Jurnal Pertanian Tropik ISSN NO: 2356- 4725/p- ISSN : 2655-7576
Vol.8.No.2. 2021 (11) 82- 86 DOI: 10.32734/jpt.v8i2, August.6375

Growth Response of Soybean (Glycine max L Merrill) to NPK Fertilizer Dosage and Distance Planting in the Field

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ABSTRACT

In order to increase soybean production, various treatments can be applied, one of which is cultivation in which spacing between the plants is adjusted to obtain ideal production. Spacing is determined depending on seed growth, soil fertility, season, and the variety of plant. Apart from spacing, the use of compound fertilizer is also very important in the growth and production of soybean plants. One way to reduce production costs and improve the quality of soil and crop yield is to apply a compound fertilizer such as NPK Mutiara (16:16:16). NPK (16:16:16) fertilizer has a balanced composition of nutrients and dissolves slowly until the end of the growth process. The purpose of this study is to discover the effect of plant spacing and dosage of NPK Mutiara (16:16:16) fertilizer, and the best interaction between spacing and NPK Mutiara (16:16:16) fertilizer dosage, on the growth and yield of soybean plants (*Glycine max (L) Merrill*). The research was conducted in a farmer's experimental garden, in Jalan Eka Suka 11, Pangkalan Mansur Village, Medan Johor District, at a height of ± 15 meters above sea level. The method used is a factorial randomized block design (RBD) with the first factor being plant spacing, and the second factor being NPK fertilizer dosage. The results of the research show that NPK fertilizer dosage and plant spacing both have a significant effect on plant height and number of branches. The highest plant height, 75.50 cm, was obtained using the treatment J3 (40 cm x 40 cm spacing), compared with the other two treatments. The lowest plant height, 61.08 cm, was obtained using the treatment J1 (30 cm x 30 cm spacing). The highest number of branches was seen in the treatment K3, with 7.00 stalks, while the lowest number of branches was found in the treatment K0, with 6.03 stalks.

Key words: Soybeans, spacing, NPK compound fertilizer

INTRODUCTION

In Indonesia, soybean is an important food commodity which is cultivated in order to improve food security on a national level, and specifically to increase the supply of soybean food. A concerted effort is therefore needed to increase its production, for which a detailed, well-planned, long-term, and targeted program is required (Adisarwanto, 2015).
Soybean production can be increased by implementing various treatments, such as cultivation in which spacing between the plants is adjusted to obtain ideal production. Population per hectare is an important factor for producing maximum yield. Maximum production can be achieved by using the right spacing. The higher the planting density, the higher the competition between plants to obtain nutrients and sunlight. Plant density must be regulated with appropriate spacing to avoid competition between plants and to facilitate cultivation (Adisarwanto and Wudianto, 2015).

Plant spacing is determined depending on seed growth, soil fertility, season, and the variety of plant. Seeds with fairly low growth need to be planted closer together, or with tighter spacing. On fertile soil, wider spacing is more beneficial because the nutrients available exceed the optimal amount for plant growth (Suprapto, 2015).

Plant spacing that is too far apart leads to an increase in the process of water evaporation in the soil, which interferes with the process of growth and development. On the contrary, plant spacing that is too dense causes greater competition between the plants to obtain water, nutrients, and sun intensity (Marliah et al, 2012).

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NPK Mutiara fertilizer has a number of advantages, such as being slow to dissolve, thereby reducing the loss of nutrients as a result of washing, evaporation, and absorption by soil colloids. One of the ways o reduce production costs and increase soil quality and crop yield is to apply a compound fertilizer such as NPK Mutiara (16:16:16). The advantage of using a compound fertilizer is that it is more efficient, both in transportation and storage (Pirngadi, 2015). NPK fertilizer (16:16:16) has a balanced composition of nutrients and dissolves slowly until the growth process is complete. The amount of fertilizer needed for each area differs, depending on the plant variety, soil type, agroclimate, and farming technology. Therefore, it is essential to pay close attention to the fertilization recommendations to ensure that an increase in production per hectare can be achieved (Rukmi, 2010).

