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Response Of Growth And Production Of Cucumber Plants (Cucumis Sativus L.) On The Administration Of Potassium Silica And Cow Manure

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ABSTRACT

This research was carried out at the UPTD BIH Gedung Johor, Medan Johor, Medan City, starting from December 2023 to February 2024. This research aims to determine the effect of cucumber plant growth and production on the provision of potassium silica and cow manure. This research used a factorial randomized block design (RAK) with 2 treatment factors. The first factor is potassium silica with the symbol (K) which consists of 3 treatment levels, namely: Ko = Without potassium silica 0-gram polybag, Ki = 2.5 cc/ liter of water, K2 = 5 cc/ liter of water. The second factor is cow manure with the symbol (S) which consists of 4 treatment levels, namely: So = No fertilizer, S = 100 grams/polybag, S2 200 grams polybag, and S: = 300 grams/polybag. The parameters observed in this study were plant length (cm), number of leaves (strands), flowering age (days), number of fruit per plant (fruit), weight of fruit per plant (kg), number of fruit per plot (fruit), weight of fruit per plot (kg). The results of the research showed that Potassium Silica treatment had a significant effect on flowering age, and the number of fruit per plot, and had a very significant effect on fruit weight per plot. Providing cow manure fertilizer had no significant effect on all parameters. The best fruit weight per plot was obtained in the K0S2 combination, namely 2.13 kg.

Keywords: Potassium Silica, Manure, Cucumber.

INTRODUCTION

Cucumber (Cucumis sativus L.) is a horticultural plant that has quite a lot of potential to be developed. The various properties and benefits it has make this plant popular with many people. The cucurbitacin compound found in cucumber plants has antitumor and antioxidant properties, often used in medicinal applications (Listari and Wijayadi, 2021). As the

population increases and the industry that uses cucumbers expands, the demand for cucumbers is projected to increase in 2021.

Cucumber cultivation is widespread throughout the world, thriving in tropical and subtropical climates. In Indonesia, cucumbers are grown in lowland and highland areas, up to an altitude of 1,000 meters above sea level, with the main production areas including West Java, Aceh, Bengkulu, East Java, and Central Java. Cucumbers are essential for meeting nutritional needs and are also used in the domestic cosmetics industry.

However, cucumber production in Indonesia is still relatively low, averaging 3.5 to 4.8 tons per hectare, while hybrid varieties can produce up to 20 tons per hectare. High-intensity cucumber cultivation is not yet common, most plants are planted as intercrops (Dewi, 2016). Potassium silica fertilizer contains Silica (Si) and Potassium (K), which are essential for plant health. Silica helps increase root oxidation, increase enzyme activity for photosynthesis, and thicken cell walls for pest protection.

Potassium plays a role in the formation and transportation of carbohydrates, acts as a catalyst in protein synthesis, increases the carbohydrate and sugar content of fruits, and improves fruit quality by affecting shape, content, and color. Silica accumulation in leaves helps leaves stay upright and maximizes the capture of sunlight for photosynthesis and the movement of CO2 and phosphorus to the fruit (Pikukuh et al. 2015).

Silica fertilizer can reduce oxidative compounds and increase antioxidant enzyme activity, thus encouraging better plant growth and higher yields (Taufiq, 2020). Cow manure is an organic fertilizer that has a relatively higher P content compared to other manures and functions as a provider of macro and micronutrients.

Cow manure is an organic material that specifically plays a role in increasing the availability of phosphorus and microelements, reducing the negative effects of aluminum, and providing carbon dioxide to the plant canopy, especially in plants with dense canopies where air circulation is limited.

The use of cow dung is a technology package that can improve the soil environment so that it can provide macro and micronutrients and even growth hormones from the auxin and cytokinin groups which can increase soil fertility. Cow dung is waste products from the

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animal digestive tract in the form of feces containing very high levels of nitrogen, feces have a chemical content in the form of: Nitrogen 0.4-1%, Phosphorus 0.2-0.5%, Potassium 0.1-1.5%, Water Content 85.-92% and several other nutrients (Ca, Mg, Mn, Fe, Cu, Zn) (Dewi et.al.,2017).

MATERIALS AND METHODS

This research was conducted at the UPTD BIH Gedung Johor located in Medan Johor, Medan City, North Sumatra, at an altitude of 25 meters above sea level, from December 2023 to February 2024.

