth of long bean plants only appears in the variable number of leaves.

Keywords— Fertilizer, Leachate, MOL, NPK, Long Bean

Introduction

Long beans are one type of vegetable horticultural plant that is popular throughout the world which is widely used as food or daily consumption, produced to be used as seeds and used as medicines in the world of health. Long beans contain many good nutrients such as vitamin K, vitamin A, vitamin C, and vitamin B complex. In addition, long beans also contain minerals such as potassium and folate. Long bean plants can be developed to improve family nutrition. Peanut plants are short-lived, can grow well in medium to lowland, are resistant to drought, and can be planted in rice fields, moor, or yards in any season (Hendriyani, et al, 2009).

Badan Pusat Statistik (2023), long bean production is 360,674 tons in Indonesia in 2022. Compared to the number in the previous year, there was a decrease of 6%, namely as much as 383,685 tons. This occurs due to several factors including soil quality that is declining due to the use of too much inorganic matter and agricultural land getting narrower due to changing functions so that crop production decreases. To achieve optimal crop production results, it is necessary to maintain good soil fertility. Plants can grow well and produce optimally if the soil has sufficient nutrient content for plant growth such as Nitrogen, Potassium and Passport (Finiliza, 2011). Improving the quality and production of cultivated plants by increasing the supply of nutrients in accordance with plant growth to replace lost nutrients. (Long et al., 2021).

Soil is a medium where plants grow so it must have a structure that suits the needs of plants because each type of media has a different influence on plants. Improving soil quality as a planting medium can be done by fertilizing. Organic fertilizers and fertilizers as additional ingredients to meet nutrients in the soil. Organic fertilizer is fertilizer derived from the remains of living organisms such as plants, animals, or other organic waste, while liquid organic fertilizer is organic fertilizer that has a liquid form so that this fertilizer is easily dissolved when used (Sunaryo, 2011).

The application of organic fertilizers such as organic liquid fertilizer, cage, compost or other organic matter can improve soil structure as a planting medium (Syahputra, et al., 2014). NPK fertilizer is an inorganic fertilizer that has macronutrients that are needed by plants in large quantities in various plant growth processes. Nitrogen (N) is a constituent component of various essential compounds in spurring vegetative growth in plants ranging from roots, stems and leaves. Phosphorus (P) is one of the essential parts that play a role in the reactions of photosynthesis, respiration and other metabolic processes. Potassium (K) acts as an activator of various enzymes that are essential in the process of photosynthesis and respiration reactions. Potassium also plays a role in regulating the osmotic potential of cells. Lack of potassium (K) elements will result in yellowing of plants and spots on leaves, fruits grow incompletely, low yields and not durable (Lingga and Marsono, 2013).

Literature Review

The application of organic or inorganic matter fertilizers is very necessary for plants to grow and develop, as well as produce. The use of leachate and mole as organic fertilizers can improve soil structure, aeration and soil texture, stimulate healthy root development and increase the ability to retain soil water (Assefa & Tadesse, 2019). Inorganic fertilizers such as excessive NPK will have a negative impact on plants and soil fertility in long-term use in the field, therefore, organic fertilizers are a better choice (Fadhilah et al., 2021).

Leachate water is a liquid from the decomposition of garbage and seepage of water that passes through a landfill that has several organic compounds that can be used as fertilizer. In Wulandari research (2022), it is known that leachate water contains several nutrients that are high (more than 10 mg / l) such as N 0.26% (medium), P 0.14% (low), and K 0.13% (low). The high and low nutrients contained in POC are caused by the process of mineralization and decomposition.

MOL is a fermented solution whose basic ingredients are from various local resources around the environment. MOL solution contains macro and micro nutrients and contains bacteria that have the potential to be used as plant growth stimulants, and as pest and plant disease control agents, so that MOL solutions can be used as biological fertilizers or organic pesticides (Jumriani et al., 2017).

NPK fertilizer is one of the compound fertilizers that has more than 2 types of nutrients, namely the nutrient content of Nitrogen (N) as much as 15% in the form of NH_3 , Phosphorus (P) as much as 15% in the form of P_2O_5 , and Potassium (K) as much as 15% in the form of K_2O . These three nutrients are the main elements needed in the growth and development of plants in large quantities (Ginting, 2015). Fertilizer application needs to be adjusted so that the nutrients in the fertilizer used can be balanced and in accordance with plant needs. This is because if the application of NPK fertilizer with a high dose can reduce the level of soil fertility, if the application of NPK fertilizer with a low dose can inhibit plant growth (Cahyono, 2001).

