JPPIPA 7(Special Issue) (2021)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Vegetative Growth of Sweet Corn (Zea mays L. Saccharata) Due to Difference Doses of Horse Manure Compost and NPK Fertilizer

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DOI: 10.29303/jppipa.v7iSpecialIssue.863

Article Info
Received: August 8th, 2021
Revised: November 25st, 2021
Accepted: December 5th, 2021

Abstract: Sweet corn has a sturdy and strong stem growth and is very suitable for cultivation in tropical climates. Research on the effect of horse manure compost combined with NPK fertilizer on the growth of sweet corn has been done with the aim of obtaining information: (1) the effect of different doses of horse manure compost on the growth of sweet corn, (2) the effect of different doses of NPK fertilizer on the growth of sweet corn, (3) The interaction effect of horse manure compost and NPK fertilizer on sweet corn vegetative growth. The application of NPK fertilizer was carried out with 4 treatment doses while the application of horse manure compost was carried out with 5 treatment doses. In this study, information was obtained (1) the application of NPK fertilizer increased the growth of sweet corn, (2) the application of horse manure compost increased the growth of sweet corn, (3) There was no increase in growth of sweet corn due to the combination treatment of NPK fertilizer and horse manure compost

Keywords: Horse manure compost; NPK fertilizer; Sweet corn growth

Citation: Raksun, A., Ilhamdi, M. L. ., Merta, I. W. ., & Mertha, I. G. . (2021). Vegetative Growth of Sweet Corn (Zea mays L. Saccharata) Due to Difference Doses of Horse Manure Compost and NPK Fertilizer. *Jurnal Penelitian Pendidikan IPA*, *7*(SpecialIssue), 168–174. https://doi.org/10.29303/jppipa.v7iSpecialIssue.863

Introduction

Sweet corn has a sturdy and strong stem growth and is very suitable for cultivation in tropical climates. Sweet corn has a large cob size. The length of the cob is about 20 – 22 cm with a diameter of 5 – 6 cm. The seed is yellow, can be harvested at age of 72 days after planting if planted in the lowlands. Once harvested, this corn usually produces productivity of 12,4 tons per hectare (Aida, 2020). Sweet corn is favored by the people of Indonesia. Sweet corn contains carbohydrates, protein, fat, vitamin A, vitamin B, vitamin C, and minerals. The minerals contained in sweet corn are calcium and phosphorous (Rizki, 2013)

Efforts to increase the growth of sweet corn can be done by applying fertilizer to the growing media. Fertilization is the key to soil fertility because fertilizer contains one or more nutrients to replace nutrients that have been absorbed by plants. Fertilization of plants can use synthetic chemical fertilizer and organic fertilizer. One of the chemical fertilizers that can be used is NPK fertilizer. This fertilizer is compound fertilizer because it contains more than one nutrient, namely nitrogen, phosphorous, and potassium (Marsono, 2008)

In an effort to reduce the use of chemical fertilizer, it is necessary to use organic fertilizer. such as compost which can be produced using cow manure, horse manure, goat manure, and other organic waste. Hardjowigeno (2003) explains that compost is organic material that has been rotten.

Compost application serves as a source of nutrients in the soil, improves soil organic matter, improves soil structures, and encourages the life of soil microorganisms. In addition, compost can improve soil physical properties such as soil permeability, soil porosity, soil water holding capacity, and soil cations

Some researchers found that the use of compost is very supportive of increasing plant growth. Wasis

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and Sandrasari (2011) concluded that giving compost can increase the growth of mahogany seedling stem height. Compost dose of 30 grams significantly affected the growth percentage of mahogany seedling of 40.70% against the control with an average growth of 6.81 cm.

