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EFFECTIVENESS OF VERMICOMPOST FERTILIZER DOSAGE AND PLANTING SPACING ON GROWTH AND YIELD OF BEANS (*PHASEOLUS VULGARIS* L.)

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Abstract

The Indonesian people cultivate and consume a variety of legumes, including the beans (Phaseolus vulgaris L.). The demand for commodities on the market was rising every year, but there are still numerous challenges facing bean farmers today, including the issue of employing chemical fertilizers and applying them with the wrong spacing. Vermicompost fertilizer and correct spacing are two methods of improving bean growing technology that can be used to increase bean production. The aim of this study was to evaluate the effects of vermicompost fertilizer dosage and spacing on beans (Phaseolus vulgaris L.) growth and yield. The experimental garden at the University of Teuku Umar's Faculty of Agriculture served as the site for this study. This study's implementation started in January 2022 and ended in March 2022. Three replications of a 3 x 3 factorial randomized block design (RBD) were employed as the experimental design in this investigation. The amount of vermicompost fertilizer, which is composed of K1 (7.5 tons/ha), K2 (15 tons/ha), and K3 (22.5 tons/ha), as the first factor. The separation of J1 (50 cm x 30 cm), J2 (50 cm x 40 cm), and J3 (50 cm x 50 cm) as the second factor. Plant length, stem diameter, leaf area, and pod weight planted were all observed. The findings demonstrated a substantial impact of the optimal vermicompost fertilizer dose on the parameters of plant length at 14 and 21 day after plant (DAP) and the leaf area assessed in the K3 treatment (22.5 tons/ha). Additionally, none of the evaluated treatment were significantly impacted by the spacing factor.

Keywords: ***Vermicompost Fertilizer, Planting Distance, Bean Plants***

1. INTRODUCTION

Phaseolus vulgaris is a species of vegetable nut that was widely cultivated and consumed by the Indonesian community. In addition, beans has been given priority research and development in Horticulture at Indonesia due to beans have a significant role and contribution to farmers, improved public nutrition, increased national income through increased exports, increased agribusiness, and expanded employment opportunities. (Hodiyah, 2007). According to data from the Central Statistical Agency (2020), In 2018 the production of beans crops in Indonesia amounted to 3.044.308 tons; in 2019 the production decreased to 2.993.102; and in 2020 the production rose again to 3.059.230. It was concluded that there was instability in production each year. Decreased in beans production was due to the land area, which has land conditions that are mostly less productive. This is one of the consequences of the ever-increasing use of chemical fertilizers, which causes the soil to become dirty. The next major reason why soil can be so hard is the use of single inorganic fertilizers over a long period of time. For example, sulfate and carbonate residues contained in fertilizers and soil can react with soil calcium, caused difficulties in soil processing. One solution to reducing the use of inorganic fertilizer is to use organic fertilizer. Organic fertilizer is a fertilizer consisting of organic material derived from animals and plants that has undergone

engineering processes. It can be solid or liquid and is used to supply organic materials and improve the physical, chemical, and biological properties of the soil (Dewanto et al., 2013). One environmentally friendly organic fertilizer is casing fertilizer.

Vermicompost fertilizer is the dirt of soil worms mixed with soil or other material that is an organic fertilizer that is rich in nutrients and is of better quality than other types of nutrients (Radian, 1994). In addition, v*ermicompost fertilizer* contains macro and micronutrients. It 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) 0.07%, iron (Fe) 0.79%, molybdenum (Mo) 14.48%, organic material 0.21%, KTK 35.80%, water storage capacity 41.23%, and humic acid 13.88% (Mulat, 2003). According to Curry (1986), cit. Sutanto (2002), the addition of cascading will increase the availability of P 4–10 times more than the surrounding soil. Sinda et al. (2015) stated that administering a dose of 20 t ha-1 can increase the number of leaves by 1.33%; 8.79% of the weight of a fresh leaf or 35 t ha-1, 8.35% of a dry leaf; 1.41% of N-total soil; 5.56% of the P-availability of soils; 3.11% of organic C-soil; 0.07% of the pH of soil and 12.89% of total soil microorganism population. The higher the dose of the given leaf fertilizer up to 20 t hectare-1, the higher the content of fertilizers in the soil, the total population of soiled micro-organisms and the yield of crustaceans.