The materials used for this study were cucumber seeds of the metavy F1 variety, potassium silica (Bante), cow manure, 10 kg polybags, treatment planks, and topsoil. The tools used included hoes, meters, watering cans, scales, scissors, machetes, scrapers, burlap, plastic ropes, cameras, and stationery.

This study used a factorial randomized block design (RAK) consisting of 2 treatment factors, each treatment repeated 3 times. The first factor is potassium silica (K) with a concentration of 3 levels, namely: K0 = Without potassium silica K1 = 2.5 cc/liter of water, K2 = 5 cc/liter of water. The second factor is cow manure (S) with a dose of 4 levels, namely: S0 = Without Fertilizer, S1 = 100 gr/polybag, S2 = 200 gr/polybag, and S3 = 300 gr/polybag.

RESULTS AND DISCUSSION

The results of the average difference test of the effect of silica potassium and cow manure on the length of cucumber plants at the ages of 2 MST and 3 MST are presented in Table 1 below.

Plant length (cm)

Treatment	plant length (cm)	
	2 MST	3 MST
Potassium silica		
K0	40.48	106.71
K1	41.67	105.21

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K2	39.6	100.17
Cowshed		
S0	36.21	100.39
S1	42.81	105.78
S2	41.28	103.67
S3	42.03	106.28
Interaction		
K0S0	35.5	103.67
K0S1	43.37	105.67
K0S2	40.67	107.33
K0S3	42.4	110.17
K1S0	39.03	104.33
K1S1	43.93	108.5
K1S2	41.03	97.83
K1S3	42.67	110.17
K2S0	34.1	93.17
K2S1	41.13	103.17
K2S2	42.13	105.83
K2S3	41.03	98.5

Note: Numbers not accompanied by letters in the same row or column indicate no significant difference at the 5% level based on the DMRT test.

The results of the analysis of variance showed that the provision of silica potassium and cow manure did not have a significant effect at the ages of 2 MST and 3 MST.

Table 1. Shows that the potassium silica treatment had no significant effect on plant growth at 2 MST and 3 MST. In the potassium silica treatment, 2 MST the longest plant was in the K1 treatment, which was 41.67 cm, while at 3 MST the longest plant was found in the K0 treatment, which reached 106.71 cm. It is suspected that spraying potassium silica through the leaves of cucumber plants is less effective, inaccurate, and inappropriate when spraying.

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However, the use of leaf fertilizer should be done carefully, paying attention to the dosage and time of spraying. Where leaf fertilizer is sprayed on the part of the leaf facing down or the back of the leaf, leaf fertilizer is sprayed during the day when the stomata are fully open and using a separate sprayer from that used for herbicides because the herbicide solution is difficult to clean.

According to Golub et al. (2018), the concentration of foliar fertilizer affects its effectiveness, although its effect on plant growth may be gradual and consistent across applications. Applying the right concentration at the optimal time and frequency increases nutrient uptake by plants. Timely foliar fertilization can also minimize nutrient loss due to leaching and volatilization, allowing plants to utilize nutrients more effectively.

Cow manure treatment showed no significant effect at the age of 2 MST and 3 MST on plant length (cm). In the cow manure treatment, the longest plant at the age of 2 MST was in the S3 treatment, namely, 42.03 cm. At the age of 3 MST, the longest plant was in the S3 treatment, namely, 106.28 cm. It is suspected that plants still have difficulty absorbing nutrients from cow dung because the release of nutrients from this organic material is slow due to the need to decompose complex organic compounds into simpler forms so that they can be absorbed by plants. The interaction between potassium silica and cow dung did not have a significant effect on plant height at the ages of 2 MST and 3 MST. The tallest plant at 2 MST was in the K1S1 combination measuring 43.93 cm, while the tallest plant at 3 MST was in the K1S3 combination, measuring 110.17 cm.

Flowering age (Days)

The results of the average difference test of the effect of silica potassium and cow manure on the flowering age of cucumber plants are presented in Table 2 below.

Potassium silica	Cow manure				Average
	S0	S1	S2	S3	
K0	21.80	21.43	21.70	21.67	21.65c
K1	21.43	21.47	21.00	21.47	21.34b
K2	21.10	21.57	21.43	20.80	21.23a

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Average	21.44	21.49	21.38	21.31

Note: Numbers not accompanied by letters in the same row or column indicate no significant difference at the 5% level based on the DMRT test.

