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EFFECTS OF KCl FERTILIZER AND GOAT URINE ON JAPANESE CUCUMBER (*Cucumis sativus* var. Japonese) PRODUCTION

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ABSTRACT

The research was conducted from June to September 2022 at a research center, Balai Penelitian Tembakau Deli (BPTD) Sampali PTPN II. It aimed to determine the effects of KCl fertilizer and goat urine on the growth and yield of Japanese cucumbers. A factorial randomized block design (RBD) with two factors were used. The first factor was KCl application at four concentrations: S0 (Control), S1 (10 g/plant), S2 (20 g/plant), and S3 (30 g/plant). The second factor was goat urine application at four concentrations: K0 (Control), K1 (200 ml/plant), K2 (400 ml/plant), and K3 (600 ml/plant). Parameters measured were vine length, leaf number, leaf area, the number of fruits per plant, fruit length, the number of fruits per plot, fruit weight per plant, and fruit weight per plot. The results showed that KCl fertilizer affects the number of fruits per plant and per plot, but goat urine has no effect on all parameters. The interaction between KCl fertilizer and goat urine does not affect all the parameters observed.

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Key words: Japanese Cucumber, Goat Urine, Growth Response and Yield.

INTRODUCTION

Japanese cucumbers, a type of fruit vegetable with various benefits in everyday life, are generally liked by the public and thus needed in large quantities. Based on the National Bureau of Statistics, the production of Japanese cucumbers reached 511,525 tonnes in 2012 but decreased to 491,636 tonnes in 2013. Cucumber plants have few growing conditions and are highly adaptable because it can grow well in lowlands and highlands. Cucumbers can grow and adapt to almost all types of soil (Sumpena, 2001).

Cucumber (*Cucumis sativus* var. Japonese) cultivation has a very good prospect in Indonesia due to their popularity and diverse use in the national dish. There is large demand for this commodity, which will continue to rise with an increase in population, living standards, public education, and public awareness of its important nutritional values. For this reason, the cultivation of Japanese cucumber plants should gain more public and scholarly attention (Wijoyo, 2012).

In the process of developing Japanese cucumber plants, the most common obstacles are the limiting physical and chemical properties of the soil. Infertile soils mean low production, and for this reason, proper land management is necessary for successful cultivation, bountiful harvest, and high national production (Yusri and Wan, 2014).

Lacks of nutrients or nutrient deficiency in soils are attributable to the easily washed out or leached away major nutrients like the element K, which normally accumulate in the top soil layer. Plants absorb potassium from the soil in the form of K^+. K^+ is dynamic so that it is easily washed off on sandy soils and soils with low pH. To overcome this, the K element is supported by another element, namely Cl to form a KCl compound (potassium chloride). Potassium plays a role in increasing resistance to diseases and increasing root growth. It is needed in promoting the growth of Japanese cucumbers (Surya et al., 2014). To increase the production of Japanese cucumber plants, fermented and chemically analyzed goat urine can be applied as KCl fertilizer. The resulting liquid fertilizer contains higher levels of N, K and C-organic nutrients than non-fermented goat urine. For example, after fermentation, the N content of biourine doubles from an average of 0.34% to 0.89%, while that of bioculture substantially increases from 0.27% to 1.22%. The K and C-organic levels also increase dramatically (Londra, 2008). Karamina et al. (2020) stated that adding fermented goat urine POC is one way to increase cucumber production as it provides balanced nutrients for plant growth and productivity. Thus, it is necessary to examine the effects of KCl fertilizer and goat urine on Japanese cucumber production.

MATERIALS AND METHOD

This research was conducted on a piece of land at the research center Balai Penelitian Tembakau Deli (BPTD) Sampali PTPN II, at an altitude of ± 25 meters above sea level, from June to September 2021. The materials used in this study were robto cucumber seeds, KCl fertilizer, goat urine, EM-4, signposts, bamboo, Decis 25 EC insecticide, Antracol 70 WP fungicide, and water. The tools used in this study were hoe, machete, rake, watering can, meter, analytical scale, bucket, scalifer, caliper, scissors, knife cutter, calculator, and stationery. This study used a factorial randomized block design (RBD) with two factors: KCl (S) fertilizer at four

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concentrations (S0 = Control, S1 = 10 g/plant, S2 = 20 g/plant, S3 = 30 g/plant) and goat urine (K) at four concentrations (K0 = Control, K1 = 200 ml/plant, K2 = 400 ml/plant, K3 = 600 ml/plant). The number of treatment combinations was 4 x 4 = 16 combinations repeated 3 times and produced 432 seedlings with 192 plant samples.