In addition to cutting fertilizer, which can increase production, the most important nutritional factor for plants is the growing distance. Planting distances affect crop growth and yield due to increased competition caused by growing crop populations. The optimum plant population density varies depending on the availability of groundwater, relative humidity, and land availability. (Elhag dan Hussein, 2014). According to Sunarjono (2010), beans is a crumbling plant; when the planting distance is not observed, it will complicate the maintenance of plants, which can ultimately inhibit the flowering process and reduce the production of crops. The recommended growing distance for beans is 50 cm by 40 cm. This is also demonstrated by Rahma et al. (2012) Treatment of planting lengths of 50cm x 20 cm and 50 cm x 30 cm can reduce the weight of the crop per hectare by 0.24 tons ha1, whereas from the growing length of 50 centimeters x 30 cm to 50 cm x 40 cm, there is an increase in the weight per hectare by 0.43 tons/ha. Based on the problems that have been described above, the purpose of this study is to find out the dosage of cane fertilizer and the growing distance that affect the growth and yield of beans crops.

2. RESEARCH METHODS

The research has been carried out at Teuku Umar University's Faculty of Agriculture Experimental Garden, which has been open from January 2022 to March 2022. This study has used a randomized group design (RGD) factororial (3 x 3 with 3 repetitions consisting of two factors). The factors that have been studied include: The dosage of Kascing fertilizer (K) consists of three categories, namely K1 (7,5 tons/ha), K2 (15 tons/he), and K3 (22,5 tons/ha). In addition, there is a growing distance factor (J) consisting of three sides, namely J1 (50 cm x 30 cm), J2 (50cm x 40 cm), and J3 (50cm x 50cm). In this study, there have been 9 combinations of treatments with 3 repetitions, for a total of 27 treatments. Data has been obtained from the measurement of each parameter and then applied to variety fingerprint analysis. Furthermore, Least Significance Different (LSD) method has been used as a further test with a 5% significance rate. The implementation of this research consists of:

2.1. Preparation of land

The soil used is first cleaned of dirt and wood branches. After that, soil treatment is included with the manufacture of a frame with a horizontal length of 130 cm and a vertical width of 140 cm and a total land width of 6 m and a length of 16 m manually using a cangkull and a scop. The soil type in this study is clay soil, and the planting process included planting two seeds in one planting hole.

2.2. Vermicompost Fertilizer application

Vermicompost fertilizer has been administered once, i.e., 1 week before planting with the appropriate fertilizer dosage (K1 = 1,008, 1,350, 1,692 grams/plot; K2 = 2.O25, 2,700, 3,375 grams/plot; K3 = 3,042, 4,050, 5,040 grams/plot). The method of application of cascading fertilizer is to sow and mix the rat with the soil around the planting hole where the buncis seed is to be planted.

2.3. Seed Preparation

The seeds used are the seeds of the Maxipro variety beans obtained from well-selected farm stores, which are of good quality anyway. When selecting seeds, they should have a uniform size and color visually, not be defective, and not be affected by pests and diseases.

2.4. Cultivation

Planting has been done on a planting medium that has been prepared by making a plant hole, and then seeds are planted in the amount of 2 seeds in each planting hole that has been prepared. The planting of beans is done in the afternoon.

2.5. Array Installation

The Ajir installation is to help the plant grow up regularly so that it does not overlap after the plant grows around the age of 10-15 DAP, the Ajir is mounted in a fixed way next to the base of the plant.

