Multitech Journal of Science and Technology (MJST)
Vol.3, No.6, 2026:713-722

Response of Sweet Corn (Zea mays saccharata Sturt) to the Addition of Bokashi and NPK Fertilizers

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ARTICLEINFO

Keywords: Sweet Corn, Bokashi, NPK

Received : 5 April
Revised : 20 May
Accepted: 20 June

ABSTRACT

Sweet corn is one of the most popular vegetable commodities in Indonesia. In 2023, corn production decreased. The purpose of this study was to find out the effect of bokashi and NPK fertilizer doses on the growth and yield of sweet corn plants (Zea Mays Saccharata Sturt). This study used a Factorial Randomized Block Design (RBD) with two factors. The first factor consisted of 3 bokashi levels: B1: 10 tons/ha, B2: 15 tons/ha, and B3: 20 tons/ha. The second factor was NPK fertilizer with 3 treatments: N1: 200 kg/ha, N2: 300 kg/ha, and N3: 400 kg/ha. The data obtained from observations of each variable were entered into a table for the F-test using analysis of variance (ANOVA) and further tested using the 5% BNT test. The best treatment result was the B2N2 combination, which is bokashi fertilizer at a dose of 15 tons/ha and NPK fertilizer at a dose of 300 kg/ha, producing the best plant height and stem diameter growth. Meanwhile, observations of the corn products were only influenced by NPK fertilizer, with the highest dose being 300 kg/ha, which produced the heaviest corn and the highest sweetness level of 10.67 Brix

DOI: https://doi.org/10.59890/mjst.v3i6.265
E-ISSN: 3089-9966
https://slamultitechpublisher.my.id/index.php/mjst/index

INTRODUCTION

Sweet corn production is most popular in the United States and Canada. The demand for sweet corn is increasing in Indonesia, as well as in Asia and America. In Indonesia, sweet corn has been grown and known since the 1970s because of its sweet taste (Syukur & Rifianto, 2013). Sweet corn kernels are rich in sugar, so they provide quite a high amount of calories (Pradana et al., 2022). The advantages of sweet corn make its market demand very high. However, sweet corn production in Indonesia is relatively low, so it has not been able to meet consumer demand (Sinuraya & Melati, 2019). Sweet corn production in 2023 experienced a decline, with the harvested area of dried shelled corn reaching 2.48 million hectares, down about 10.03 percent from 2022. Shelled corn production in 2023 is estimated to drop to around 14.46 million tons (Statistics Indonesia, 2020).

The production and quality of sweet corn are influenced by two factors, namely genetic factors and environmental factors, including soil fertility. One way to improve soil fertility is by applying fertilizer. Even though fertilization technology has improved, it still hasn't achieved optimal productivity because the management of soil nutrients is not balanced, resulting in consistently low productivity. Deficiencies in macro and micronutrients are one of the obstacles to reaching maximum productivity in sweet corn (Ramdhani, 2019). Increasing land productivity can be done through fertilization. Using organic materials in fertilization plays an important role in preserving land productivity and maintaining the stability of soil nutrients. Bokashi fertilizer is a type of organic fertilizer that can be used to increase microbial diversity in the soil, thereby improving nutrient availability for plants. Nowadays, bokashi fertilizer is well known among farmers, and some of them are already using it.

LITERATURE REVIEW

The purpose of the research is to study the effect of the interaction between bokashi fertilizer and NPK fertilizer on the growth and yield of sweet corn. Bokashi fertilizer also needs to be balanced with the application of an inorganic fertilizer. The inorganic fertilizer used is NPK, which provides N, P, and K nutrients in the soil, and is an important factor in maintaining and improving soil fertility. These three elements help promote vegetative growth, increase dry matter and seed weight, improve crop quality, speed up flowering, strengthen roots and stems so the plants don’t easily topple, and increase the plants' resistance to diseases caused by fungi (Siltor & Tyasmoro, 2020).

METHODOLOGY

The research was conducted on land with sandy clay soil located in Ringinsari Hamlet, Padangan Village, Kayen Kidul District, Kediri Regency at an altitude of 86 meters above sea level. The study took place from January 2025 to May 2025. The tools used included hoes, rakes, an analytical balance, a sprayer tank, watering cans, tag labels, measuring tape, rulers, books, pens, and a camera. The research materials consisted of: Talenta variety sweet corn seeds from an agricultural store, bokashi fertilizer from an agricultural store, NPK Mutiara fertilizer from an agricultural store, water, Kayabas herbicide, Minecto Xtra insecticide, and Amistartop fungicide.