The results of the analysis of variance showed that the treatment of potassium silica had a significant effect on the flowering age of cucumber plants. However, the treatment of cow manure did not have a significant effect on the flowering age, and the interaction between treatments also did not have a significant effect on the flowering age of plants.

Table 2. Shows that potassium silica treatment has a significant impact on the flowering age of cucumber plants. Among these treatments, the K2 treatment produced the earliest flowering at 21 days, which was very different from the K1 treatment at 21 days and the K0 treatment at 22 days. This difference may be due to the nutrients provided by potassium silica, which can improve the flowering process and the overall growth and development of cucumber plants. The nutrient content in silica fertilizer, especially phosphorus and potassium, helps strengthen branches and encourages faster flowering. Potassium strengthens plants, making their leaves, flowers, and fruits less likely to fall off. In addition, potassium increases plant resistance to drought and disease. This is under the statement of Sobari (2019) who stated that Potassium (K) and Phosphorus (P) are very much needed by plants in increasing plant vegetative growth, Phosphorus functions as a raw material for the formation of certain proteins, and helps assimilation and respiration, and accelerates flowering, seed, and fruit ripening and potassium helps the formation of proteins and carbohydrates. Potassium also plays a role in strengthening plant stems so that leaves, flowers, and fruit do not fall off easily and is also a source of strength for plants in dealing with drought and disease (Purba, 2020).

Cow manure treatment did not significantly affect the flowering age of cucumber plants. Among the various cow manure treatments, S3 produced the earliest flowering at 21.31 days, followed by S2. At 21.38 days, S0 treatment at 21.44 days, and S1 at 21.49 days. This limited effect is most likely due to the low availability of nutrients in cow manure and soil conditions that are not yet suitable for plants. Because cow manure is only applied once a

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week before planting, the nitrogen content provided is very small. Meanwhile, nitrogen plays an important role in increasing overall vegetative growth, including the development of roots, stems, and leaves. When using solid organic fertilizers such as cow manure, it is important to pay attention to the correct dosage. Studies have shown that higher fertilizer application causes increased nutrient absorption by plants, and more frequent application also increases nutrient availability (Saputra, 2019).

The interaction of potassium silica and cow manure did not have a significant effect on flowering age, with the highest value observed in the K0S0 combination, which was 21.80 days. These results indicate that one treatment is more influential than the other. According to the research findings, the potassium silica treatment proved to be the most effective, while the cow manure treatment appeared to be less effective, possibly because its performance was suppressed. As a result, each factor operates independently, preventing any interaction from occurring. This may also be due to an imbalance of nutrients in the soil, which can inhibit plant growth. According to Nurkholifah (2019) Plant growth and production will reach optimum if the supporting factors supporting the growth are in optimal condition, balanced elements, and the right dose of fertilizer can increase yields. Likewise, Dharma et al. (2020) highlighted that the availability of sufficient and balanced nutrients is very important for metabolic processes in plant tissues, which involve the synthesis and breakdown of nutrients and organic compounds. Deficiencies in key nutrients such as nitrogen, phosphorus, and potassium can harm plant growth.

Number of fruits per plot (fruit)

The results of the average difference test of the effect of silica potassium and cow manure on the number of fruits per plot (fruit) of cucumber plants are presented in Table 3 below.

Potassium silica	Cow manure				Average
	S0	S1	S2	S3	
K0	10.67	11.00	12.67	11.00	11.33a
K1	9.00	10.33	9.00	9.67	9.50b
K2	5.67	7.33	9.00	6.67	7.17c

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Average	8.44	9.56	10.22	9.11

Note: Numbers not accompanied by letters in the same row or column indicate no significant difference at the 5% level based on the DMRT test.

The results of the analysis of variance showed that potassium silicate treatment had a significant effect on the number of fruits per plot of cucumber plants. While the manure treatment had no significant effect, and there was no significant interaction effect between the two treatments on the number of fruits per plot.

Table 3. Shows that the potassium silica treatment has a significant effect on the number of fruits per plot. In the potassium silica treatment, the highest number of fruits per plot was in the K0 treatment, namely 11.33 fruits, which was significantly different from the K1 treatment, namely 9.50 fruits, and the K2 treatment, namely 7.17 fruits. This shows that the absorption of potassium silica nutrients in cucumber plants effectively supports the nutritional needs of plants during flower and fruit development. And this is still related to the flowering age because earlier flowering will accelerate fruit development and ultimately produce higher yields. Optimizing the photosynthesis process and increasing the movement of photosynthate to the fruit is very important to increasing fruit weight (Haris, 2014). The decrease in the number of fruits per plot may be due to errors when spraying unevenly and hitting sensitive parts of the plant, such as flowers, which can cause damage. Cucumber plants are very sensitive to direct contact with chemicals on flowers, and this can cause flowers to fall off and not develop into fruit. Nair, A., & Subramanian, KS (2016).

