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The Application of Bokashi Fertilizer on the Growth of Cucumber Plants (*Cucumis Sativus* L.)

Febrita Damena Sinaga(*)[1], Novilda Elizabeth Mustamu[2], Yudi Triyanto[2], Lutfi Fadillah Zamzami[2]

[1] Student of Agrotechnology Bachelor Program of Science & Technology faculty, Labuhanbatu University;
[2] Lecture of Agrotechnology Bachelor Program of Science & Technology faculty, Labuhanbatu University,
Jl. SM Raja No. 126 A KM 3.5 Labuhanbatu, Sumatera Utara, Indonesia, Postcode 21418

***Corresponding Author:** sinagafebrita20@gmail.com

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Abstract

The cucumber (Cucumis sativus L.) belongs to the Cucurbitaceae family (gourd plant), which is very popular with all levels of society. This research aimed to determine the proper use of bokashi fertilizer in the growth and production of cucumber plants (Cucumis sativus L). This research was carried out from January 24, 2024, to March 2024, at Jl. Lintas Gunung Tua, Simatahari Village, Kotapinang District, North Sumatra, Indonesia a. This study used a non-factorial randomized block design (RAK) consisting of 1 factor, each factor consisting of 6 levels, namely T0:Control, T1: bokashi 200g, T2: bokashi 300g, T3: 400g, T4: 500g, T5: 600g, and analyzed with statistical analysis using SPSS. The research results show that the lowest dose of bokashi fertilizer was given at the control dose. At the same time, the best dose was at a dose of 600g/plant, which showed the highest response from each treatment.

Keywords: *Bokashi Fertilizer; Cucumber; Growth response*

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INTRODUCTION

Japanese cucumber (*Cucumis sativus* L.) is a popular fruit vegetable with a high economic value. According to data from the Central Statistics Agency (2021), cucumber plants were among the top five most consumed vegetable commodities, following kale, spinach, tomatoes, and eggplant. Superior plant seeds are one factor that determines plant cultivation's success (Lestari, 2022). According to Birnadi (2017) The market demand for Japanese cucumbers has surged to 50,000 tonnes per year. Nevertheless, Indonesia produces 2,000 tonnes of cucumbers annually. It is important to note that cucumbers are annual plants that develop and grow by spreading. We must persist in our efforts to enhance production. Enhancing cultivation techniques, like pruning, is possible. One approach to enhancing cucumber production through cultivation techniques is to limit the vegetative growth of the plant by pruning and applying fertilizer.

Regulating vegetative growth is necessary because if environmental factors support it, the plant will continue to undergo vegetative growth, thereby obstructing generative growth. Hindered or postponed. Shoot pruning, which involves the removal of the plant's tip or crown, is a pruning method (Rinaldi *et al.*, 2021). Through the implementation of training on the production of bokashi fertilizer in Kotadirumali Village, Keo Tengah District, Nagekeo Regency, the local government and the campus collaborate to develop community understanding regarding using organic fertilizer to preserve the environment (Syamsuwirman *et al.*, 2023).

Using bokashi fertilizer on plants can improve their growth by providing them with the necessary nutrients. To compare the results of literature studies using bokashi fertilizer mixed with NPK fertilizer and kendang fertilizer mixed with NPK fertilizer in Sukawening Village, compare the agricultural outcomes of the two fertilizers and determine which is more effective. l microorganisms in Bokashi can accelerate the decomposition process of organic matter in the soil, thereby increasing the availability of N, P, and K nutrients for plants (Fitriany & Abidin, 2020).

Due to its simplicity in both preparation and acquisition, people frequently use bokashi as compost. Meanwhile, efficient microorganisms (EM4) facilitate the fermentation process to produce bokashi fertilisers. The fermentation process uses EM4 technology to generate bokashi, a compost. *Azotobacter* sp., *Lactobacilus* sp., yeast, photosynthetic bacteria, and cellulose-decomposing fungi are all present in EM4. Generally, materials found near agricultural land, such as straw, husks, manure, or bran, make up bokashi materials. Bran is the most favourable material to use, as it contains nutrients that are highly beneficial to microorganisms (Mahyuddin *et al.*, 2019). Additionally, bokashi serves various functions for plants and soil, including the ability to loosen the soil, which facilitates the absorption of other nutrients and repair damaged or critical soil structures, affecting plant growth. Bokashi can supply the soil with nutrients, which plants can utilize to enhance their productivity and quality of growth. According Santoso et al., (2019), Bokashi has four advantages: it increases soil fertility by improving its physical, chemical, or biological properties, accelerates and facilitates plant absorption of nitrogen nutrients, and prevents pest-plant growth through composting.

