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Influence the phosphorous and silicon on growth and yield of sweet corn

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Abstract

A field experiment was conducted during *Kharif* season of 2023 at Crop Research Farm Department of Agronomy. The treatments consisted of 3 levels of phosphorus (45, 60 and 75 kg P/ha) and silicon (1.5, 3.0 and 4.5 ml/L of water) along with recommended doses of nitrogen and potash and a control (120-60-60 kg N-P-K/ha). The experiment was laid out in a Randomized Block Design with 10 treatments and replication thrice. Application of Phosphorus (75 kg/ha) + Silicon 3.0 ml/L of water (Treatment 8) recorded highest dry weight (94.73 g), cobs per plant (2.21), rows per cob (19.15), grains per row (31.15), cob yield (6.37 t/ha). The aforesaid treatment also recorded B:C ratio (2.39).

Keywords: Economic, growth, phosphorus, silicon, sweet corn, sweety

Introduction

Maize (*Zea mays* L.) is a cereal crop and it is called as "queen of cereals" and "non-tillering plant". Maize is one of the three major world food crops, is recognized as the "golden food" because of its high grain yield and nutrition value, and plays a very important role in the daily calorie intake of humans. Maize is the third most important crop in India after rice and wheat. In the world, India's ranks 5th in acreage and 8th in production of maize. Globally, total area of maize was 186.86 m/ha, production 1078.56 million tone and in India area under maize cultivation is about 9.63 m/ha, production 25.90 million tonne in 2017. Maize is grown in an area of 9.43 million hectares with production of 24.35 million tonnes and productivity of 2583kg/ha.

Sweet corn is a medium plant type and provides green Cobs in 65 to 75 days after sowing. These are harvested earlier by 35 to 45 days compared to normal grain maize. The demand for sweet corn as a crunchy bite in the amusement parks, theatres, circus and exhibitions is increasing with increasing urban population. Due to its increasing demand, there is an increasing tendency for commercial production of sweet corn (Thakur *et al.* 2015) [28] of late, sweet corn is emerging as one of the important enterprises projecting diversified and value-added uses of maize. sustainability of sweet corn scientific cultivation practices must be ensured to attain the goal of agricultural sustainability. Sweet corn is picked at milk stage and eaten as a vegetable, rather than a grain. Its consumption at immature stage as roasted and boiled ears is a popular practice as the kernels are sweet (12-20% sugar).

Phosphorus is an essential factor for cell division because it is a constituent element of nucleoproteins which are involved in the cell reproduction processes. It is also a component of a chemical essential to the reactions of carbohydrate synthesis and degradation. It is important for seed and fruit formation and crop maturation. Phosphorus hastens the ripening of fruits thus counteracting the effect of excess nitrogen application to the soil. It helps to strengthen the skeletal structure of the plant thereby preventing lodging. It also affects the quality of the grain and it may increase the plant resistance to diseases. Since the phosphate availability is usually low in the soils, the plants have developed special adaptations to acquire the same with the help of multiple high affinity transporters. (Raghothama, 1999) [19].

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Silicon (Si) is the second most common element on earth's crust. It comprises approximately 28% of the earth crust and supposed to be beneficial element to improve plant growth, development and productivity. Besides this, silicon is also helpful in promoting mechanical strength, light interception and resistance to various biotic and abiotic stresses, improving both quantity and quality of production. Although Si is universal in nature, evidence of its essence for higher plants is still lacking. According to scientific literature, however, Si is conducive to the healthy growth of plants directly or indirectly. Si may be applied through soil as well as foliar application. Under stressful conditions, it acts as a bio stimulant and exhibits optimistic results. Solubilization of silicon in situ in soil by silicate-solubilizing bacteria is also being attempted, and some bacterium is used as a biofertilizer to solubilize silicon and potassium bound in silicates. The use of silicon fertilizers provides rigidity and reverses the succulence induced by high nitrogen, paving the way for a higher crop yield.

