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Effect of Boron on Growth and Yield of Sweet Corn (*Zea mays* L. Saccharata) Varieties

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

At the Department of Agronomy's Crop Research Farm, SHUATS, Prayagraj, a field experiment was carried out in the month of Zaid 2022. (U.P). The soil in the experimental plot had a sandy loam texture, a pH of 7.1 that was almost neutral, a low level of organic carbon (0.36%), and low availability of the nutrients N, P, K (171.48 kg/ha, 15.2 kg/ha, and 232.5 kg/ha, respectively). Ten treatments, each replicated three times, were used in the experiment, which was set up using a randomised block design over the course of a year. The treatments which are T1: Sugar-75 + 0.1 % boron foliar application, T2: Sugar-75 + 0.2 % boron foliar application, T3: Sugar-75 + 0.3 % boron foliar application, T4: Madhuri + 0.1 % boron foliar application, T5: Madhuri + 0.2 % boron foliar application, T6: Madhuri + 0.3 % boron foliar application, T7: Misthi + 0.1 % boron foliar application,

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T8: Misthi + 0.2 % boron foliar application, T9: Misthi + 0.3 % boron foliar application, T10: Control - N:P:K-120:60:40(kg/ha) are used. The results showed that treatment T9-Misthi + 0.3% boron foliar application was recorded significantly higher growth parameters like Plant height (175.5 cm), Plant dry weight (141.6 g/plant) at 80 DAS and highest Crop growth rate (22.1 g/m^2/day) at 60-80 DAS. However, yield attributes and yield parameters like No. of Cobs/plant (1.81), No. of Grains/Cob (617.7), No. of Rows/cob (14.37), Seed index (68.4 g), cob length (18.5 cm), Grain yield (9.5 t/ha), Stover yield (15.4 t/ha) were recorded with the treatment T9-Misthi+ 0.3 % boron foliar application.

Keywords: Boron; madhuri; misthi; sugar-75; growth; varieties; yield.

1. INTRODUCTION

One of the most adaptable developing crops, maize (*Zea mays* L.), has a wide range of adaptation under various agro-climatic situations. Given that it possesses the largest genetic production potential of all the cereals, maize is referred to as the "queen of cereals" internationally. In addition to rice and wheat, maize is a significant cereal crop worldwide. The management of its nutrients is what determines the productivity of maize [1]. Maize can use sun energy more effectively than other grains since it is a C4 plant. Every state in the nation grows maize all year long for a variety of uses, including animal feed, food grain, sweet corn, baby corn, green cobs, and popcorn. Corn flour is also a common ingredient in Indian cuisine. After rice and wheat, maize ranks third in importance among grains as a source of food in India. Increasing agricultural productivity requires either cultivating new land, which is rarely feasible, or increasing yield on the lands that are already being used for agriculture.

In India, which is the fifth-largest producer in the world and accounts for 3% of worldwide production, maize is grown over an area of roughly 9.18 million hectares, with a yield of 27.23 million tonnes and an average productivity of 2965 kg/ha. With a contribution of 14.87% (1.37 million tonnes) of the total Indian maize produced area, Madhya Pradesh leads the list. In India, Tamil Nadu had the highest productivity of about 6551 kg/ha while Karnataka produced maize at a rate of nearly 3.73 million tonnes, or 13.69% of the nation's total production. Whereas Uttar Pradesh contributes an area of around 0.73 million hectares (7.98% of the total area of India), with production of approximately 1.53 million tonnes (5.63% of the whole India), and productivity of 2090 kg/ha, respectively [2]. Due to its high nutrient requirements, sweet corn is a very demanding crop [3]. Since nitrogen has a vital role in the growth and development of maize plants and is a necessary element in large amounts because it is a key component of leaves in the form of proteins and chlorophyll.

The use of boron boosts plant stress tolerance, growth, and grain output. The global lack of boron is more severe than any other micronutrient shortage for plants. Insufficient amounts of boron in the soil decrease crop yield, degrade grain quality, and make crops more susceptible to disease. Boron deficiency induced sterility in maize. As a crucial component for plant growth and development, boron is more susceptible to a B deficiency in sexual reproduction than in vegetative growth [4]. Cell wall strength and development, cell division, fruit and seed development, sugar transport, and hormone development are all related to the primary functions of boron. The main mechanism by which commercial maize yield is reduced by boron deficiency is grain set failure. Since minerals are most needed when developing new tissue, deficiencies in boron are typically visible on maize's new leaves [5].