Cucumber plants frequently encounter challenges during their development, particularly with the physical and chemical characteristics of the soil. Production is diminished as a result of diminished fertility in the soil. The soil must be cultivated, and nutrients must be added during planting. Inorganic fertilizer may be implemented to supplement nutrients (Purnomo et al., 2013).

This plant is required to enhance cucumber production. To increase cucumber production, we intensify the nutrient addition process. Micronutrients and macronutrients are essential for the growth process. In order to optimize production outcomes, including nutrients in a planting medium is intended to satisfy the nutrient content. The addition of nutrients in a manner that is appropriate for the plant's requirements will result in a positive response (Sihaloho et al., 2015).

Cucumber plants can increase their resistance to drought and leaf chlorophyll formation by providing nutrients (Fitriani et al., 2019).

Cow dung bokashi fertilizer contains mineral macronutrients (N, P, K, Mg, S, and Ca) and micronutrients (Zn, B, Fe, Cu, Mn, Mo, and Cl). The ready-made bokashi organic fertilizer is characterized by its brownish-black color, jelly-like structure, mold growth, warm sensation, lack of odor (feces), and lack of clumping. Bokashi's chemical composition includes a C/N ratio of 10-20%, a N content of 0.40%, P_2O_5 of 0.10%, K_2O of 0.20%, C-organic of 27–58%, a pH of 6.80–7.49%, and a water content of 0–50%. These parameters are by SNI 19-7030-2004 (Khoirunnisa et al., 2019). This research aimed to determine at what dose bokashi fertilizer was applied to the growth and production of cucumber plants (*Cucumis sativus* L.). Apart from its role in maintaining soil fertility and as animal feed, bokashi fertilizer can also help maintain the balance of nutrients in the soil and has an environmentally friendly effect (Higuchi, 2021).

METHOD

This research was carried out from January 24, 2024, to March 2024, located on Jl. Lintas Gunung Tua, Simatahari Village, Kotapinang District, North Sumatra, Indonesia.

Sample or Participant

Bokashi fertilizer, water, soil, and F1 Harmony Plus hybrid cucumber seeds were employed in this investigation. Polybags, hoes, buckets, scissors, plastic ropes, measuring instruments (meters), vernier calipers, scales, stationery, shovels, label paper, bamboo sticks as stakes, parent nets, member, and cameras were the tools employed in this research.

Instrument

This study used a 6 x 4 non-factorial randomized block design (RBD) with 4 replications and 1 non-factorial factor. Each factor consisted of 6 levels, including T0 (control) (no treatment), T1 (Bokashi 200 g), T2 (Bokashi 300 g), T3 (Bokashi 400 g), T4 (Bokashi 500 g), and T5 (Bokashi 600 g). An analysis of variance (ANOVA) will be conducted to ascertain the response of cucumber plants to the growth and production of bokashi fertilizer. If it is genuine, we will implement the effect ($F_{count} > F_{table}$ at the 5% level). Subsequently, Duncan (DMRT) will conduct an additional 5% test.

Procedure

We prepared the soil planting medium by mowing the surrounding grass to loosen and remove weeds from the soil plants. The next step involved mixing the dirt with compost, specifically cow dung. We mixed soil media and filled it into polybags with bokashi fertilizer as a fundamental fertilizer. The planting process involved applying bokashi fertilizer and mixed soil at a rate of 1 WPA. After mixing the soil with compost and filling it to approximately 80% of its total volume, we filled the polybag and labeled the soil filling.

