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THE EFFECT OF POTASSIUM SULFATE FERTILIZER ON POTASSIUM AND SULFUR CONTENT IN SOIL AND CORN YIELD (*Zea maysL.*) IN INCEPTISOL JATINANGOR

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ABSTRACT

Sulfur and potassium are two crucial elements that plants need. Sulfur is crucial for boosting the quality and quantity of agricultural harvests, whereas potassium is important for the process of plant growth. The research aimed to determine the effect of applying K_2SO_4 fertilizer on the K and S content in the soil and corn crop yields on Inceptisol.A Randomized Completely Design was used in the experiment at the Laboratory of Soil Chemistry and Plant Nutrition. Seven different potassium sulfate dose combinations were used, along with one dose of standard NPK, and one dose of control treatment for comparison. Each treatment was carried out three times.The parameters in this experiment were the content of potassium and sulfur also the yield of corn components. The results showed that, in comparison to the control and other treatments, applying one and a quarter-dose of potassium sulfate fertilizer had the greatest outcomes for the soil's potassium and sulfur content as well as corn yield. The maximum weight of corn cobs per hectare in comparison to the control and other treatments was 8,959 kg ha^{-1}.

KEYWORDS:

Potassium Sulfate Fertilizer, Potassium and Sulfur Content In Soil, Corn, and Inceptisols.

INTRODUCTION

Corn ***(Zea mays*** L.) is a food-crop commodity that plays a significant role in the Indonesian economy. In 2018, Indonesia produced 30.05 million tons of corn [1]. In Indonesia, corn productivity is not yet at the highest level.The productivity of corn in Indonesia is not yet optimal. Indonesia imports 1.77 million tons and has increased by 24.75% per year [2].

Suboptimal growth of plants and output are controlled by a variety of soil factors, particularly soil fertility, particularly low nutrient availability. Long-term plant growth and yield are highly dependent on proper soil fertility management. Plants require nutrients to grow and develop effectively[3]; nutrients that are absent or inaccessible in the soil might impair the quality and quantity of agricultural harvests [4]. Applying fertilizer is one method of improving soil fertility. Appropriate fertilization can assist in meeting plant nutrient needs while also improving agricultural yield quality and quantity [5].

Although NPK (Nitrogen, Phosphorus, and Potassium) fertilizer is commonly used as the major fertilizer in corn cultivation to provide nutrients to the soil and enhance yields, potassium sulfate (K_2SO_4) is also considered an alternative to supply nutrients to the soil and increase corn production. Potassium is essential for plant growth, particularly during plant maturation, because it impacts photosynthesis, chlorophyll creation, seed filling, and carbohydrate formation [6]. Sulfur is an essential macronutrient for plants that helps to increase plant yields by providing nutrients directly, and indirectly as soil improvers, especially in soils with high pH, and increasing the efficiency with which other essential nutrients, particularly nitrogen and phosphorus, are used [7].

Based on research, it has been shown that the addition of K_2SO_4 fertilizer to the soil can improve the potassium status in the soil and provide a quadratic increase in vegetative growth and dry weight of tomato plants, with higher K status yielding the best response [8]. The provision of sulfur significantly influences chlorophyll formation in plants[9]. The application of fertilizer containing sulfur (S) significantly affects the yield of shallots, resulting in a higher dry bulb yield [10].The application of K_2SO_4 fertilizer on potato seeds can have an impact on tuber weight based on grade. The results of the study showed that the treatment with a concentration of 2.5 gl^{-1} K_2SO_4 fertilizer dosage significantly differed from the other treatments. [11].

The research aimed to determine the effect of applying K_2SO_4 fertilizer on the K and S content in the soil and corn crop yields in Inceptisols Jatinangor

RESEARCH METHODOLOGY

The experiment was carried out at the Experimental Field of Soil Chemistry and Plant Nutrition Laboratory, Department of Soil Science and Land Resources, Faculty of Agriculture, Universitas Padjadjaran Jatinangor, Sumedang Regency, West Java, at an elevation of 794 meters above sea level. This study was carried out between May and September of 2021.

Paragon variety corn seeds, Inceptisol soil as a planting medium, Urea (46% N), SP-36 (36% P_2O_5), KCl (60% K_2O), and K_2SO_4 fertilizers were utilized. The experiment used a Randomized Completely Design with seven treatments of potassium sulfate fertilizer dose, along with one dose of standard NPK, and one control treatment as a comparison. Each treatment was carried out three times. The F test was used to examine the differences in response to the growth and productivity of corn plants from each treatment applied. Furthermore, to assess differences in mean values between treatments, further statistical tests were carried out at the 5% level using the Duncan Multiple Range Test.