Fertilizer application aims to stimulate overall growth, especially on branches, stems, leaves, and plays an important role in the formation of green leaves. In addition, fertilization can increase the supply of lost nutrients needed by plants in increasing crop production and quality. The availability of sufficient and balanced nutrients can provide a good growth process in plants. Some important nutrients are needed for plants for growth and production contained in organic matter such as Nitrogen, Potassium, Phosphate, Magnesium, Calcium, and micronutrients (Lubis, et al. 2019).

Based on the description above, testing of the growth and production of long bean plants (*Vigna Sinensis* L.) through the application of different types of fertilizers needs to be done to determine the level of productivity of the long bean plant itself. The utilization of this type of fertilizer is expected to increase the production of long bean crops in an effort to increase farmers' income.

Research Method

This research was carried out in Lembang Village, Banggae Timur District, Majene Regency, Sulawesi Barat Province from April 2023 to July 2023. The altitude of the place is 500 meters above sea level with an average temperature of 28°C - 32°C. The tools used are hoes, meters, trowels, stationery, cameras, raffia ropes, measuring cups, bamboo, sprayers and digital scales. The materials used are long bean seeds, leachate water, MOL, NPK, polybag volume of 5 kg.

This study was designed with a simple Group Randomized Design with 4 treatments and 4 repeats, namely: P0 (Without Fertilizer (control), P1 (Leachate 5 ml), P2 (MOL 5 ml, P3 (NPK Fertilizer 5 ml. Leachate and MOL as liquid organic fertilizers dissolved in water and applied per week after planting. NPK fertilizer as an inorganic fertilizer that is thawed with water and applied 1 week after planting.

Results and Discussion

Plant Height

From the results of the analysis of the variety observed in plant height showed that all treatments (P0, P1, P2, and P3) had no real effect on the observation of plant age 2 and 4 msa. Meanwhile, the observation of plant age 3 and 5 msa showed significantly different results in P1 treatment (leachate 5 ml) with other treatments, namely P2 (mol 5 ml) and P3 (NPK 5 ml) (Table 1.). This is because leachate water has nutrients N, P, and K which are needed by plants in improving the growth process of plant roots and stems (Wulandari, 2022). Nitrogen is a nutrient that plays an important role in the process of plant growth. Plant growth and development are influenced by the adsorption process of nitrogen content by plants. The faster the growth of plants, the higher the absorption of nutrients by plants. Nitrogen (N) has benefits for plants, namely, spurring vegetative growth starting from roots, stems, and leaves. Another role of nitrogen nutrients is to help the process of photosynthesis. In addition, Phosphorus (P) and Potassium (K) nutrients are an important part of macronutrients for plant growth which play a role in the process of respiration, photosynthesis, and other metabolic processes (Kurniawati, et al., 2018). One of the functions of potassium (K) nutrients is the transportation of assimilated products of plants, minerals and enzymes and helps the process of photosynthesis. Plants will turn yellow and spots on the leaves due to lack of potassium nutrient content (Ariska et al., 2019).

The absorption of nutrients in the early phase of vegetative growth of string bean plants is very low. New cancan plants will require a lot of N nutrients in the vegetative growth phase (Subedi and Ma, 2011).

Table 1. Average Height of Long Bean Plants with Fertilizer Type Treatment at Various Ages of Peanut Plants After Application.

Fertilizer Treatment	Plant Age (cm)			
	2 WAA	3 WAA	4 WAA	5 WAA
P0 (No Fertilizer)	7,00 ± 1,50tn	19,66 ± 2,25b	35,00 ± 8,66tn	96,66 ± 11,55b
P1 (Lindi)	6,16 ± 0,76 tn	22,16 ± 0,29c	44,66 ± 4,16tn	116,83 ± 19,04c
P2 (MOL)	5,84 ± 0,29tn	17,00 ± 0,50a	28,83 ± 4,75tn	75,00 ± 18,03a
P3 (NPK)	6,17 ± 0,29tn	18,33 ± 0,58ab	39,66 ± 5,77tn	74,33 ± 6,66a
CV (%)	13,73%	11,61%	21,63%	2,44%

Information : Numbers followed by the same letter in the same column did not differ markedly in Duncan's test with a level of 0.05; WAA = week after application.