The term "plant distance" denotes the living space of plants or plant populations. Determining the optimal distance relied on understanding the characteristics of the plants that needed planting. Accurate measurements were required for plant spacing. Excessively close plant spacing resulted in an increase in competition among plants for water, nutrients, and sunlight. In the interim, the main plant's competitiveness with weeds in obtaining nutrients, water, and sunlight increased as a result of the high evaporation rate and the increased level of weed development resulting from an excessively wide planting distance (Sihombing, 2005).

Then, polybags were positioned at the research site with a planting distance of 60 cm x 30 cm, a more appropriate planting distance for cucumber plants. This arrangement ensured that nutrients were absorbed optimally.Meanwhile, according to Rasyid et al., (2020), the optimal results for cucumber plant production were achieved by planting at a distance of 60 cm by 40 cm. The availability and capacity of a plant to utilize environmental resources for plant growth significantly influenced its growth and production. In order to establish suitable environmental conditions that facilitated plant growth and yield, it was necessary to implement appropriate plant spacing (Wicaksana & Sulistyono, 2017).

The interaction between bokashi fertilizer and plant spacing optimized the absorption of nutrients available to plants. Manure and planting distance together enhanced the yield of Japanese cucumber plants. In addition to enhancing the physical characteristics of the soil, bokashi fertilizer also supplied nutrients (Sukasih & Yudiono, 2022). Plants relied on the availability of sufficient nutrients in the soil to fuel their vegetative and generative growth by providing them with photosynthetic materials and energy. Placed in polybags and labeled according to their treatment.

Planting cucumber seeds was done by making holes in a polybag with a depth of 5 cm. Each hole was filled with two or three seeds (Abullah et al., 2009). Subsequently, the hole was sealed to a depth of 2 cm. The basic fertilizer was compost fertilizer, which was mixed with soil in each polybag. Bokashi fertilizer was administered at the appropriate concentration for each plant. The treatments were conducted twice, with fertilizer applied at three-week intervals, specifically the week following planting (WAP) i.e: 7 WAP, 14 WAP, and 28 WAP. The solid bokashi fertilizer was applied in early morning at approximately 06.00 A.M.

We used polybags to apply fertilizer and maintained the plants to prevent the development of pests and diseases. Consequently, the plants thrived and yielded high-quality fruit if there was no need for water during the rainy season, water twice a day in the morning and evening. Installation of stakes (support poles) to maintain an upright position, the cucumber's growth required support poles or stakes. It did not impede the plant's formation, producing regular (straight) fruit, reducing pest attacks, and facilitating harvesting. Consequently, stakes were installed (Zamani, 2021).

If weeds were present, we manually removed them from each polybag. We harvested the cucumber fruit 39 days after planting. The fruit was mature, oversized, and had no thorns (Rustianti et al., 2019). We employed Gembor to water the soil twice daily, in the morning and evening, until it was damp. We watered the soil twice daily until the vegetative phase and then once daily during the generative phase. We adjusted the watering to the conditions of the research area during high-intensity rainfall (Junaidi et al., 2021).

The stakes were fashioned from wood that was 2 meters in height and was positioned in the plot at a distance of 10 cm from the growing plants to prevent any disturbance to the roots. Standing bamboo was supplied when the plants were 2 WAP. It served as a plant support and facilitated observation. The standing bamboo was rectangular.

We conducted the initial weeding 14 days after planting and continued weeding at 2-week intervals until harvest. Weeding involved removing the grass surrounding the plants and cleaning the grass surrounding the plot with a hoe. Afterward, we eliminated the research area's refuse to prevent it from becoming a breeding ground for pests and diseases (Saptorini, 2018). We implemented pest and disease control by keeping the research land free of weeds and other debris and spraying 50 ml (milliliters) of Decis pesticide, 2 bottle caps, and 1 liter of water onto plants susceptible to pest attacks.

RESULTS AND DISCUSSION

Plant height

We conducted plant height measurements 1 week after planting (WAP), 2 weeks after planting (WAP), 3 weeks after planting (WAP), and 4 weeks after planting (WAP). Observations of plant height at 2 WAP and 4 WAP indicated that plant height had a valid impact on the variance.