Varieties are crucial for achieving a better and bigger yield. We can get products that are free of diseases, pests, hybrids, etc. depending on the variety. One of the most crucial factors in crop output is variety. The majority of the agronomic requirements for baby corn are comparable to those for grain maize; however, in order to successfully produce baby corn, it is necessary to research the best varieties for the specific agroclimatic circumstances in the area. As for plant dry weight, crop growth rate, days to tasseling, days to silking, number of cobs/plants, weight of corn with husk, weight of corn without husk, corn yield, and fodder yield, among other factors, varieties also significantly add to higher growth and yields [6].

2. MATERIALS AND METHODS

At the Crop Research Farm (CRF), Department of Agronomy, SHUATS, Prayagraj (U.P.), India, which is situated at 25.40° N latitude, 81.85° E longitude, and 98° altitude above mean sea level, a field experiment was carried out during the month of Zaid in 2022. (MSL). The soil in the experimental plot had a sandy loam texture, a pH of 7.1 that was almost neutral, a low level of organic carbon (0.36%), and low availability of the nutrients N, P, and K (171.48 kg/ha, 15.2 kg/ha, and 232.5 kg/ha, respectively). On the premise of a one-year experiment, the experiment was set up using a Randomized Block Design with ten treatments that were each replicated three times. To meet the requirements for nitrogen, phosphorus, and potassium, respectively, nutrient supplies included urea, single super phosphate, and murate of potash. All treatments used an RDF of 120:60:40 NPK kg/ha as a base dosage, and the foliar application of the nutrient Boron was carried out in accordance with the treatments. Manual seeding was done at a depth of 3–4 centimetres. From germination until harvest, the plants' growth parameters were monitored at regular periods. After harvest, the yield parameters were monitored. The Randomized Block Design was used to statistically evaluate these parameters using analysis of variance (ANOVA).

3. RESULTS AND DISCUSSION

3.1 Plant Height (cm)

The significantly taller plant height (68.20 cm) at 40 DAS was recorded in treatment 9 with variety Misthi + 0.3 % boron foliar application. However, treatment 8 with Misthi + 0.2 % boron foliar application (67.6 cm) was found to be statistically at par with treatment 9 Misthi + 0.3 % boron foliar application as compared to other treatments.

The use of boron in various physiological processes, such as enzyme activation, electron transport, chlorophyll formation, stomatal regulation, etc., may be the likely cause of the impact on plant height, as the Misthi variety has proven to be superior to other varieties. The plant height steadily increased as boron levels rose, which may be related to higher photosynthetic activity and chlorophyll synthesis as a result of boron fertilisation leading to better vegetative growth. Adhikary et al. [7] and Alom et al. [8] both reported findings that were similar.

3.2 Plant Dry Weight (g)

The significantly maximum plant dry weight (24.7 g) was recorded with treatment 9 in treatment 9 with Misthi + 0.3 % boron foliar over the other treatments. However, treatment 2 Sugar-75 + 0.2 % boron foliar application (24.0 g/plant), treatment 3 Sugar-75 + 0.3 % boron foliar application (24.2 g/plant), treatment 6 Madhuri + 0.3 % boron foliar application (23.8 g/plant) and treatment 8 Misthi + 0.2 % boron foliar application (24.5 g/plant) were found to be statistically at par with treatment 9 Misthi + 0.3 % boron foliar as compared to other treatments.

Due to its greater development and accumulation of biomass when compared to other varieties, the Misthi variety displayed the greatest dry weight. Singh et al. [9,10] discovered similar patterns. With rising levels of boron, dry weight rose significantly. Due to the fact that boron typically affects cell division and nitrogen uptake from the soil may promote plant development, which is reflected in terms of plant dry weight. These conclusions agree with those reached by Kumar et al. [1].