Materials and Methods

The experiment was carried out during Kharif season of 2023 at the C.R.F (Crop Research Farm) Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agricultural, Technology and Sciences, Prayagraj, Uttar Pradesh, India which is located at 25° 24' 42'' N latitude, 81° 50' 5'' E longitude and 98 m altitude above the mean sea level. This area is located on the right side of river Yamuna which is 11 km away from Prayagraj city. Geographical location of Prayagraj is 25° 24' 41.2'' N latitude, 81° 51' 3.42'' E longitude and 98 m altitude above mean sea level. The experiment was conducted in Randomized Block Design consisting of 10 treatment combinations which are replicated thrice and was laid out with the different treatments allocated randomly in each replication. Factor 1: Levels of Phosphorous as basal at 45kg/ha, 60kg/ha and 75kg/ha and Factor 2 :Levels of silicon as foliar at 1.5ml/l, 3.0 ml/l and 4.5ml/l. Allocation of the treatment was done by the randomization. Sweety vareity was used in experiment. Fertilizers were applied as band placement, for which 4-5cm deep furrows were made along the seed rows with a hand hoe. The nutrient sources were Urea, SSP and MOP to fulfil the requirement of nitrogen, phosphorous and potassium. The recommended dose of 120 kg/ha nitrogen, 60 kg/ha phosphorous and 60 kg/ha potassium was applied according to the treatment details.

Results and Discussion

Plant dry weight

At 60 DAS, significant and higher plant dry weight (76.64 g) was observed in the treatment 8 [Phosphorus (75 kg/ha) + Silicon 3.0 ml/L of water]. However, treatment 5 [Phosphorus (60 kg/ha) + Silicon 3.0 ml/L of water] and treatment 1 [Phosphorus (45 kg/ha) + Silicon 1.5 ml/L of water] was found to be statistically at par with treatment 8 [Phosphorus (75 kg/ha) + Silicon 3.0 ml/L of water]. Significant and higher plant dry weight was with the application of phosphorus (75 kg/ha) due to Phosphorus encourage formation of new cells, promote plant vigour sly and hastens leaf development, which help in harvesting more solar energy and better utilization of nitrogen, which help towards higher plant dry weight. Similar results also found by Alias *et al.* (2003) [3]. Further, significant and higher plant height was with application of silicon 3.0 ml/L of water due to Si improved chlorophyll content and net photosynthesis rate of leaves, which promoted dry matter accumulation of maize seedlings. Similar results were

also reported by Yang *et al.* (2008) [30].

Number of cobs/plants

The number of cobs/plant was recorded at harvest, the data reveals that there was significant effect among different treatments on number of pods/plant.

Significant and higher number of cobs/plant (2.21) was observed in the treatment 8 [Phosphorus (75 kg/ha) + Silicon 3.0 ml/L of water]. However, treatment 5 [Phosphorus (60 kg/ha) + Silicon 3.0 ml/L of water] was found to be statistically at par with treatment 8 [Phosphorus (75 kg/ha) + Silicon 3.0 ml/L of water]. Significant and maximum number of cobs/plant was with the application of phosphorus (75 kg/ha) due to the fact that optimum availability of Phosphorus has associated with increase rapid growth and development thus those plots which received optimum Phosphorus produced more cobs/plant. Similar result was also reported by Sabu *et al.* (2021) [23]. Further, significant and higher number of cobs/plant was with application of silicon 3.0 ml/L of water due to silicon increases more number of functional leaves and leaf area resulting in increased photosynthetic activity, carbohydrate formation and nutrient uptake which might have increased the number of cobs/plant. Similar result was also reported by Ashok (2013) [7].

Number of rows/cob

The number of rows/cob was recorded at harvest. The data reveals that there was significant effect among different treatments on number of rows/cob.

Significant and higher number of rows/cob (19.15) was observed in the treatment 8 [Phosphorus (75 kg/ha) + Silicon 3.0 ml/L of water]. However, treatment 5 [Phosphorus (60 kg/ha) + Silicon 3.0 ml/L of water] was found to be statistically at par with treatment 8 [Phosphorus (75 kg/ha) + Silicon 3.0 ml/L of water]. Significant and maximum number of rows/cob might be due to the combined effect of Phosphorus (75 kg/ha) + Silicon 3.0 ml/L of water that play a vital role in producing growth hormone, pollen tube formation, increasing the efficiency of fertilization process and hence the number of grain increases. Similar results was also reported by Meena *et al.* (2016) [13].

Number of grains/row

The number of grains/row was recorded at harvest, is presented in Table 1. The data reveals that there was significant effect among different treatments on number of grains/row.

Significant and higher number of grains/row (31.15) was observed in the treatment 8 [Phosphorus (75 kg/ha) + Silicon 3.0 ml/L of water]. However, treatment 5 [Phosphorus (60 kg/ha) + Silicon 3.0 ml/L of water] was found to be statistically at par with treatment 8 [Phosphorus (75 kg/ha) + Silicon 3.0 ml/L of water].