Table 1. Cucumber plant height

Treatment	Average Plant Height			
	1WAP	**2WAP**	**3WAP**	**4WAP**
T0	14,2 a	21,68b	29,93d	58,83a
T1	12,01 a	24,15ab	33,60d	69,95a
T2	10,74 a	24,23ab	36,65cd	72,13a
T3	14,84 a	24,46ab	44,90bc	76,19a
T4	10,71 a	26,15ab	47,30b	77,06a
T5	12,89 a	27,70a	58,05a	81,50a

Note: Numbers in rows and columns followed by the same lower case letter are not significantly different based on Duncan's advanced test at the 5% level.

According to the results of the DMRT test analysis at the 5% level (Table 1) on plant height at 2 WAP, the highest plant height was achieved by plants that were administered 600 g/plant, which was not significantly different from those that were administered 500 g/plant. The doses of 400 g/plant, 300 g/plant, and 200 g/plant were also significantly different from the control. At the same time, the plants at 3 WAP exhibited the highest plant height (58.08 cm) when administered 600 g/plant of bokasi, which was significantly higher than the plants that received 500 g/plant, 400 g/plant, 300 g/plant, 200 g/plant, and the control.

The height of cucumber plants at 2 WAP and 3 WAP is favorably affected by the application of bokashi fertilizer at a rate of 600 g/plant, as indicated by this investigation. As indicated by this research, the height of cucumber plants can be increased by administering higher doses of bokasi fertilizer. The adequate nutrient content of the soil may facilitate plant growth.

Trunk Diameter

We conducted plant diameter measurements 1 week after planting (WAP), 2 weeks after planting (WAP), 3 weeks after planting (WAP), and 4 weeks after planting (WAP). The observations from 1 to 4 WAP significantly influenced the variance. The DMRT test analysis at the 5% level (Table 2) on plant diameter at 1 WAP shows that plants given a dose of 600 g/plant produced the highest plant diameter (9.44 cm), which did not significantly differ from those given a dose of 500 g/plant. Plants were dosed with 400 g/plant, 300 g/plant, and 200 g/plant, but the results significantly differed from the control's. The plants at 2 WAP exhibited the highest plant diameter (11.44 cm) when administered 600 g/plant bokasi. This dose was not significantly different from those given at 500 g/plant, 400 g/plant, and 300 g/plant, but it was significantly different from the control and 200 g/plant doses. Plants administered with 600 g/plant of bokasi at 3 WAP exhibited the highest plant diameter (13.60 cm).

This dose was not significantly different from those administered at 500 g/plant, 400 g/plant, and 300 g/plant. However, the 200 g/plant dose and the control dose were significantly different. The plants at 4 WAP exhibited the highest plant diameter (14.43 cm) when administered bokashi at a dose of 600 g/plant. This value did not differ significantly from the control group, but it did differ significantly from the 500g/plant, 400g/plant, 300g/plant, and 200g/plant groups.

Table 2. Cucumber Plant Trunk Diameter

Treatment	Trunk Diameter (cm)			
	1WAP	2WAP	3WAP	4WAP
T0	6,16b	6,78b	7,69c	8,95b
T1	6,78ab	7,41b	8,84bc	10,09ab
T2	8,54ab	9,58ab	11,93abc	12,98ab
T3	9,18a	10,05ab	12,15ab	13,48ab
T4	9,34a	11,10a	12,65ab	13,75ab
T5	9,44a	11,44a	13,60a	14,43a

Note: Numbers in rows and columns followed by the same lower case letter are not significantly different based on Duncan's advanced test at the 5% level.

In this investigation, bokasi fertilizer significantly impacted each observation result. The optimal dosage for plant diameter parameters in this investigation was 600 g/plant of bokashi fertilizer. As the dose of bokashi fertilizer increases, the diameter of the cucumber plants increases. It is consistent with the research findings (Toding et al., 2021), which indicate a linear correlation between the dose of bokasi jeramipadi and stem diameter. It implies that the stem diameter of cucumber plants increases with each addition of rice straw bokashi.

Number of Leaves

Observations on the number of leaves were carried out at 1 week after planting (WAP), 2 WAP, 3 WAP, and 4 WAP. The results of observing the number of leaves at the age of 2 WAP and 4 WAP on the variance showed that the number of leaves showed a real influence.