RESULTS AND DISCUSSION

Number of Fruits per Sample Plant

Based on the analysis results using the factorial randomized block design, KCl fertilizers significantly affect the number of fruits per plant, while goat urine and the interaction between the two factors show no significant effects on the number of fruits per Japanese cucumber plant. Table 1 shows Number of Fruits per Japanese Cucumber Plant Sample with KCl Fertilizer and Goat Urine Treatments

Table 1. Number of Fruits per Japanese Cucumber Plant Sample with KCl Fertilizer and Goat Urine Treatments

Treatment	Goat Urine				Average
KCl	K_0	K_1	K_2	K_3	
S_0	1.25	1.17	1.42	1.25	1.27b
S_1	1.33	1.33	1.33	1.33	1.33ab
S_2	1.33	1.17	1.42	1.17	1.27b
S_3	1.58	1.42	1.75	1.33	1.52a
Average	1.38	1.27	1.48	1.27	1.35

Note: Numbers followed by different letters in the same column indicate significant differences between treatments according to Duncan's Test at a 5% significance level.

The S3 treatment (30 g/plant) produced the highest number of fruits per plant, which was 1.52. This result was not significantly different from S1 (10 g/plant), which produced 1.33 fruits per plant, but significantly different from S2 and S0. The relationship between the number of fruits per Japanese cucumber plant and the application of KCl fertilizer is illustrated in Figure 1.

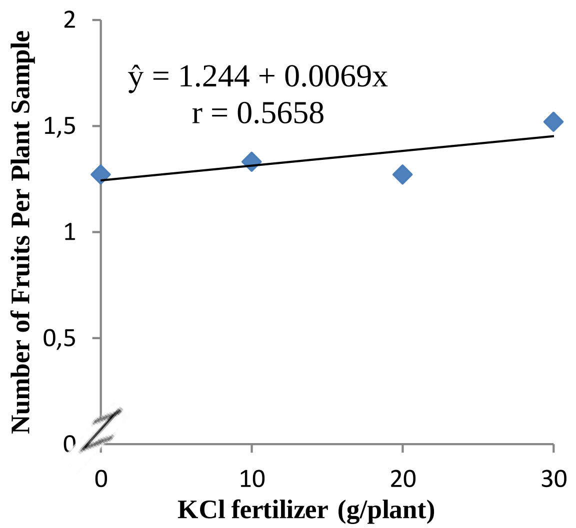

Figure 1. Graph Connecting the Number of Fruits per Japanese Cucumber Plant Sample with KCl Fertilizer Levels

Figure 1 shows a positive linear relationship between the number of fruits per Japanese cucumber plant with KCl fertilizer, with the regression equation y = 1.244 + 0.0069x and r = 0.5658. From this equation, it can be inferred that the number of fruits per plant likely increases with an addition in KCl fertilizer concentration.

The significant effect of each treatment on this parameter was believed to result from additional nutrients that the plants absorbed and utilized to bear fruits. This finding corresponds to Gani et al. (2013), which stated that KCl plays an important role in stimulating the formation of flowers, fruits, and seeds. In addition to increasing the available K, KCl can improve soil structure and nutrient absorption by plants. Production is determined by the number of fruits and fruit weight. The more and heavier fruits the Japanese cucumber plant produces, the higher productivity it has.

Fruit Length (cm)

The analysis showed that KCl fertilizer and goat urine applications and their interactions have no significant effects on the fruit length (Table 2). Table 2 shows that, among the KCl fertilizer applications, S1 and S3 produced the longest cucumber (25.02 cm), while S0 or the control produced the shortest (23.81 cm). In goat urine applications, the treatment K3 (600 ml/plant) gave the longest cucumber (25.08 cm), whereas K0 (control) produced the shortest (24.35 cm).