The application of cow manure did not have a significant effect on the number of cucumber fruits per plot. In the cow manure treatment, the highest number of fruits was in the S2 treatment, which was 10.22 fruits, followed by the S1 treatment with 9.56 fruits, the S3 treatment with 9.11 fruits, and the S0 treatment with 8.44 fruits. It is suspected that cow manure does not provide the nutrients needed by cucumber plants. In the use of solid organic fertilizers such as cow manure, the correct dosage must be considered. According to several studies, increasing the amount and frequency of fertilizer application can increase the nutrient content of plants (Saputra, 2019). The combination of potassium silica and cow

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manure also did not have a significant effect on the number of fruits per plot, with the highest number of fruits being 12.57 fruits in the K0S2 combination. This may be caused by differences in the doses of potassium fertilizer and cow manure which may cause slow plant growth and no interaction between the two treatments.

Fruit weight per plot (kg)

The results of the average difference test of the effect of silica potassium and cow manure on the weight of cucumber fruit per plot (kg) are presented in Table 4 below.

Potassium silica	Cow manure				Average
	S0	S1	S2	S3	
K0	3.71	3.62	4.09	3.97	3.85a
K1	2.75	3.01	3.13	3.40	3.07b
K2	1.63	2.75	2.97	2.10	2.36c
Average	2.70	3.12	3.40	3.16	

Note: Numbers not accompanied by letters in the same row or column indicate no significant difference at the 5% level based on the DMRT test.

The results of the analysis of variance showed that the treatment of potassium silica had a significant effect on the weight of cucumber fruit per plot. In contrast, the treatment of cow manure did not have a significant effect on the weight of fruit per plot. In addition, the interaction between treatments did not have a significant effect on the number of fruits per plot.

Table 4. Shows that the Potassium silica treatment has a significant effect on the fruit weight per plot of cucumber plants. In the potassium silica treatment, the highest fruit weight per plot was in the K0 treatment, which was 3.85 kg, which was significantly different from the K1 treatment, which was 3.07 kg, and the K2 treatment, which was 2.36 kg. This shows that cucumber plants are very efficient in absorbing potassium, along with other nutrients available in the soil, supporting optimal growth and improving fruit quality. Potassium plays an important role in the formation and transport of carbohydrates, acts as a catalyst in protein

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synthesis, increases carbohydrate and sugar levels in fruit, and improves its shape, content, and color. However, cow dung treatment did not have a significant effect on the fruit weight per plot of cucumber plants. The decrease in fresh weight can be caused if potassium is given irregularly or given in high amounts, according to the statement of Ma, JF, et al. (2020). Potassium is an important element for the transport of water and nutrients in plants. However, giving high amounts of potassium, especially in the form of potassium silica, can disrupt the ion balance in plants, inhibit the water transport process, and cause a decrease in the efficiency of water and other nutrient utilization. This can lead to decreased growth and fresh weight.

In the cow manure treatment, the highest fruit weight was observed in the S2 treatment, which was 3.40 kg, followed by S3 at 3.16 kg, S1 at 3.12 kg, and S0 at 2.70 kg. This is likely due to the slow absorption of nutrients by cucumber plants from cow manure, which requires a larger amount. The combination of potassium silica and cow manure did not significantly affect the fruit weight per plot with the highest weight recorded in the K0S2 combination at 4.09 kg.

CONCLUSION

1. The treatment of potassium silica significantly affected the flowering age, number of fruits per plot, and fruit weight per plot. The best treatment for flowering age was in K2 which was 21 days, the number of fruits per plot was in the K0 treatment which was 11.33 and the best fruit weight was in the K0 treatment which was 3.85 kg.
2. The provision of cow manure treatment did not have a significant effect on all parameters. The best treatment was in S2, which was 200 grams.
3. The interaction of giving silica potassium and cow manure did not have a significant effect on all parameters. The best treatment combination was in the K treatment 0S2 (without potassium silica) cow manure 200 grams/polybag.

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