2.6. Harvesting

Harvesting can be done after planting at 49 to 54 DAP. At the time of harvesting, the tools used are sharp and clean scissors that can also be punched by hand. Characteristics of a buncis that can be harvested when the buds are young and the small seeds are not yet prone to the surface of the bud, and usually it occurs in the 2–3 weeks after the flowering. The observation parameters are Plant Length, Stem Diameter, Leaf Width, and Pod Weight.

3. RESULTS AND DISCUSSION

3.1. Effected of Vermicompost fertilizer

The result has shown that vermicompost fertilizer has a direct effect on plant lengths 14 and 21 DAP, and leaf widths. And has a non-direct effect on the length of the plant at age 28 DAP, the base diameter of the stem age 14, 21 and 28 DAP and the weight of pods. Average values can be seen in Table 1.

Tabel 1. Average length of plant, stem diameter, leaf width, and weight of pods due to vermicompos fertilizer

Parameter	Age of Plant	Vermicompos Dosage			LSD 0.05
		K1	K2	K3	
Length (cm)	14 DAP	71.00a	93.33b	96.00b	2.15
	21 DAP	431.33a	424.67a	615.00b	15.20
	28 DAP	1254.00	1269.33	1475.00	-
Stem Diameter (mm)	14 DAP	23.67	26.41	26.55	-
	21 DAP	29.11	32.66	34.25	-
	28 DAP	38.15	39.78	42.66	-
Leaf Width (cm)		823.33a	1066.67b	1096.00c	22.30
Weight of pods (g)		555.79	492.62	788.67	-

Description : The numbers followed by different letters mean a real difference at the LSD test level of 0.05.

Table 1 has shown that the best result length of the plant at 14 DAP has had a significant effect due to the administration of doses of vermicompos fertilizer obtained on the treatment of K3 (22,5 tons/ha) and has not differed significantly on the treatments of K2 (15 tons/ha) but has been significantly different on the therapy of K1 (7,5 tons/ha). Then, at 21 DAP, it has been shown that the plant has had an effective effect on treatment (K3) but has differed substantially with treatment (K2) and (K1). It is assumed that the vermicompos fertilizer contains the nutrient elements that plants need, especially nitrogen (N), which, in addition to the N elements that are readily available in coconut soil, can also support the long growth of the stems of beans plants. Sartika Rihana et al. (2013) have stated that the primary function of the N grain element is to stimulate plant growth in the vegetative period, so that the given vermicompos fertilizer has the purpose of promoting vegetative growth of plants faster and better. This has been supported by the statement (Prihmantoro, 1996 in Syrifah et al., 2016), which also states that in the vegetative phase plants need nitrogen for plant growth. Lingga and Marsono (2005) also stated that vermicompos fertilizers contain various nutrients that plants need, such as N, P, K, Ca, Mg, S, Fe, Mn, Al, Na, Cu, Zn, Co, and Mo.

The base diameter of the stems at 14, 21, and 28 DAP beans has had no significant influence on the dosage treatment of vermicompos fertilizer (Table 1). However, there has been a tendency for the highest values in the treatment of K3 (22,5 tons/ha) compared to that of K1 (7,5 tons/ha) and K2 (15 tons/ha). This is presumed because the potassium (K) element in the vermicompos fertilizer has not been able to adequately grow the diameter of the beans plant stem. While the growth of the diameter of the plant stem is influenced by the potassium element available in the vermicompos fertilizer. Leiwakabessy (1998) has stated that the potassium element plays a major role in increasing the diameter of the crop, especially as the connected tissue between the roots and leaves in the transpiration process. This statement has been supported by the opinion of Ardiana et al. (2016), who stated that the stem is an area of accumulation of growth in plants, especially in younger plants, so that the presence of the element hara can stimulate the vegetative growth of the plant, including the formation of chlorophyll on the leaves, so that it will drive the rate of photosynthesis. The faster the photosynthetic rate, the greater the resulting photosynthesis and the increase in diameter of the stem.