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Table 2. Fruit Length (cm) of Japanese Cucumber Plants Receiving Different Concentrations of KCl Fertilizer and Goat Urine

Treatment KCl	Goat Urine				Average
	K_0	K_1	K_2	K_3	
S_0	24.42	24.08	23.42	23.33	23.81
S_1	24.08	25.17	24.58	26.25	25.02
S_2	23.92	24.33	25.17	26.42	24.96
S_3	25.00	25.58	25.17	24.33	25.02
Average	24.35	24.79	24.58	25.08	24.70

Notes: Unnotated numbers indicate no significant differences between treatments according to Duncan's test at a 5% significance level

These results indicated that the application of KCl fertilizer on the plants cannot increase the size or length of Japanese cucumbers. It is presumably because the nitrogen (N) and phosphorus (P) supplies provided solely by KCl fertilizer were inadequate for promoting fruit formation and growth. Both nutrients play a crucial role in the generative phase, i.e., the time of fruit formation. According to Akmal (2018), sufficient nutrients during plant growth increase metabolic activities, thus improving cell elongation and differentiation, which in turn encourage an increase in fruit length and weight.

On the contrary, goat urine has no substantial effect on plant development. The P nutrient available at the generative phase was not sufficient to form fruits, thus the length was not favorable. This result is in line with Hanafiah (2014), which explained that the element P plays a vital role in the formation of seeds and fruits; thus, farmers refer to P fertilizer as "fruit fertilizer". A sufficient supply of P will stimulate the development of plant root systems.

Number of Fruits per Plot

The analysis of the factorial randomized block design showed that KCl fertilizer has a significant effect on the number of fruits per plot, while goat urine and the interaction of the two factors have no significant effects on the number of fruits per plot (Table 3).

Table 3. Number of Japanese Cucumber Fruits per Plot with KCl Fertilizer and Goat Urine Treatments

Treatment KCl	Goat Urine				Average
	K_0	K_1	K_2	K_3	
S_0	6.00	6.00	6.33	5.67	6.00b
S_1	7.00	5.67	7.00	6.67	6.58ab
S_2	6.33	6.00	6.33	5.33	6.00b
S_3	7.00	7.00	8.67	6.67	7.33a
Average	6.58	6.17	7.08	6.08	6.48

Notes: Numbers followed by different letters in the same column indicate significant difference between treatments according to Duncan's Test at a 5% significance level

Table 3 suggests that KCl fertilizer significantly affects the number of fruits per plot. S3 (30 g/plant) produced the highest number of fruits per plot (7.33 fruits), which was not significantly different from S1 (10 g/plant; 6.58 fruits) but significantly different from S2 and S0. Furthermore, Figure 2 shows a positive linear relationship between the number of fruits per plot and KCl fertilizer, with the regression equation y = 5.966 + 0.0341x and r = 0.4872. Based on this equation, it can be concluded that the number of fruits per plot increases with an addition in the concentration of KCl fertilizer.

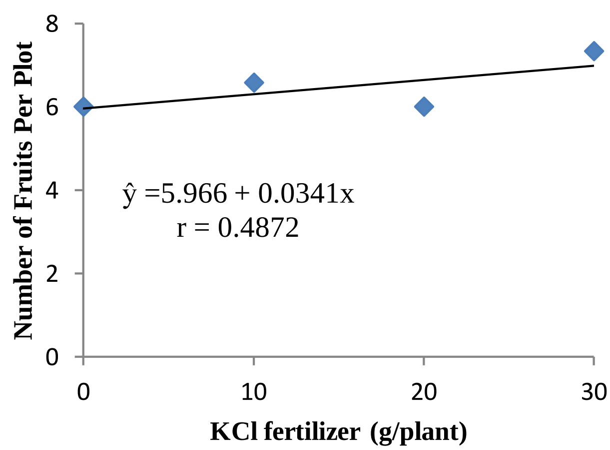

Figure 2. Graph Connecting the Number of Japanese Cucumber Fruits per Plot with KCl Fertilizer Levels

These results indicated that the potassium content of KCl fertilizer can be absorbed and utilized by Japanese cucumber plants to form seeds and fruits. Potassium has a very important function in plants, including for respiration, transfer, division, cell enlargement, photosynthesis, and energy storage. Syafrina (2010) added that K is one of the most

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important nutrients in plant survival that plays a direct role in various metabolic processes, including the formation of fruit. Moreover, potassium stimulates generative growth, such as flower formation, fruit formation, and seed filling.