Planting was done in plots that were 2 m x 3 m in size, with a 75 cm gap between them. Plant spacing was 75 cm x 25 cm, with 32 planting holes in each plot. Manure was distributed evenly on the soil surface two weeks before planting. Corn seeds of the Paragon variety were planted by discovering to a depth of 3 cm and planting two seeds in each hole. At planting time, an appropriate dose of potassium sulfate fertilizer was applied. SP-36 and KCl fertilizers were applied during planting time, whereas Urea fertilizer was applied 7 and 14 days after transplanting, respectively. The treatment details can be seen in Table 1.

Table 1. The Treatment Scheme for the Potassium Sulfate Fertilizer Effectiveness Test on Corn Plants.

Code	Treatment	Fertilizer Rate ($kgha^{-1}$)			
		Kalium Sulfate	Urea	SP-36	KCl
A	Control	0	0	0	0
B	Standard NPK	0	300	150	50
C	% Dose K_2SO_4Fertilizer+ N, P	75	300	150	0
D	% Dose K_2SO_4 Fertilizer+ N, P	150	300	150	0
E	^{3}% Dose K_2SO_4 Fertilizer+ N, P	225	300	150	0
F	1 Dose K_2SO_4 Fertilizer+ N, P	300	300	150	0
G	1 % Dose K_2SO_4 Fertilizer+ N, P	375	300	150	0
H	1 % Dose K_2SO_4 Fertilizer+ N, P	450	300	150	0
I	1 % Dose K_2SO_4 Fertilizer+ N, P	525	300	150	0

Description:

a. Control is the treatment without potassium sulfate fertilizer and N, P, and K fertilizers.
b. Standard N P K fertilizer is the local recommended dose of inorganic fertilizer for Corn (300 kg Urea, 150 kg SP-36, and 50 kg KCl per hectare).
c. The recommended dose treatment of potassium sulfate fertilizer is given according to the recommended dose of 300 kg/ha.

Watering, replanting, thinning 2 days after planting, weeding, and insect handling are all examples of field maintenance. Watering was done using groundwater using a hose every day in the morning or evening until the planting media was moist. Replanting is done to replace dead plants; this activity is carried out by taking plants from the same treatment and growing them in various replicates so that they can grow in the same media conditions. Thinning is carried out 14 days after planting leaving one plant with the best growth and burying the others as organic materials for the planting media. Every week, weeds that develop around the plants are carefully removed. Only fungicide (Antracol 70 WP) at a dosage of 3 $g.L^{-1}$ was used to control the disease.

Soil samples were collected for analysis during the peak of the vegetative phase, 56 days after planting. Samples were obtained from the soil around the roots (rhizosphere) and weighed up to 100g before being transported to the laboratory for analysisof nutrient elements K and S in the soil. K and S nutritional analysis was performed, as well as yield components such as cob diameter per plant (mm), cob length per plant (cm), fresh cob weight per plant (g), and cob weight per plot (kg).

Harvesting occurred when the plants were 85 after planting, with 90% of the sweet corn leaves turning yellowish, the corn stalks drying up, and the hair on the cob beginning to dry. Harvesting took place in the morning, while the weather was sunny. The weight of the cob weight taken in 1 plot is the observation of cob weight per plot. Corn cob diameter, cob length per plant, fresh cob weight per plant, and cob weight per plot are typically measured by collecting a sample of cobs from each plant. However, not all cobs are observed because it is time-demanding and inefficient; the cob samples obtained are cobs with features or attributes that approximate the average of all cobs on the plant; and the cobs taken are 5 cobs per treatment. After selecting the samples, the diameter of the cob was measured at its widest point with a Vernier caliper. A ruler was used to measure the length of each cob. The average cob length per plant was calculated by adding the measurement findings from all cob samples and dividing them by the number of cobs obtained.

RESULTS AND DISCUSSION

1. Results of Soil Analysis Before Providing Treatment

The results of soil analysis of inceptisol before giving treatment, namely as follows:clay texture, pH= 6.52, organic-C = 1.57%, total N = 0.16%, and P-potential = 26.65 mg $P_2O_5$100 g^{-1}, K-potential) = 32.20 mg K_2O.100 g^{-1}, and CEC = 34.08 cmol kg^{-1}.

