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Dose treatment of legume compost with the number of plants per planting hole for land efficiency and increasing sweet corn production

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Abstract. Sweet corn requires large nutrients for growth and production. Legume compost can be used as fertilizer to fulfill nutrients that are beneficial for plant growth. The use of legume compost can substitute NPK elements which function for plant growth. Other efforts that can be made to increase sweet corn production due to the narrowing of agricultural land are to increase the plant population, which is usually 1 plant per planting hole can now be added to 2 to 3 plants per planting hole. The purpose of this study was to determine the best dosage combination of legume compost with the number of plants per planting hole. This research was conducted in an experimental field in Politeknik Negeri Jember. The study was conducted using a factorial randomized block design (RBD) with 2 factors, namely the dose of legume compost and the number of plants per planting hole. From this study there were 9 treatment combinations and 3 replications so that there were 27 experimental units. Anova test results showed that the treatment of legume compost dosage and the number of plants per planting hole had no significant effect on the parameters of plant height, number of leaves, corn cob length, corn cob weight, corn cob diameter, and sweetness level, but had significant effect on the parameter of corn cob production per unit observation.

1.Introduction

Fertilization is one aspect of sweet corn cultivation that must be done to meet plant nutrient needs. Fertilization has two main objectives, namely replenishing sufficient plant nutrient supplies and improving or maintaining the integrity of soil conditions, in terms of structure, pH conditions, potential binding to plant nutrients [1]. Fertilization efficiency must be done, because excess dosage means that it increases costs and negatively affects soil fertility

Nutrient is one of the limiting factors for the production of sweet corn plants. To achieve maximum sweet corn yield, sweet corn plants must not be nutrient deficient. The recommended fertilizer for sweet corn plants is inorganic fertilizer as much as 200 kg N ha-1 or equivalent to 435 kg urea ha-1, 150 kg P2O5 ha-1 equivalent to 335 kg TSP ha-1, and 150 kg K2O ha-1 equivalent to 250 kg of KCl ha-1 as well as 10 to 20 tonnes of organic matter per hectare [2].

The use of inorganic fertilizers generally uses inadequate doses, so that nutrient depletion is suspected. In addition, the use of organic fertilizers or returning the crop residues to agricultural land is hardly practiced. This results in low nutrient and organic matter content [3]. In order to reduce deterioration of soil fertility and increase sustainable yield productivity, it is necessary to use adequate organic fertilizers in quantity, quality and continuity.

Legume is a type of legume plant that has the ability to fix or utilize nitrogen in the air. Nitrogen will be broken down into ammonium form which can be absorbed by plants with the help of rhizobium sp. This ability causes legume plants to have symbiosis with the appropriate type of

rhizobium bacteria which can reduce the need for additional fertilizers with high nitrogen content from the outside [4].

Trichokompost is an organic fertilizer made from legume plant material composted with the bioactivator Trichoderma sp. The composting process will be fast using soil microorganism bioactivators such as Trichoderma sp. These microorganisms are able to accelerate the process of decomposition of organic matter so that it can be easily absorbed by plants and can maintain soil fertility [5]. Compost with the bioactivator Trichoderma sp has the advantages of being easy to apply, non-toxic, environmentally friendly, does not interfere with other organisms in the soil and does not produce residues in plants or in the soil [6].

The cultivation of sweet corn that is usually carried out by Indonesian farmers from year to year is to use one seed per planting hole, with the consideration of saving the production cost of buying seeds. Several studies have shown that cultivating maize using a high population and dense spacing results in higher production and productivity than using common cultivation [7]. Plant population or use of the right number of seeds per unit area will greatly affect crop production. This is related to the level of competition between plants in obtaining light, water, space, and nutrients. The results of other studies indicate that there is a tendency that the higher the population per unit area, the higher the production. Besides, it is also more efficient in the use of production land [8].

2. Research Methods

This research has been carried out in Politeknik Negeri Jember field research, Tegalgede Village, Sumbersari District, Jember Regency. The time of this research is June to September 2020. Material used in this research is topsoil inceptisol, corn seeds of Bonanza variety, litter leguminosa, bio-activator Trichoderma sp, pesticides, cow manure, urea, SP36, KCl, and dolomite.

The study was conducted using a factorial randomized block design (RBD) with two factors, namely the dose of legume compost (P) consisting of 3 levels and the number of plants per planting hole (B) with 3 levels and 3 replications, so that there were 27 experimental units. As for the treatment given includes:

Factor 1 is dose treatment (P) consists of 3 levels, namely:
P1 = Cow Manure 20 tons / ha + 100% Inorganic Fertilizer
P2 = legume compost 30 tons / ha + 75% Inorganic Fertilizer
P3 = legume compost 40 tons / ha + 50% Inorganic Fertilizer
Factor 2 is the number of plants per planting hole (B) consists of 3 levels, namely:
B1 = 1 plant per hole
B2 = 2 plants per hole
B3 = 3 plants per hole

Sweet corn planting 2 weeks after treatment by making planting with a plant spacing of 75 cm x 25 cm. Dosage for 100% inorganic fertilizer using an urea 435 kg /ha, TSP 335 kg/ha, and KCL 250 kg/ha. The parameters studied were plant height (cm); number of leaves (strand), corn cob length (cm), corn cob weight (gram), corn cob diameter (cm), and sweetness level (brix), and corn cob production per unit observation. Data were analyzed with ANOVA test, and then continued with Duncan's New Multiple Range Test (DMRT) level of 5%.