Fruit Weight per Sample Plant (g)

The analysis showed that KCl fertilizer, goat urine, and their interaction have no significant effects on the fruit weight per Japanese cucumber plant (Table 4). In the KCl fertilizer treatment groups, S1 (10 g/plant) produced the heaviest fruit per plant, 272.92 g, whereas S0 (control) produced the lowest fruit weight, 237.69 g. Meanwhile, in the goat urine treatments, K3 (600 ml/plant) produced fruits with the highest weight average, 263.71 g, whereas K2 (400 ml/plant) produced the lowest, 252.46 g.

Table 4. Fruit Weight (g) per Japanese Cucumber Plant Sample with KCl Fertilizer and Goat Urine Treatments

Treatment KCl	Goat Urine				Avg.
	K_0	K_1	K_2	K_3	
S_0	252.50	241.67	242.42	214.17	237.69
S_1	249.50	281.33	242.00	318.83	272.92
S_2	277.25	246.42	248.50	274.33	261.63
S_3	263.00	262.17	276.92	247.50	262.40
Avg.	260.56	257.90	252.46	263.71	258.66

Notes: Unnotated numbers indicate no significant differences between treatments according to Duncan's test at a 5% significance level

These results indicated that fruit weight depends on the number and size of the fruit, which are influenced by the plant’s nutrient requirements. According to Dwijoseputro (2002), crop production in any plant species is generally influenced by the amount (fruit, seeds, or tubers) and weight (fruit, seeds or tubers) produced by the plant. If fruits, seeds, or tubers have a favorable weight (heavy) but exist in a small number, the overall weight of fruits, seeds, or tubers per plant will be relatively low and vice versa. In addition, Liferdi (2010) explained that fruit weight is determined by the availability of potassium released by humic acid and fulvic acid through the fermentation of organic matter. Potassium is a charged element that makes it nearly irreplaceable in translocating assimilate, transferring and storing energy that is generated by photosynthesis and used in the metabolic process.

Fruit Weight per Plot (g)

The analysis showed that the KCl fertilizer, goat urine, and the interaction between the two factors have no significant effects on fruit weight per plot (Table 5). In the KCl fertilizer treatment groups, S3 (30 g/plant) produced the heaviest fruit per plot, 1254.17 g, whereas S0 (control) produced the lowest fruit weight, 1033.33 g. Meanwhile, in the goat urine treatments, K2 (400 ml/plant) produced fruits with the highest weight average per plot, 1229.17 g, whereas K3 (600 ml/plant) produced the lowest, 1054.17 g.

Table 5. Fruit Weight per Plot (g) Japanese Cucumber with KCl Fertilizer Treatment and Goat Urine

Treatment	Goat Urine				Avg.
KCl	K_0	K_1	K_2	K_3	
S_0	1033.33	1033.33	1100.00	966.67	1033.33
S_1	1233.33	966.67	1233.33	1150.00	1145.83
S_2	1133.33	1033.33	1116.67	966.67	1062.50
S_3	1200.00	1216.67	1466.67	1133.33	1254.17
Avg.	1150.00	1062.50	1229.17	1054.17	1123.96

Notes: Unnotated figures indicate no significant differences between treatments according to Duncan's test at a 5% significance level

These results indicated that the fruit weight per plot is influenced by the availability of nitrogen (N), phosphorus (P), and potassium (K), which can improve physiological processes in the generative phase and be ultimately manifested in an increase in the number and size of fruits. This finding is in line with Syamsudin et al. (2010), which stated that plant growth and yield can be improved by providing sufficient nutrients needed by different plants. This way, photosynthesis runs optimally and produces more food reserves in the tissue, which will allow the formation of many flowers or fruits. Nutrient availability controls the rate of photosynthesis and thus determines plant growth and production. Nutrient excess/deficiency potentially results in poor photosynthesis and reduces the amount of photosynthate yield translocated to fruits. Consequently, it indirectly decreases the fruit quality and weight (Sabaruddin, 2019).

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CONCLUSION

KCl fertilizer significantly determines the number of fruits per sample plant and per plot. On the contrary, goat urine treatment has no significant effect on all the parameters observed. In addition, there was no interaction between KCl fertilizer and goat urine on all these parameters.

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