2. Analysis of Soil Nutrient Content

The macronutrients K and S are required in sufficient quantities for optimal plant growth and yield. The use of potassium sulfate fertilizer treatment alters the soil's K and S levels. Table 2 shows the effect of potassium sulfate fertilizer on soil fertility.

Table 2: Effect of Potassium Sulfate Fertilizer Application on Soil K and S Content

Code	Treatment	KPotensial (mg K_2O/100 g)	S (%)
A	Control	47.61 a	0.05 a
B	Standard NPK	55.96 b	0.06 a
C	¼ Dose K_2SO_4Fertilizer+ N, P	57.07 b	0.11 b
D	½ Dose K_2SO_4Fertilizer+ N, P	57.52 b	0.11 b
E	¾ Dose K_2SO_4Fertilizer+ N, P	60.90 c	0.11 b
F	1 Dose K_2SO_4Fertilizer+ N, P	61.08 c	0.12 b
G	1 ¼ Dose K_2SO_4Fertilizer+ N, P	63.35 d	0.17 c

H	1 ½ Dose K_2SO_4Fertilizer+ N, P	59.91 c	0.12 b
I	1 ¾ Dose K_2SO_4Fertilizer+ N, P	59.53 c	0.12 b

Note: Mean numbers followed by the same letter are not significantly different based on Duncan's Multiple Range Test at the 5% Level.

Table 2 shows the results after analyzing the potential K content measured using AAS and S measured using UV-Vis Spectrophotometer, and the table shows that statistical analysis of Potassium Sulfate fertilization has a significant effect on the soil compared to the control. Duncan's multiple range further test results revealed that the treatment of Potassium sulfate combined with a single N and P fertilizer in the treatment of 1 % dose K_2SO_4 fertilizer + N, P had the highest K and S content compared to other treatments, which had soil K and S content values of 63.35 Mg K_2O100 g^{-1} and 0.17%, respectively.

After the control treatment, the standard NPK treatment has the lowest soil K and S concentration of 55.96 mg100 g^{-1} and 0.06%, respectively. This occurs because potassium sulfate fertilizer contains nutrients that corn plants require, such as K and S. Inorganic fertilizers are excellent at increasing nutrients. After all, they may supply nutrients to the soil quickly and in sufficient quantities. The increased availability of nutrients in the soil will correspond to greater nutrient uptake by plants. The availability of nutrients in the soil influences plant nutrient uptake [12].Soil and organic material were the sources of nutrition for plants [13;14]. The process of releasing nutrients into the soil as additional nutrients such as macronutrients require the decomposition of organic waste [15]. Besides that, where the suitability of the land for certain types of plants is concerned, the amount of soil fertility utilized as a medium for growing plants becomes important [16].

3. Yield of Corn

The yield components of corn plants cultivated in the same growth environment but with various treatments differed. Cob diameter, cob length, fresh cob weight, and cob weight/plot are the yield components noted. Table 3 shows observation data on the yield components of the corn plant Paragon variety.

Table 3. The Effect of Potassium Sulfate Fertilizer Application on Yield Component of Corn Plant Paragon Variety

Code	Treatment	CD	CL	FCW	CWP
A	***Control***	***38.7 a***	***12.7 a***	***76.3 a***	***2.44 a***
B	***Standard NPK***	***39.3 a***	***13.3 b***	***154.8 b***	***4.96 b***
C	***% Dose K_2SO_4 Fertilizer+ N, P***	***42.5 b***	***13.5 b***	***168.9 c***	***5.40 c***
D	***% Dose K_2SO_4 Fertilizer+ N, P***	***43.1 b***	***14.2 bc***	***183.5 d***	***5.87 d***
E	***% Dose K_2SO_4 Fertilizer+ N, P***	***46.3 c***	***13.8 bc***	***202.1 e***	***6.47 e***
F	***1 Dose K_2SO_4 Fertilizer+ N, P***	***45.7 c***	***15.3 d***	***180.4 d***	***5.77 d***
G	***1 % Dose K_2SO_4 Fertilizer+ N, P***	***48.2 d***	***16.3 e***	***210.0 e***	***6.72 e***
H	***1 % Dose K_2SO_4 Fertilizer+ N, P***	***47.1 c***	***14.5 c***	***177.1 cd***	***5.67 cd***

Notes: Mean numbers followed by the same letter are not significantly different based on Duncan's Multiple Range Test at the 5% level. CD = cob diameter (mm); CL = cob length (cm); FCW = fresh cob weight (g); CWP = cob weight per plot (kg).