3.Result and Discussion

3.1. Plant Height

The results of the analysis of variance showed that the treatment of various compost legume dosage combinations with the number of plants per planting hole had no significant effect on the plant height parameters of sweet corn (Table 1). Table 1 shows the combination treatment of compost legume dosage and the number of plants per planting hole in sweet corn plants showed a different response in each treatment. Plant height in P3B3 treatment starting at the age of 3, 4, 5 and 6 weeks after planting (WAP) tended to show the highest plant height, where as in P1B1 treatment tended to show the lowest plant height. When using cow manure and the number of 1 plant per planting hole, the plant height is lower than that of the combined dose of trichocompost legume 40 ton / ha + 50% inorganic fertilizer and the number of 3 plants per planting hole. This indicates that P3B3 is best treatment.

Table 1. Average Height of Sweet Corn Plants

Treatment	Average Plant Height (cm)				
	2 WAP	3 WAP	4 WAP	5 WAP	6 WAP
P1B1	16.6a	26.7a	49.3a	78.3a	123.7a
P1B2	16.3a	28.7a	55.3a	92.3a	131.3a
P1B3	15.7a	28.3a	53.3a	86.3a	121.3a
P2B1	15.0a	26.3a	50.7a	79.0a	126.0a
P2B2	17.7a	28.0a	52.7a	84.3a	128.3a
P2B3	15.7a	29.0a	54.3a	86.7a	137.7a
P3B1	19.0a	32.0a	60.7a	93.2a	132.0a
P3B2	16.0a	28.0a	55.3a	87.3a	134.3a
P3B3	18.0a	33.7a	63.3a	97.0a	148.7a

Note: Numbers not followed by the same lowercase letter indicate not significantly different according to further tests DMRT at the level of 5%.

The increase in the height of the sweet corn plant is thought to be due to the nutrients contained in the legume compost and inorganic fertilizers which are able to meet the nutrient needs needed by the plants. Compost legume in this study is an organic fertilizer containing Trichoderma sp. which functions as a decomposer of organic material and at the same time as pest control. The advantage of compost legume is that it contains macro and micro nutrients that can increase soil fertility. The nutrients N, P, K contained in legume compost and inorganic fertilizers are much needed by sweet corn plants, especially in the vegetative phase. The occurrence of high growth of a plant was due to the occurrence of cell division and extension events which were dominated at the shoot tips of the plant [9]. This process is the synthesis of proteins obtained by plants from the environment such as organic matter in the soil. The element N is needed by plants for the synthesis of amino acids and proteins, especially at the point of plant growth, so that it can increase plant height [10].

In sweet corn cultivation, the plant population needs to be considered, including the number of plants per unit area. Plant density greatly affects plant growth. This is related to the level of competition between plants in obtaining sunlight, water, space, and nutrients. Using the right number of plants will give a good end result, and will be more efficient in using land, sunlight, water and fertilizers [11]. Furthermore, it is stated that planting density has a significant effect on plant height.

3.2. Number of Leaves

Based on the analysis of variance, it was found that the combination treatment of compost legume dosage and the number of plants per planting hole on sweet corn plants showed no significant effect on the number of sweet corn leaves. The results of the analysis of the average number of leaves can be seen in Table 2.

The application of legume compost with the number of plants per planting hole did not have a significant effect on the number of leaves. Based on the results of laboratory analysis on compost legume, it is known that the elemental content of N, P and K is 0.958%, 0.647% and 1.561%. The N element is the main nutrient for plant vegetative growth, namely leaves, stems and roots [12]. The N element is also beneficial for the formation of chlorophyll which is very important for the photosynthetic process so that it can increase the vegetative growth of plants [13]. It is estimated that the combination of legume compost and inorganic fertilizers cannot be utilized properly by sweet corn plants.