Significant and higher grains/row was with phosphorus (75 kg/ha) might be due increased fertility level might have enhanced number of flowers and their fertilization resulting in higher number of filled cobs or grain per cob. Further, in most of cereals greater assimilating surface at reproductive developments results in better grains formation because of adequate production of metabolites and their translocation towards grains. Similar results was also reported by Sankadiya and Sanodiya (2021) [24]. Further, significant and higher number of grains/row was with application of silicon 3.0 ml/L of water due to silicon significantly improved the photosynthetic rate and decreased the transpiration rate, which ultimately increases the number of grains per row of the crop. Similar result was also reported by Amin *et al.* (2018) [5].

Cob yield (t/ha)

The observations recorded on Cob yield of sweet corn have been presented in Table 4.2.1.

Significant and higher cob yield (6.37 t/ha) was observed in the treatment 8 [Phosphorus (75 kg/ha) + Silicon 3.0 ml/L of water]. However, treatment 4 [Phosphorus (60 kg/ha) + Silicon 1.5 ml/L of water], treatment 5 [Phosphorus (60 kg/ha) + Silicon 3.0 ml/L of water] and treatment 7 [Phosphorus (75kg/ha) + Silicon 1.5 ml/L of water] were found to be statistically at par with treatment 8 [Phosphorus (75 kg/ha) + Silicon 3.0 ml/L of water]. Significant and higher cob yield was with phosphorus (75 kg/ha) might be due to Phosphorus application is attributed to source and sink relationship. It appears that greater translocation of photosynthates from source to sink might have increased Cob yield. Similar results was also reported by Sharma *et al.* (2018). Further, significant and higher cob yield was with application of silicon 3.0 ml/L of water due to silicon enhances the sturdiness

in plant and helps to grow erect without lodging. The erectness exposed the plant to sunlight and enhanced the photosynthetic activity and better assimilation of organic constituents (carbohydrates). This assimilation promoted the growth and development of crop, as well as reduced the incidence of pest and diseases. The crop grown vigorously and utilized the nutrients and moisture from soil which were turned into the economic yield of the crop. Similar results were also reported by Anand *et al.* (2018) [6].

Benefit-cost ratio

Benefit cost ratio (2.39) was found to be highest in treatment 8 [Phosphorus (75 kg/ha) + Silicon 3.0 ml/L of water] and minimum benefit cost ratio (1.64) was found in control as compared to other treatments.

Application of treatment 8 recorded maximum B:C ratio (2.39) compared to all other treatments.

Table 1: Influence of phosphorous and silicon on the growth and yield of sweet corn

Treatment	Dry weight 60DAS	Cobs/Plant	Rows/Cob	Grains/Ro W	Cob yield	BC Ratio
Phosphorous - 45 kg/ha + Silicon 1.5 ml/L of water	71.15	1.69	15.46	26.91	4.94	1.93
Phosphorous - 45 kg/ha + Silicon 3.0 ml/L of water	69.44	1.46	16.85	27.43	5.03	1.90
Phosphorous - 45 kg/ha + Silicon 4.5 ml/L of water	68.79	1.53	16.60	26.83	4.98	1.83
Phosphorous - 60 kg/ha + Silicon 1.5 ml/L of water	65.36	1.83	17.30	26.36	5.84	2.24
Phosphorous - 60 kg/ha + Silicon 3.0 ml/L of water	73.51	2.08	18.09	28.84	6.23	2.32
Phosphorous - 60 kg/ha + Silicon 4.5 ml/L of water	72.87	1.65	16.24	27.87	5.64	2.05
Phosphorous - 75 kg/ha + Silicon 1.5 ml/L of water	72.50	1.64	17.05	27.61	5.94	2.23
Phosphorous - 75 kg/ha + Silicon 3.0 ml/L of water	76.64	2.21	19.15	31.15	6.37	2.39
Phosphorous - 75 kg/ha + Silicon 4.5 ml/L of water	71.81	1.49	16.10	27.03	5.64	2.02
Control (RDF) 120-60-60 kg N-P-K/ha	64.13	1.37	15.21	24.35	4.16	1.64
F Test	S	S	S	S	S	—
S.E.M (±)	2.19	0.13	0.55	0.78	0.24	—
CD (P=0.05)	6.52	0.39	1.64	2.32	0.72	—

Conclusion

On the basis of one season experimentation, it can be concluded that with the application of Phosphorus (75 kg/ha) + Silicon 3.0 ml/L (T8) was found to be more desirable in terms of increasing in yield and economics of sweet corn.

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