Treatment of solid compost can increase plant growth if it is given to planting media that have poor soil physical properties such as high soil density (Harso, 2017). The treatment of compost and phosphorous fertilizer with a dose of 3 grams gave a very significant result in increasing plant height and leaf area with the highest green bean height reaching 32,5 cm, the most leaves being 13,5 leaves and the highest leaf area being 12,55 cm2 (Suratmin at al., 2017). Composting can increase the growth of green beans (Vigna radiate L.) which included the parameters of stem height and plant leaf area. The combination between compost and phosphorous fertilizer has a positive influence on stem height and leaf area of green beans.

Based on the above background, research was conducted on the vegetative growth of sweet corn (Zea mays L. saccharata) due to differences in the doses of compost and NPK fertilizer. The aims of this study were to determine: 1) the effect of different doses of horse manure compost on the growth of sweet corn, (2) the effect of different doses of NPK fertilizer on the growth of sweet corn, (3) The interaction effect of horse manure compost and NPK fertilizer on sweet corn vegetative growth.

Method

This research has been carried out for 6 months starting from May to October 2020 on the agricultural land of Terong Tawah Village, West Lombok. This research is experimental research conducted using a factorial completely randomized design. The first factor was the compost treatment (M), which consisted of 5 levels, namely: M_0 = 0 kg, M_1 = 0.6 kg, M_2 = 1.2 kg, M_3 = 1.8 kg and M_4 = 2.4 kg compost for 1 m^2 of farmland. The second factor is the treatment of NPK fertilizer (P) which consists of 4 levels, namely: P_0 = 0 grams, P_1 = 4 grams, P_2 = 8 grams, P_3 = 12 grams of NPK fertilizer for 1 plant. The compost treatment was carried out 15 days before planting while the NPK fertilizer treatment was carried out when the plants were 15, 30, and 45 days old. Before use, NPK fertilizer first dissolved in water

The materials used were horse manure compost, sweet corn seed, river water, paddy field soil, NPK fertilizer, 250 ml curation insecticide, furadan, and fungicide Siento 55 EC. The tools used are a water pump machine, hoe, sickle, machete, measuring cup plastic bucket, meter, analytical balance, and hand sprayer. The research was carried out in 9 stages of activity: (1) making compost with horse manure as raw material, (2) cleaning the experimental land, (3) cultivating the land and making beds with a length = 16 m and a width of 1 m (4) application of compost to the land experiment 15 days before planting, (5) planting sweet corn seeds, (6) irrigating the experimental field once in 2 weeks, (7) eradicating pests and plant diseases using insecticides and fungicides, (8) measuring the growth parameters of sweet corn, (9) carry out research data analysis, The sweet corn growth parameters data ware analyzed using Anova (Teutenburg and Shalabh, 2009).

Result and Discussion

Sweet Corn Leaf Length

The mean length of sweet corn leaves is different in each experimental unit. In general, sweet leaf length increased with increasing doses of compost and NPK fertilizer in each treatment combination. Sweet corn leaf growth data can be seen in Table 1.

Table 1. Sweet Corn Leaf Length in Each Treatment Combination

Treatment	Average Leaf Lenght (cm)	Treatment	Average Leaf Lenght (cm)
P_0M_0	64	P_2M_0	68
P_0M_1	65	P_2M_1	68
P_0M_2	68	P_2M_2	71
P_0M_3	69	P_2M_3	74
P_0M_4	68	P_2M_4	74
P_1M_0	66	P_3M_0	72
P_1M_1	67	P_3M_1	72
P_1M_2	69	P_3M_2	74
P_1M_3	71	P_3M_3	80
P_1M_4	70	P_3M_4	78

Based on the results of data analysis, it is known that the combination of P0M0 treatment resulted in the lowest leaf length of 64 cm. Furthermore, the length of sweet corn leaves is getting longer due to the increasing dose of NPK fertilizer and compost given.