The treatment was carried out using a factorial Randomized Block Design (RBD) consisting of 2 factors. The first factor was bokashi dose treatment (B) consisting of 3 dose levels and the NPK dose treatment (N) consisting of 3 dose levels:

1. Factor 1 Bokashi fertilizer with 3 combinations: B1: 10 tons/ha = 200 g/plant, B2: 15 tons/ha = 300 g/plant, B3: 20 tons/ha = 400 g/plant
2. Factor 2 NPK fertilizer with 3 combinations: N1: 200 kg/ha = 4 g/plant, N2: 300 kg/ha = 6 g/plant, N3: 400 kg/ha = 8 g/plant

From the two factors above, there are 9 treatment combinations, namely B1N1, B1N2, B1N3, B2N1, B2N2, B2N3, B3N1, B3N2, B3N3.

Research Implementation

1. Land Preparation

Land processing is done by plowing the land using a tractor, as well as getting rid of weeds that grow and cleaning the plants from dirt or remnants of previous plants. Then it is continued by making plots measuring 400 cm x 100 cm, a total of 27 plots, with 50 cm spacing between plots.

2. Planting

Planting sweet corn is done by making planting holes using a dibble about 5 cm deep, then putting 2 sweet corn seeds into the holes and covering them back with soil. The planting is done with a spacing of 70 cm by 25 cm. There are 20 plants per plot.

3. Fertilization

Fertilization is done by applying base fertilizer, which is bokashi fertilizer, and it also serves as the treatment in this study. The doses of bokashi fertilizer for soil treatment have been determined, namely B1 = 10 tons/ha, B2 = 15 tons/ha, and B3 = 20 tons/ha, with each trial spread over 27 plots. The fertilizer is applied during planting and also serves to cover the planting holes. Next, fertilization is done using NPK fertilizer, applied by placing it in fertilizer holes, which are made by poking the soil about 5 cm from the plant. The doses of NPK fertilization are N1 = 200 kg/ha, N2 = 300 kg/ha, and N3 = 400 kg/ha, and the fertilization is done twice at 10 and 25 days after planting.

4. Irrigation

Watering is done according to the conditions in the field, irrigation is used to prevent water shortage for sweet corn plants.

5. Weeding

The weeding process for sweet corn is done at 14 and 30 days after planting using chemicals with a selective herbicide branded Kayabas.

6. Hilling

Hilling is done by covering the roots of plants that appear above the soil surface by piling soil from the sides. Hilling functions to strengthen the plants.

7. Pest and Disease Control

Efforts made to prevent the emergence and spread of pests on sweet corn plants include observing the sweet corn plants every day, and when attacked by FAW pests, using Minecto Xtra insecticide.

8. Harvest

Harvesting is done when sweet corn is about ± 70 days after planting, with the signs that the plant is ready for harvest being the cob is fully filled, the corn kernels are yellow, and the corn silk is yellowish-brown.

9. Observation

Vegetative observations were carried out 4 times, namely when the plants were 14, 21, 28, and 35 days old. For generative observations, they were done when the plants were harvested. In each observation, 10 samples were taken from each plot, with the observation variables as follows:

Vegetative Observation

1. Plant Height

Plant height observation is done by measuring vertically from the ground surface to the tip of the last leaf using a measuring tape.

2. Stem Diameter

Stem diameter measurement is done by measuring the diameter at the middle part of the stem using calipers.

3. Number of Leaves

Leaf count observation is done by counting the number of complete leaves on each plant.

Generative Observation

Weight of cobs with husks : Observations are done by weighing samples of cobs that still have husks.

Weight of cobs without husks : Observations are done by weighing samples of cobs that no longer have husks.

Sweetness level : Observations are done by taking water from the corn kernels in the middle of the cob, then dropping it onto a Brix refractometer to check the sugar content.

Data Analysis

The data obtained from observing each variable were subjected to an F test using the analysis of variance (ANOVA) method.