Table 3. Number of leaves on a cucumber plant

Treatment	Number of Leaves (pieces)			
	1WAP	2WAP	3WAP	4WAP
T0	4,44a	10,68b	11,68b	13,43a
T1	5,58a	11,03b	12,65b	16,15a
T2	6,98a	12,58ab	14,68b	19,44a
T3	7,05a	13,50ab	15,23b	19,58a
T4	7,59a	13,75ab	15,33b	20,99a
T5	7,86a	17,63a	22,43a	20,99a

Note: Numbers in rows and columns followed by the same lower case letter are not significantly different based on Duncan's advanced test at the 5% level.

Based on the results of the DMRT test analysis at the 5% level (Table 3) on the number of leaves at the age of 2 WAP, it shows that plants given bokasi at a dose of 600 g/plant produced the highest number of leaves (17.63 pieces), which were not significantly different from those given a dose of 500 g/plant. plants, dose 400 g/plant, and dose 300 g/plant, but significantly different from dose 200 g/plant and control. Meanwhile, plants at 3 WAP showed that plants given 600 g/plant bokasi produced the highest number of plants (22.43 pieces), significantly different from those given a dose of 500 g/plant, a dose of 400 g/plant, a dose of 300 g/plant, a dose of 200 g/plant, and the control.

Table 4. Fruit weight of cucumber plants

Treatment	Fruit Weight (gr)
T0	992,50a
T1	1002,50a
T2	1135,00a
T3	1200,00a
T4	1435,50a
T5	1435,00a

Note: Numbers in rows and columns followed by the same lower case letter are not significantly different based on Duncan's advanced test at the 5% level.

Based on what is known from this research, giving higher doses of bokasi fertilizer can increase the number of leaves on cucumber plants. Toding et al., (2021) stated that bokashi conditions have not been able to improve soil structure, the number of leaves produced is almost the same between treatments, the nutrients in rice straw bokashi are not yet fully available to be absorbed by plant roots at the beginning of the growth, and development of cucumber plants because the fermentation process of organic materials originating from plant materials which contain a lot of lignin and carbon contained in bokashi is still relatively high. As a result, high-dose treatment causes the organic material to become moist, which inhibits the growth of root tips and leaves aged 2 WAP.

Fruit Weight

The fruit weight was observed when the cucumber plants were ready to be harvested. Fruit weight data was collected until the cucumber plant died. Observing fruit weight showed that each treatment's results were not significantly different. According to the DMRT test analysis results at the 5% level (Table 4), the highest fruit weight was achieved by plants that were administered 500g/plant of bokasi, which was not significantly different from those that were administered 600g/plant, 400g/plant, 300g/plant, 200g/plant, or the control.

It is evident from this research that the optimal dosage of bokasi fertilizer is 600g per plant, and it has a positive impact on the weight of cucumber fruits. An adequate amount of potassium in the soil can increase the fruit weight of cucumber plants (Gustia, 2016). Consequently, fruit development is facilitated by high levels of K elements, particularly in the formation of optimal fruit flesh and seeds. Element K also significantly facilitates the process of water absorption by plants from the soil, thereby ensuring the smooth flow of water. Consequently, element K significantly contributes to the growth and development of cucumber fruit, composed of 90% water. Using bokashi fertilizer is highly advantageous for enhancing soil fertility (Adi et al., 2023). It can have an advantageous influence on the weight of the plant.

CONCLUSION

The research findings on the impact of Bokashi fertilizer doses on the growth and production of the Harmony variety of cucumber (*Cucumis sativus* L.) lead to the following conclusions: The Bokashi fertilizer dose treatment significantly influences the growth and production of the Harmony variety cucumber (*Cucumis sativus* L.) for all parameters at each observation. The Bokashi fertilizer treatment yielded the highest average plant height, leaf count, fruit count per plant, and weight per plant and plot. 2WAP, 3WAP, and 4WAP are the average plant heights. The average number of leaves is 2WAP, 3WAP, and 4WAP. Fresh fruit had an average weight of T5 per polybag (1435.00a), significantly different from the treatment.

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