The highest sweet corn leaf length was 80 cm indicated by the combination of 1,8 kg of compost and 8 grams of NPK fertilizer. Anova analysis showed that the application of NPK fertilizer could increase leaf length, horse manure compost could increase leaf length, the combination of NPK fertilizer and compost could not increase sweet corn leaf length

The significant effect of compost treatment on sweet corn leaf length is due to the compost containing a lot of organic matter. Organic matter in the soil can increase the availability of nutrients in the soil. Gusmini et al (2008) explains that the application of organic matter could increase the nutrient content of

nitrogen, phosphorus, and potassium in the soil. The percentage increase in nutrient availability depends on the type of organic matter provided. Likewise, Afandi et al (2015) found that giving some organic materials such as chicken manure, cow manure, and compost had a significant effect on the chemical properties of the entisol soil, the uptake of nitrogen, phosphorus, and potassium in plants and tubers as well as the growth and production of sweet potatoes.

The difference in the treatment of NPK fertilizer causes differences in the length of sweet corn leaves. The results of this study are in line with the results of research on pineapple and other plants. NPK fertilizer treatment can increase the leaf length of pineapple (Annanas comosus L. merr). The optimum dose of NPK fertilizer for pineapple is 15 grams per plant (Cahyono et al, 2014). Cow manure compost treatment can increase leaf length, leaf width, number of leaves, and wet weight of fruit green eggplant. The optimum dose of cow manure compost is 1,5 kg for 1 square meter of agricultural land (Raksun et al, 2021). Compost treatment can increase the length of spinach leaves (Raksun et al, 2021)

Sweet Corn Stem Height

The results of the study on the effect of NPK fertilizer and horse manure compost on the vegetative growth of sweet corn showed differences in plant height, leaf length, number of leaves, and stem diameter. In general, all measured sweet corn growth parameters increased in line with increasing doses of compost and NPK treatment. The data obtained about the height of sweet corn stem can be seen in Table 2.

Table 2. Plant Height of Sweet Corn in each Treatment Combination

Treatment	Avarage Plant Height (cm)	Treatment	Avarage Plant Height (cm)
P_0M_0	135	P_2M_0	140
P_0M_1	137	P_2M_1	141
P_0M_2	137	P_2M_2	143
P_0M_3	140	P_2M_3	146
P_0M_4	139	P_2M_4	144
P_1M_0	138	P_3M_0	145
P_1M_1	138	P_3M_1	145
P_1M_2	141	P_3M_2	146
P_1M_3	143	P_3M_3	152
N_1K_4	141	N_3K_4	151

In Table 1, it can be seen that the height of sweet corn varies in each experimental unit. The lowest stem height was 135 cm, obtained on sweet corn without NPK fertilizer and horse manure compost. Furthermore, the highest was 152 cm, obtained in the interaction of treatment of 1.8 kg of horse manure compost and 8 grams of NPK fertilizer. Anova test results showed that NPK fertilizer treatment can increase the height of sweet corn stem. Horse manure compost treatment can increase the height of sweet corn stem. There was no significant effect of interaction between horse manure compost and NPK fertilizer to increase the height of sweet corn stem.

The increase in sweet corn stem height is due to the compost containing organic matter that can improve the chemical and physical properties of the soil. Ameliorant treatment based on organic matter can improve the chemical and physical properties of tailings soil. Organic matter 20% water hyacinth + 20% cow manure + 20% market waste + 20% rice straw increased plant height and leaf count of sweet corn (Sondakh et al, 2017). Organic fertilizers treatment on soils that contain low C-organic and N-total can increase sugarcane yields. Compost treatment can increase the nitrogen content and C-organic of the soil. Compost can reduce the density of the soil, increase the maturity of the aggregates, soil fertility, and water content of the soil. (Zulkarnain et al, 2013). The provision of compost made from cow manure, chicken manure, Gamal leaves and Angsana leaves can improve soil physical properties (soil moisture and soil porosity) and soil chemical properties (soil pH, C-organic soil, and soil organic matter (Hasibuan, 2015). Compost treatment can also increase stem height, leaf length, number of leaves, and stem diameter of spinach (Raksun et al., 2021).