RESULTS AND DISCUSSION

Height of Sweet Corn Plants

Based on the results of the analysis of variance (ANOVA), it shows that there is an interaction between bokashi fertilizer and NPK on the height of sweet corn at 14 DAP. There is also a significant effect on the height of sweet corn with bokashi fertilizer treatment at 21 DAP and 35 DAP, as well as with NPK fertilizer treatment at 35 DAP. The average plant height can be seen in the following table:

Table 1. Average Height of Sweet Corn Plants Due to the Interaction of Bokashi and NPK Treatments

Treatment	The average height of the plant is 14 HST
B1N1	19.42 a
B1N2	18.52 a
B1N3	21.33 a
B2N1	19.62 a
B2N2	22.72 b
B2N3	19.42 a
B3N1	21.15 a
B3N2	20.65 a
B3N3	21.60 a
BNT 5%	**0.60**

This happens because of the addition of bokashi and NPK in sufficient doses. According to Mulyanti et al. (2015), having enough nitrogen creates a balance between leaves and roots, so vegetative growth proceeds normally and perfectly. This is supported by Maulana et al. (2015), who stated that bokashi and NPK fertilizers are very good for adding the soil nutrients needed for plant height growth. Low nutrient levels result in a lack of the nutrition plants need for physiological processes to carry out growth.

Number of Leaves of Sweet Corn Plants

The analysis of variance (ANOVA) showed that there was no interaction and no significant individual effect of bokashi and NPK fertilizer treatments on the number of sweet corn leaves. The average number of leaves can be seen in Table 2 below:

Table 2. Average Number of Sweet Corn Leaves Due to Individual Bokashi and NPK Treatments

Average Number of Leaves				
Treatment	14 HST	21 HST	28 HST	35 HST
B1	6.00	8.11	9.56	12.00
B2	6.33	7.78	9.56	11.67
B3	6.44	8.11	9.67	11.56
BNT 5%	**tn**	**tn**	**tn**	**tn**
N1	6.00	7.89	9.78	12.00

N2	6.44	8.11	9.56	11.78
N3	6.33	8.00	9.44	11.44
BNT 5%	**tn**	**tn**	**tn**	**tn**

Based on Table 3, bokashi and NPK treatments did not have a significant effect on the observed variable of leaf number. According to (Syah et al., 2016), leaves are the main organs responsible for photosynthesis because they contain pigments that play a role in absorbing sunlight. The chlorophyll in plant leaves increases their ability to absorb sunlight, allowing the photosynthesis process to run smoothly. The number of leaves is related to plant height; the taller the plant, the more leaves it tends to have. Nitrogen (N) plays a crucial role in cell division and enlargement, so if a plant lacks nitrogen, it can hinder leaf formation. Therefore, sufficient nitrogen is needed for the plant.. The nitrogen (N) content in the soil will be utilized by plants during cell division and enlargement to form young leaves. As for phosphorus (P), it functions to stimulate root growth, especially in younger plants, while potassium (K) plays a role in cell division activities, the assimilation process, and speeding up flowering and the ripening of seeds and fruits (Ayu et al., 2017).

Sweet Corn Stem Diameter

Based on the variance analysis, there is an interaction between bokashi fertilizer and NPK on stem diameter during stem growth observations. The average diameter in Table 3 shows the best combination is B2N2 (bokashi 15 tons/ha and NPK 300 kg/ha) with a size of 0.97 cm.

Table 3. Average Diameter of Sweet Corn Stems Due to the Interaction of Bokashi and NPK Treatments

Treatment	Average Stem Diameter 21, 28, 35 HST
B1N1	0.88 a
B1N2	0.87 a
B1N3	0.90 a
B2N1	0.88 a
B2N2	0.97 b
B2N3	0.82 a
B3N1	0.82 a
B3N2	0.87 a
B3N3	0.90 a
BNT 5%	**0.07**

This is because bokashi and NPK fertilizers have a complementary interaction in increasing the growth rate of stems when they are sufficiently available and play a good role in nutrient intake. This is supported by Maulana et al. (2015), who stated that the addition of bokashi and NPK nutrients is very good for plant growth. Homer et al. (2017) mentioned that the nitrogen in cow manure bokashi helps stimulate vegetative growth in plants. Similarly, Nuryadin et al. (2016) explained that NPK fertilizer is very important and irreplaceable by any other element. Nitrogen is an essential element that influences sweet corn plants more than other nutrients.

Weight of Corn Cob With Husks of Sweet Corn

Based on Table 4, it can be seen that NPK treatment affects the observation of shelled cob weight, with the best treatment being N2 with an average of 399.6 g, but bokashi treatment does not have a significant effect.