The results in Table 1 have shown that the best leaf width of the beans plant has had a direct effected on treatment (K3) and has not had any direct effect on treat (K2), but has had direct effect on treatments (K1). From the observations have been obtained stretched values on treatment K3 (22,5 tons/ha) 1096.00cm. This is presumed because the vermicompos fertilizer contains macro and micro elements, especially N elements, which are readily available in coconut soil and are capable of supplying the leaf growth of buncis plants. It has been agreed with Sutedjo, (2010) which states that nitrogen is an essential element for enhancing plant growth, leaf growth with a greener colour and generally essential for the formation or growth of vegetative parts of plants such

as stems and roots. has also been in agreement with Harjadi (1996) which has stated that the nitrogen needed by plants to stimulate plant growth especially stems, branches, and leaves.

3.2. Effect of Separation

The results has shown that separation has a non-direct effect on all parameter on this factor. Average values can be seen in Table 2.

Tabel 2. Average length of plant, stem diameter, leaf width, and weight of pods due to separation

Parameter	Age of Plant	Separation			LSD 0.05
		J1	J2	J3	
Length (cm)	14 DAP	85.67	89.00	85.67	-
	21 DAP	435.67	535.00	500.33	-
	28 DAP	1210.00	1419.67	1368.67	-
Stem Diameter (mm)	14 DAP	23.86	27.08	25.69	-
	21 DAP	28.63	33.11	34.27	-
	28 DAP	35.05	43.26	42.27	-
Leaf Width (cm)		861.00	1029.00	1096.00	-
Weight of pods (g)		534.47	617.31	685.31	-

Description : The numbers followed by different letters mean a real difference at the LSD test level of 0.05.

Table 2 has shown that the plant lengths 14, 21 and 28 DAP, as well as the base diameter of the stem 14, 21 or 28 DAP have no-direct effect on the treatment of the tested crop distance. This is supposed to be due to plants have interfered with other plantations and have intertwined between plants, so that the reception of sunlight becomes non-maximum. This has been in line with Tesar et al., (1984) which stated that the rate of net assimilation is heavily influenced by the spread of sunlight on plant titles, the presence of each other-covering leaves will reduce the net asimilation rate. Furthermore, according to (Guritno and Sitompul, 1995) one way to good growth is by setting up a wider growing distance, because competition in acquiring elements of harvest, water and sunlight between plants becomes lower. This has been in line with the view of Hidayat (2011) which has said that close plant distances, the roots of one plant will enter into the other plant so that each other in obtaining material, besides that light obtained becomes less so that the results of photosynthesis are not maximum. Light competition occurs when a plant covers another plant or a leaf covers other leaves so that it has affected the process of photosynthesis. This has supported a study by Utomo et al., (2017) which has stated that too close growing distances will result in competition between plants in obtaining the elements of harvest, sunlight, and water so that it can drive plants to grow and allow the growth and development of plants at maximum.

The leaf width parameters, and the weight of the seedlings have no-direct effect on the planting distance tested. However, a predisposition to J3 treatment (50x50) has been found to have the highest value on all observations in the generative phase. This leads to the assumption that wider growing distances provide optimum growing space to obtain hares and water until wider plant distances can yield better results. This finding has been in line with the opinion of Sohel, et al., (2009), which states that optimum planting distances will provide good top growth of plants so that it can take advantage of more sunlight and the growth of the root part is also good so that more hares can be used and increase plant production.Based on the results of the research, there was no apparent interaction between the dosage of vermicompos fertilizer and the growing distance given to the buncis plant against all observation parameter variables. This suggests that the result of the

bunciss plant does not depend on the administration of the given dosage and also on the planting distance and so on.

4. CONCLUSION

The administration of a dosage of vermicompos fertilizer has effected on the length of the plant 14, 21 DAP and the leaf width where each observation parameter is found to be the best result on the treatment of K3 with a dose (22,5 tons/ha). The treatment of separation has no-direct effect on all the treatments tested. There is no interaction between the vermicompos fertilizers and the separation treatment given to the growth and the yield of the crops.

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