The aim of this research is to discover the effect of plant spacing and NPK Mutiara fertilizer (16:16:16) dosage, and the best interaction between spacing and NPK Mutiara fertilizer (16:16:16) on the growth and yield of soybean plants *(Glycine max (L) Merrill).*

MATERIALS AND METHODS

The research was conducted in a farmer's experimental garden, in Jalan Eka Suka 11, Pangkalan Mansur Village, Medan Johor District, at an altitude of ± 15 meters above sea level. The research was carried out from July to September 2020.

The materials used in this research were: soybean seeds, Grow More fertilizer with a content of NPK Mutiara (16:16:16) and Decis 25 EC, and other materials needed to support the research.

The tools used in the research were: a rake, a hand sprayer, a measuring meter, rolls, scales, a hoe, a cleaver, a watering can, and other writing tools needed to support the research.

This research uses a factorial Randomized Block Design (RBD) with 2 factors: Plant Spacing (J) and NPK fertilizer dosage (K) with 3 repetitions. Factor I : Plant Spacing (J) consists of 3 levels; J_1 = 30 cm x 30 cm, J_2 = 30 cm x 40 cm, J_3 = 40 cm x 40 cm.

Factor II : Dosage of NPK Mutiara fertilizer (16:16:16) (K) consists of 4 levels; K0= Control (without fertilizer), K_1 = 75 grams/plot, K_2 = 85 gram/plot, K_3 = 95 grams/plot. The parameters observed in this research were Plant Height and Number of Branches.

RESULTS AND DISCUSSION

Plant Height

The results of the analysis show that different treatments of plant spacing and dosage of NPK fertilizer, and their interaction, had a significant effect on plant height at all ages of observation.

According to Table 1, it can be seen that for plant spacing, the highest plant height was obtained with treatment J3 (40 cm x 40 cm), namely 75.50 cm, compared with the two other treatments. The lowest plant height was achieved with treatment J1 (plant spacing of 30 cm x 30 cm), namely 61.08 cm. For the treatments with different doses of NPK fertilizer (K), it can be seen that the highest soybean plant height was obtained with treatment K3 (NPK dose of 95 gr/plot), namely 71.67 cm, and the lowest plant height was seen with treatment K1 (NPK dose of 75 gr/plot), namely 65.67 cm. It can be seen that the interaction between the uses of the two treatments in this research that produced the highest plant height was the treatment K3J3 (NPK dose of 95 gr/plot and plant spacing of 40 cm x 40 cm), which produced a height of 79.33 cm, and the lowest plant height was with the treatment K0J1 (without NPK fertilizer and plant spacing of 30 cm x 30 cm), which produced a height of 59.67 cm.

The regulation of plant spacing in the research had a significant effect on the growth of soybean plants. Spacing at a distance of 40 cm x 40 cm was found to be the best treatment in this research for the parameters of plant height and number of branches. Wider plant spacing has the ability to increase plant growth, especially in relation to the absorption of nutrients needed by the plant.

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Table 1. Average Plant Height (cm) of soybeans with different treatments of NPK fertilizer dosage (K) and Plant Distance (J) at 20, 30 and 40 days after planting (DAP)

Treatment	Plant Height		
	20 DAP	30 DAP	40 DAP
K0J1	9.18f	38.33d	59.67f
K0J2	9.80e	38.00d	60.00e
K0J3	9.76e	40.00c	60.67e
K1J1	11.39d	42.00b	64.00e
K1J2	11.62c	43.00a	66.33d
K1J3	12.18b	43.00a	67.33d
K2J1	11.91c	43.00a	67.67d
K2J2	12.12b	43.00a	71.67c
K2J3	12.26b	42.00b	74.33b
K3J1	11.97c	42.00b	69.67c
K3J2	14.45b	40.00c	78.67a
K3J3	14.74a	39.00d	79.33a
Plant Spacing			
J1 = 30 x 30 cm	30.10c	39.58c	61.08c
J2 = 30 x 40 cm	35.87b	40.75b	68.25b
J3 = 40 x 40 cm	40.06a	43.00a	75.50a
NPK Fertilizer (K)			
K0 = control	10.83d	41.11b	66.78c
K1 = 75 gr/plot	11.32c	41.00c	65.67d
K2 = 85 gr/plot	11.87b	41.00c	69.00b
K3 = 95 gr/plot	12.57a	41.33a	71.67a

Note: Figures followed by the same letter in the same treatment are not significantly different at a level of 5%.