In this study, the C / N ratio value is still high, so it will cause the decomposition time to be longer. If the C / N ratio is high, the biological activity of microorganisms will decrease. It takes several cycles of microorganisms to degrade compost, so it takes a long time for composting and results in lower quality. From the results of laboratory analysis, it was found that the C content of legume compost was 51.826%. This shows results that exceed the threshold requirements for C-Organic content stipulated by Permentan No. 70/Permentan/SR.140/10/2011, namely the minimum requirement for C-Organic content is 6%. The C/N ratio of organic material to compost raw materials

is an important factor in the rate of composting [14]. According to other studies [15] states that to obtain optimal soil productivity, more than 2% c-Organic is needed. This condition is intended so that the content of organic material in the soil does not decrease over time due to the mineralization decomposition process. For the results of 0.958% legume compost it can be said to be good, because the minimum N-Total of SNI 19-7030-2004 is 0.4%. The results of field research on sweet corn plants, although the C N ratio value is still above 30, it does not cause nutrient deficiency. From the study shows that the use of legume compost 40 ton/ha+50% inorganic fertilizers tends to increase vegetative growth of plants. This can be seen in plant height and number of leaves. Plants tended to have the highest number of leaves in the treatment with three seeds per planting hole combined with 40 ton/ha legume compost + 50% inorganic fertilizer.

Table 2. Average Number of Leaves of Sweet Corn Plants

Treatment	Average Number of Leaves (strand)				
	2 WAP	3 WAP	4 WAP	5 WAP	6 WAP
P1B1	3.00a	4.33a	6.00a	7.00a	8.67a
P1B2	3.33a	4.67a	6.00a	7.33a	8.67a
P1B3	3.00a	4.00a	6.00a	7.00a	7.33a
P2B1	3.67a	4.33a	6.00a	7.00a	9.00a
P2B2	3.33a	4.33a	6.33a	7.33a	8.67a
P2B3	3.00a	4.33a	6.00a	7.67a	8.67a
P3B1	3.33a	5.00a	6.67a	8.33a	9.00a
P3B2	3.00a	4.67a	6.00a	7.33a	8.33a
P3B3	4.00a	5.00a	6.33a	7.33a	9.00a

Note: Numbers not followed by the same lowercase letter indicate not significantly different according to further tests DMRT at the level of 5%.

3.3. Parameters of Length, Diameter and Weight of Sample Cobs, Level of Sweetness, and Corn Producti

Based on the results of the analysis of variance, it was found that the combination of legume compost dosage treatment and the number of plants per planting hole on sweet corn plants had no significant effect on length, diameter, weight of sample cobs and level of sweetness, but had significant on cobs weight per unit observation. The results of the analysis can be seen in Table 3.

Table 3. Parameters of Sweet Corn Plants Production

Treatment	Parameters				
	Cobs Length (cm)	Cobs Diameter (cm)	Cobs Weight (gram)	Level of Sweetness (brix)	Corn Production (kg)
P1B1	26.0a	5.89a	397a	19.1a	3.0a
P1B2	27.0a	5.44a	331a	20.7a	3.6ab
P1B3	25.0a	5.64a	346a	19.3a	5.4bc
P2B1	27.0a	5.97a	417a	19.7a	3.8ab
P2B2	27.0a	5.55a	332a	19.6a	3.7ab
P2B3	27.4a	5.52a	334a	19.8a	4.8bc
P3B1	26.0a	5.67a	398a	19.6a	4.2ab
P3B2	28.0a	5.87a	362a	20.0a	5.9c
P3B3	27.0a	5.55a	336a	19.3a	4.2ab

Note: Numbers not followed by the same lowercase letter indicate not significantly different according to further tests DMRT at the level of 5%.

The application of legume compost with the number of plants per planting hole did not have a significant effect on production factors, which included cobs length, cobs diameter, cobs weight per sample, and level of sweetness, but had a significant effect on cobs weight per observation unit. This is

presumably because plants lack a supply of potassium nutrients, because potassium is directly involved in the fruit ripening process. Lack of K elements show the symptoms of the fruit dropping at early ripe, the taste of the fruit is not real because it is less acidic, the fruit ripens unevenly, the number of fruits is small and the storage organs have low weight [16]. This is because the nutrient elements in the legume compost have not dissolved completely and have not been optimally utilized by sweet corn plants. The interaction of legume compost 40 ton / ha + 50% inorganic fertilizer with the number of 2 plants per planting hole gave a significant effect on the weight of cobs per sweet corn bed, with the highest yield of 5.9 kg, followed by P1B3, namely 5.4 kg, where between P3B2 and P1B3 were not significantly different (Table 3).

In sweet corn cultivation, the plant population needs to be considered, including the number of seeds per unit area. Plant density greatly affects crop yield or production. This is related to the level of competition between plants in obtaining light, water, space and nutrients. Plant density can be adjusted by using the right number of seeds. The use of the right amount of seeds will provide good final results, besides being more efficient in land use [17].

4. Conclusion

The combination of compost legume dosage and the number of plants did not significantly affect the growth of sweet corn on the parameters of plant height and number of leaves. The combination of compost legume dosage and number of plants also had no significant effect on the parameters of length, diameter, cob weight per sample, and sweetness level of sweet corn, but had a significant effect on cob weight per treatment. The combination of legume compost 40 ton/ha + 50% inorganic fertilizer with the number of 2 plants per planting hole gave a significant effect on the weight of cobs, with the highest yield of 5.9 kg.

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