The treatment of NPK fertilizer significantly affected the height stem of sweet corn. Research on other plants also shows that NPK fertilizer treatment can increase plant height. The application of nitrogen and phosphorus fertilizers simultaneously on maize plants in regosol and latosol soils had a significant effect on plant growth such as plant height, shoot dry weight, root dry weight, and total dry weight (Fahmi et al, 2010). The application of NPK fertilizer had a significant effect on the growth of shallots. The best treatment was found in the treatment of 250 g/plot produces the highest plant height of 35.28 cm (Khadijah et al, 2021). NPK fertilizer had a significant effect on the growth of height and stem diameter of Gmelina seedlings (Waris and Fathia, 2010). Stem height and stem diameter of eggplant gave a positive response to the application of N, P, K fertilizers (Firmansyah et al, 2017). The application of NPK fertilizer at a dose of 2 g/plant gave a good effect on the growth of plant height and stem diameter of cocoa seedlings (Daryadi and Andrian, 2017).

Number of Leaves

The total of leaves is counted from the first leaf to the last leaf. The number of sweet corn leaves varied

in each experimental unit. In general, an increase in the dose of NPK fertilizer and cow manure compost causes an increase in the number of sweet corn leaves. The maximum number of leaves was 14 leaves, found in the combination treatment of 1.8 kg of compost and 8 grams of NPK fertilizer. The lowest number of leaves was 9 leaves, found in the control treatment. The average number of sweet corn leaves in each treatment can be seen in Table 3.

Table 3. Average Number of Sweet Corn Leaves in Each Treatment Combination

Treatment	Avarage Number of Leaves	Treatment	Avarage Number of Leaves
P_0M_0	9	P_2M_0	11
P_0M_1	10	P_2M_1	11
P_0M_2	10	P_2M_2	12
P_0M_3	10	P_2M_3	12
P_0M_4	10	P_2M_4	13
P_1M_0	10	P_3M_0	12
P_1M_1	10	P_3M_1	12
P_1M_2	11	P_3M_2	12
P_1M_3	11	P_3M_3	14
P_1M_4	10	P_3M_4	13

The average number of sweet corn leaves in table 3 shows that the lowest number was 9 leaves, found in the control. The highest number of leaves was 14 leaves, found in the combination treatment of 1.8 kg of horse manure compost and 8 grams of NPK fertilizer Te Anova test gives the result that the interaction of compost and NPK fertilizer treatment had no significant effect on the total of sweet corn leaves. The horse manure compost treatment can increase the number of sweet corn leaves. The treatment of NPK fertilizer can increase the number of sweet corn leaves.

The significant effect of compost treatment on increasing the number of plant leaves was also found in other plants. The application of domestic waste compost at a dose of 4.5 tons per hectare had a significant effect on vegetative growth such as the number of leaves, plant height, stem diameter, and the number of new shoots of sugarcane (Apriscia et al, 2016). Compost treatment had a significant effect on increasing the number of red chili leaves. The dose of 20% horse manure compost is the best dose to increase the growth and yield of red chili (Imas et al., 2017). The treatment of organic compost and manure can increase the number of kale land leaves at the age of 14 days after planting (Sayekti et al., 2016).

The application of NPK fertilizer can also increase the number of sweet corn leaves. Similar results were also found in other plants. The number of productive branches, leaf area index, leaf number, stem diameter, and yield showed a positive response to NPK fertilizer treatment at doses of 200 kg nitrogen per hectare, 100 kg P_2O_5, and 75 kg K_2O per hectare (Firmansyah et al, 2017). The combination of NPK fertilizer treatment and shoot source significantly affected the number of leaves, plant height, leaf length, leaf width, and leaf area of pineapple (Cahyono et al, 2014). NPK fertilizer treatment significantly affected the number of leaves, plant height, leaf area, number of fruits, and dry weight of green bean seeds (Murdaningsih, 2020)

Sweet Corn Stem Diameter

In this study, sweet corn stem diameter varied in each treatment. The lowest sweet corn stem diameter was 25 mm, found in the control. The highest diameter of sweet corn was 34 mm found in the treatment of 1.8 kg of compost combined with 8 grams of NPK fertilizer. The data on the average diameter of sweet corn diameter is presented in Table 4.