According to Pangli (2014), wider spacing enables better absorption of the sun's energy by the leaves for the metabolic process of carbohydrate formation, and also provides more room for the roots to absorb nutrients from the soil. If the plant canopy receives insufficient energy from the sun, the net assimilation rate will decrease, thus leading to a decline in assimilation. This also causes a decrease in production.

Number of Branches (Stalks)

The results of the analysis show that different treatments of plant spacing and the application of different doses of NPK fertilizer, and their interaction, have a significant effect on the number of soybean plant branches at all ages of observation.

The use of NPK fertilizer doses in the 4 treatments was K0 = control, K1 = NPK dose of 75 gr/plot, K2 = NPK dose of 85 gr/plot and K3 = NPK dose of 95 gr/plot. The highest number of branches was obtained using the treatment K3, which produced 7 stalks, and the lowest number was found using the treatment K0, which produced 6.03 stalks. The use of NPK compound fertilizer helps to provide sufficient nutrients to aid with plant growth and production.

Research by Sukristiyonu (2009) shows that the nutrients from NPK compound fertilizer utilized by plants for growth have the same benefit as nutrients from urea fertilizers, SP36, and KCl.

According to Suminarti (2016), NPK fertilizer contains macro nutrients that are generally needed by plants, and provides a good balance of nutrients for plant growth and production. Menawhile, Rukmi (2010) also states that NPK fertilizer (16:16:16) has a balanced composition of nutrients and dissolves slowly throughout the growth process until growth is complete. The amount of fertilizer needed differs from one area to another, depending on plant variety, soil type, agroclimate, and farming technology. Therefore, fertilization recommendations must be properly followed in order to ensure that an increase in production per hectare is achieved.

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Table 2. Average number of soybean branches (stalks) with different doses of NPK fertilizer (K) and Plant Spacing (J) at 20, 30 and 40 days after planting (DAP)

Treatment	Number of branches		
	20 DAP	30 DAP	40 DAP
K0J1	1.03e	3.47g	6.00f
K0J2	1.06e	3.53g	5.83g
K0J3	1.06e	3.60f	6.00f
K1J1	1.32d	3.83f	6.50e
K1J2	1.40c	4.00e	6.83d
K1J3	1.64a	4.17d	6.83d
K2J1	1.42c	4.17d	6.83d
K2J2	1.46b	4.33c	7.00c
K2J3	1.57a	4.67b	7.33b
K3J1	1.48c	4.33c	7.00c
K3J2	1.50b	4.67b	7.33b
K3J3	1.51a	4.83a	7.50a
Plant Spacing			
J1 = 30 x 30 cm	1.12c	3.61c	6.08c
J2 = 30 x 40 cm	1.52a	4.17b	6.88b
J3 = 40 x 40 cm	1.48b	4.63a	7.29a
K0 = control	1.34d	4.04c	6.03d
K1 = 75 gr/plot	1.39c	4.01d	6.56c
K2 = 85 gr/plot	1.33b	4.14b	6.72b
K3 = 95 gr/plot	1.43a	4.33a	7.00a

Note: Figures followed by the same letter in the same treatment are not significantly different at a level of 5%.

CONCLUSION AND SUGGESTION

Conclusion

Different treatments of plant spacing have a significant effect on plant height and number of branches. Interaction between plant spacing and NPK Mutiara fertilizer 16:16:16 has a significant effect on plant height and number of branches.

Suggestions

It is suggested that further research be carried out in order to determine the best doses of NPK fertilizer to be used in accordance with the soil requirements.

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