Number of leaves

The results of variety analysis on the number of long bean tananam leaves showed that all treatments (P0, P1, P2, and P3) at the age of 2 msa and 4 msa plants had no real effect. while at plant age 3 and 5 msa P3 treatment (NPK 5 ml) had a significant effect on the number of leaves from other treatments (P0, P1, P2) and P0 treatment had no real effect on the number of leaves with P1 and P2 treatment at the age of 5 msa (Table 2). This is thought to be due to the availability of Nitrogen, Phosphorus, and Potassium nutrients in liquid NPK fertilizer given able to meet nutrient needs during plant growth. The availability of Nitrogen (N) elements as a whole spurs growth, stems, branches and leaves, and Phosphorus (P) elements play a role in stimulating root growth and Potassium (K) elements function in the process of forming proteins and carbohydrates and maintain leaf turgor (Wibowo et al, 2017).

It is suspected that the application of NPK fertilizer at the right dose to long bean plants so as to spur plant growth and development. if NPK fertilizer is given at high doses, it can reduce the fertility rate of planting media, if NPK fertilizer is given at low doses, it can cause stunted plant growth (Cahyono, 2001).

Saribun in Ginting (2015) explained that the application of NPK fertilizer in planting media can increase nutrient content so that it has a good influence on plant growth because the main nutrients contained in the elements of Nitrogen, phosphorus and Potassium are needed for plants for growth and development.

Table 2. Average Number of Long Bean Leaves with Fertilizer Type Treatment at Various Ages of Peanut Plants After Application.

Fertilizer Treatment	Plant Age (cm)			
	2 WAA	3 WAA	4 WAA	5 WAA
P0 (No Fertilizer)	2,00 ± 0,00tn	8,66 ± 0,58b	11,66 ± 1,15tn	24,33 ± 1,15b
P1 (Lindi)	2,00 ± 0,00tn	8,00 ± 0,00b	13,66 ± 0,58tn	20,33 ± 2,08 ^a
P2 (MOL)	2,00 ± 0,00tn	8,00 ± 0,00b	12,33 ± 1,53tn	23,00 ± 1,73ab
P3 (NPK)	2,00 ± 0,00tn	5,66 ± 1,15a	13,33 ± 1,15tn	28,66 ± 0,58c
CV(%)	0,00%	17,29%	10,10%	14,10%

Information : Numbers followed by the same letter in the same column did not differ markedly in Duncan's test with a level of 0.05; WAA = week after application.

Number of Fruits

Observations on the number of fruits showed that all treatments had no significant effect on the number of fruits, be it P0, P1, P2 or P3 treatments (Table (3). The number of fruits can decrease due to insufficient supply of nitrogen (N) for the photosynthesis process so that plant growth is less optimal and branches are less so that the development of fewer fruits (Usha et al., 2019).

Ilmam and Guritno (2023) stated that the nutrient Potassium (K) also plays a role in the process of opening and closing the entry of CO₂ compounds from the air, namely stomata, for respiration and transpiration in the process of photosynthesis. The results of photosynthesis affect the number of fruits, this is in line with Kurniawan's statement (2017) which states that the percentage of the number of fruits that are not fully filled is a reflection of the photosynthetic process that is less than optimal.

Table 3. Average Number of Long Bean Leaves with Fertilizer Type Treatment at Various Ages of Peanut Plants After Application.

Fertilizer Treatment	Harvest to -	
	1	2
P0 (No Fertilizer)	3,33 ± 0,57tn	1,00 ± 1,00tn
P1 (Lindi)	3,33 ± 1,52tn	2,33 ± 1,52tn
P2 (MOL)	3,66 ± 1,15tn	3,67 ± 2,08tn
P3 (NPK)	3,00 ± 2,00tn	2,00 ± 0,00tn
CV(%)	36,90%	8,62%

Information : Numbers followed by the same letter in the same column did not differ markedly in Duncan's test with a level of 0.05

Conclusion

The conclusion of this study shows that the treatment of various fertilizers (P0, P1, P2, and P3) does not have a real effect on the growth and production of string bean tama, especially on the number of fruits. while the application of leachate water fertilizer dose of 5 ml (P1) gave higher results on the height and number of leaves of long bean plants compared to without fertilizer (P0) and the application of MOL 5 ml (P2) and NPK dose 5 ml (P3). The effect of applying NPK 5 ml (P3) fertilizer on the growth of long bean plants only appears in the variable number of leaves.

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