Table 4. Average Diameter of Sweet Corn Stem Due to Difference Doses of Compost and NPK Fertilizer

Treatment	Average Stem Diameter (mm)	Treatment	Average Stem Diameter (mm)
P_0M_0	25	P_2M_0	30
P_0M_1	27	P_2M_1	31
P_0M_2	29	P_2M_2	31
P_0M_3	30	P_2M_3	32
P_0M_4	29	P_2M_4	30
P_1M_0	29	P_3M_0	31
P_1M_1	30	P_3M_1	32
P_1M_2	30	P_3M_2	32
P_1M_3	31	P_3M_3	34
P_1M_4	31	P_3M_4	32

Anova test shows that the interaction of compost and NPK fertilizer treatment had no significant effect on sweetcorn stem diameter. The difference in the dose of NPK fertilizer has a significant effect on the stem diameter of sweet corn. Differences in compost dose significantly affect the diameter of the sweet corn stem diameter.

This research gives the same result as another research. Media with a mixture of soil, sand, and cow manure compost can increase stem diameter, plant height, number of leaves, and leaf dry weight (Handayani and Apriani, 2020). The treatment of several doses of compost can increase stem diameter, the volume of roots, and the plant height of soybean. The best compost dose is 24.5 grams per polybag (Nazirah, 2019). Compost treatment can increase the diameter of the spinach stems. In addition, compost treatment can also increase stem height, the number of leaves, and the length of spinach leaves. The optimum dose of compost for spinach is 1.5 kg per 1 m^2 of agricultural land (Raksun, et al., 2021). Compost treatment significantly affected the stem diameter of

sweet orange seedlings at the age of 30 days, 60 days, and 90 days after planting. It also can increase the number of leaves at the age of 30 days and 60 days after planting. (Mario et al, 2020). The combination of soil media, compost, and husk charcoal had a significant effect on the diameter of pakcoy stems. The combination of 1600 grams of soil + 1600 grams of compost and 800 grams of husk charcoal resulted in the highest pakcoy stem diameter and was significantly different from the control (Safitri et al., 2020).

The application of NPK fertilizer can also increase the stem diameter of sweet corn. Similar results were found in other plants. The application of domestic waste compost at a dose of 4.5 tons per hectare had a significant effect on vegetative growth such as stem diameter and the number of new shoots of sugarcane (Apriscia et al., 2016). NPK fertilizer treatment had a significant effect on stem diameter of broccoli at 2 weeks, 4 weeks, and 6 weeks after planting, significantly affected stem height at 6 weeks after planting and a number of leaves 6 weeks after planting. The combination of 100 kg per hectare of NPK fertilizer and 10 tonnes of cow manure per hectare resulted in the highest stem diameter and yield (Costa et al, 2014) NPK fertilizer treatment had a significant effect on melon stem diameter. The highest stem diameter was 11.86 mm found in the treatment of 5 grams of NPK fertilizer per plant (Ayu et al, 2017).

Conclusion

In this study, it was concluded that the interaction between cow manure compost and NPK fertilizer cannot increase the vegetative growth of sweet corn. NPK fertilizer can increase the vegetative growth of sweet corn, the optimum dose of NPK fertilizer is 8 grams per plant given at age of 15, 30, and 45 days after planting. Horse manure compost can increase the vegetative growth of sweet corn, the optimum dose of horse manure compost for sweet corn is 18 tons per hectare

Acknowledgments

We express our gratitude to the Rektor of Mataram University, who has facilitated the provision of a research fund. We also thank all those who have assisted in carrying out this research.

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