According to the yield component data in Table 3, varied doses of potassium sulfate fertilizer in each treatment resulted in different cob diameter, cob length, fresh weight of cob, and weight of peeled cob. The cob diameter was greatly altered by the varied fertilizer doses. The treatment of 1/4 to 1 % dose K_2SO_4 fertilizer of test fertilizer produced statistically different outcomes than the control and regular NPK treatments, ranging from 42.5 mm to 48.2 mm.

Cob diameter and cob length are crucial factors that influence yield because the larger the cob diameter and cob length, the greater the cob weight [17]. According to the findings of the statistical study, the dose of potassium sulfate fertilizer mixed with a single fertilizer has a substantial effect on cob length. The control treatment had the shortest cob length (12.7 cm), while the 1 % dose test fertilizer treatment had the longest cob length (16.3 cm).

The potassium sulfate dose treatment had a substantial impact on the weight of fresh cob and cob weight per plot. For the parameters of fresh weight of cob and cob weight per plot, which were 210 g and 6.72 kg, respectively, the greatest treatment was 1 % dose K_2SO_4 fertilizer. For the cob weight per plot metric, the regular NPK treatment yielded a lower value of 4.96 kg than the potassium sulfate fertilizer dose treatment. The K ingredient in potassium sulfate fertilizer can improve corn plant weight per plot. The availability of K elements that plants may absorb has a considerable influence on corn grain filling [18].

Table 4. Convertion of Cob Weight

Code	Treatment	Cob Weight per plot (kg plot^{-1})	Cob Weight per Hectar (Mgha^{-1})
A	Control	2.44	3,255
B	Standard NPK	4.96	6,607
C	% Dose K_2SO_4 Fertilizer+ N, P	5.40	7,206
D	***%2*** Dose K_2SO_4 Fertilizer+ N, P	5.87	7,830
E	% Dose K_2SO_4 Fertilizer+ N, P	6.47	8,624
F	1 Dose K_2SO_4 Fertilizer+ N, P	5.77	7,695
G	1 % Dose K_2SO_4 Fertilizer+ N, P	6.72	8,959
H	1 % Dose K_2SO_4 Fertilizer+ N, P	5.67	7,556
I	1 % Dose K_2SO_4 Fertilizer+ N, P	5.85	7,804

Note: Mean numbers followed by the same letter are not significantlydifferent based on Duncan's Multiple Range Test at the 5% level.

According to the results in Table 4, the 1 % dose K_2SO_4 fertilizer + N, P treatment has the highest cob weight per hectare among the other treatments, at 8,959 Mgha^{-1}. This can be attributed to the application of inorganic fertilizer treatments where essential nutrients such as K, S, N, and P are available in optimal and balanced quantities, thus providing a balanced supply of micronutrients to the plants. Potassium sulfate fertilizer contains potassium and sulfur, both of which play key roles in improving soil quality and crop yield quality. Potassium plays a crucial role in plant growth, especially during the plant's maturation stage, as it influences photosynthesis in chlorophyll formation and seed filling, and is essential in carbohydrate formation [19].While sulfur has a function in plant physiology, the development of chlorophyll related to the process of photosynthesis aids in the formation of green grains of leaves, root nodules, and productive tillers [20].

CONCLUSIONS

Based on the findings of a study on the effect of potassium sulfate fertilizer on soil K and S content in soil and yield of corn ***(Zea mays*** L.) Paragon variety in Inceptisol Jatinangor, it can be concluded that the treatment dose of 375 kgha^{-1}K_2SO_4 fertilizer + Urea 300 kgha^{-1}, SP-36 150 kgha^{-1}, or 1 % dose K_2SO_4 fertilizer + N, P yields the highest yield among other treatments. The addition of K_2SO_4 fertilizer can enhance the quantity of nutrients in the soil, causing nutrients in the soil to increase, and affecting plant production. The cob weight per hectare of the treatment dose of 375 kgha^{-1} of K_2SO_4 fertilizer + Urea 300 kgha^{-1}, SP-36 150 kgha^{-1}, or 1 % dose K_2SO_4 fertilizer + N, P is 8,959 Mg ha^{-1}, which is the highest among other treatments.

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