Table 4. Average Weight of Sweet Corn Cobs With Husks Due to Single Treatments of Bokashi And NPK

Treatment	Average
B1	381.11
B2	389.38
B3	377.89
BNT 5%	**tn**
N1	361.36 a
N2	399.6 b
N3	387.33 a
BNT 5%	**18.871**

This is because NPK elements are very much needed by corn plants during the generative phase, as nitrogen fertilization in the soil can directly increase protein content, phosphorus helps improve cob weight quality, and potassium speeds up the rate of photosynthesis and translocation to increase cob weight. According to Maulana et al. (2015), NPK elements are crucial for corn plants during the generative phase or cob formation. If these elements are lacking, the development of cobs and stigmas will be incomplete, resulting in imperfect pollination, uneven seeds, and ultimately reduced production.

According to Hartanti & Yumadela (2018), a plant will grow well if the nutrients it needs are sufficiently available, and better plant growth will increase the plant's weight. Ruarita et al. (2017) stated that adequate nutrient availability will boost the plant's generative growth, thereby speeding up the plant growth process. Applying foliar fertilizer accelerates flowering and produces bigger cobs.

Weight of Corn Cob Without Husk

Table 5. Average Weight of Sweet Corn Cobs Without Husks Due to Single Treatments of Bokashi and NPK

Treatment	Average
B1	284.69
B2	291.56
B3	283.38
BNT 5%	**tn**
N1	270.60 a
N2	297.78 b
N3	272.24 a

BNT 5%	**12.99**

This aligns with the opinion of Siltor & Tyasmoro (2020), who stated that to achieve good production, plants need to be supported with fertilization and proper nutrient fulfillment. If plants lack nutrients, they can't perform their physiological functions properly. Pandjung et al. (2024) stated that increasing nutrient supply during the photosynthesis process will result in maximum photosynthate, which plants use in forming the cob and seeds on the cob. According to Maruli Nasution et al. (2024), a plant reaches a high level of production if the nutrients it needs are sufficiently available and balanced in the soil, and the N, P, K elements, which are three of the six essential macronutrients required by plants. If these nutrients are not available in the soil, it will affect plant growth and production. The P element plays a role in fruit formation and seed filling, so providing P will increase the plant's weight.

Sweetness Level (Brix) of Sweet Corn

Table 6. average sweetness level (Brix) of sweet corn due to single bokashi and NPK treatment

Treatment	Average
B1	10.44
B2	10.39
B3	10.56
BNT 5%	**tn**
N1	10.11 a
N2	10.67 b
N3	10.61 a
BNT 5%	**0.46**

Based on Table 6, NPK treatment has a significant effect on the observed variable of sweetness (Brix) in sweet corn, but bokashi treatment does not have a significant effect. This is because the sweetness of sweet corn is influenced by the presence of K (Potassium) nutrients. According to Pradipta et al. (2014), potassium plays an important role in the growth and yield of plants by enhancing the photosynthesis process, so that the translocation of photosynthates to the ears of sweet corn can be optimal, allowing sugar content to develop optimally in the ears.

According to Sebastian & Barunawati (2022), potassium plays a role in improving plant quality. Fertilizing corn plants with potassium will increase the amino acid content and grain protein content by carrying out carbohydrate translocation, protein production, and absorption processes.

The translocation of NO3 and amino acids in plants affects the quality of sweet corn. Potassium plays a role in determining the sweetness level of sweet corn. This is supported by Uliyah et al. (2017), stating that potassium in plants has an important role in growth and crop yield by enhancing the photosynthesis process so that the translocation of photosynthates to the sweet corn cob can be optimal, allowing sugar levels to form optimally in the cob. This is one of the roles of potassium, which is to form cellulose, starch, and sugar, as well as to translocate sugar to the cob of sweet corn.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the study on the effect of bokashi fertilizer and NPK doses on the growth and yield of sweet corn (Zea mays saccharata Sturt), it can be concluded that:

There is an interaction between bokashi fertilizer and NPK fertilizer on plant height observation at 14 DAS, with the best value being 22.72 cm, and on stem diameter at 21 DAS, with the best value being treatment B2N2 at 0.96. The best treatment for sweet corn production is the effect of NPK fertilizer at a dose of 300 kg/ha, producing the highest corn weight and a sweetness level of 10.67 brix.

FURTHER STUDY

This study still has limitations, so further research on the topic Response of Sweet Corn (Zea mays saccharata Sturt) to the Addition of Bokashi and NPK Fertilizers is needed to improve this study and provide more insights for readers and the author

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