3.3 Crop Growth Rate (g/m^2/day) and Relative Growth Rate (g/g/day)

There was a noticeable variation between the treatments during the first 40 to 60 DAS. However, the treatment 8 Misthi + 0.2% boron foliar had the greatest crop growth rate (15.7 g/m2/day), while the treatment 10 Control (N: P: K-120: 60: 40 kg/ha) had the lowest crop growth rate (15.1 g/m2/day). The treatment 6 Madhuri + 0.3% boron foliar spray had the highest relative growth rate (0.05g/g/day), while treatment 10 Control (N: P: K-120: 60: 40 kg/ha) had the lowest relative growth rate (0.053g/g/day).

3.4 Yield Attributes

The significantly higher number of cobs/plant (1.81), number of grains per cob (617.7), number of rows per cob (14.37) seed index (68.4 g) and cob length (18.5 cm) were found with treatment 9 (Misthi + 0.3 % boron foliar application). However, the treatment 8 Misthi + 0.2 % boron foliar application (18.3 cm) was found to be statistically at par with treatment 9 Misthi + 0.3 % boron foliar application.

Increase in this characteristic after foliar spraying could be attributed to boron's role in early phases of starch utilisation, stomatal balance, chlorophyll formation, enzyme activation, and membrane integrity, all of which promoted assimilate accumulation and led to heavier grains. These outcomes support the conclusions reached by Khan et al. [11]. Regarding yield attributes, the

Misthi variety's performance was found to be better. The genetic makeup of the variety that has assisted in improving photosynthetic activity due to greater source capacity and effective photosynthesis translocation to the washbasin may be the most likely explanation for this. The outcomes were consistent with Mashood et al. [12].

Table 1. Effect of Boron on growth and growth attributes of sweet corn varieties

S. No.	Treatment combinations	40 DAS		40 DAS - 60 DAS	
		Plant height (cm)	Dry weight (g)	Crop growth rate ($g/m^2/day$)	Relative growth rate (g/g/day)
1.	Sugar-75 + 0.1 % boron foliar application	64.3	23.4	15.2	0.05
2.	Sugar-75 + 0.2 % boron foliar application	65.8	24.0	15.6	0.05
3.	Sugar-75 + 0.3 % boron foliar application	66.9	24.2	15.6	0.05
4.	Madhuri + 0.1 % boron foliar application	63.5	22.9	15.2	0.05
5.	Madhuri + 0.2 % boron foliar application	63.9	23.2	15.2	0.05
6.	Madhuri + 0.3 % boron foliar application	65.2	23.8	15.5	0.05
7.	Misthi + 0.1 % boron foliar application	64.5	23.6	15.4	0.05
8.	Misthi + 0.2 % boron foliar application	67.6	24.5	15.7	0.05
9.	Misthi + 0.3 % boron foliar application	68.2	24.7	15.6	0.05
10.	Control - N:P: K-120: 60:40(kg/ ha)	62.8	22.5	15.1	0.05
	F-test	S	S	NS	NS
	SEm (±)	0.23	0.27	0.16	0.00
	CD (p=0.05)	0.68	0.82	-	-

Table 2. Effect of Boron on yield and yield attributes of sweet corn varieties

S. No.	Treatments	No. of cobs/plant	No. of grains/cob	No. of rows/cob	Seed Index (g)	Cob length (cm)	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
1.	Sugar-75 + 0.1 % boron foliar application	1.41	585.4	12.91	66.1	17.5	8.7	14.1	38.23
2.	Sugar-75 + 0.2 % boron foliar application	1.55	598.7	13.57	67.2	18.1	9.1	14.7	38.10
3.	Sugar-75 + 0.3 % boron foliar application	1.56	608.1	13.77	67.7	18.2	9.2	15.0	37.96
4.	Madhuri + 0.1 % boron foliar application	1.22	578.7	12.50	65.1	17.1	8.6	13.9	38.12
5.	Madhuri + 0.2 % boron foliar application	1.24	582.3	12.66	65.6	17.4	8.7	14.2	37.95
6.	Madhuri + 0.3 % boron foliar application	1.52	593.0	13.45	66.8	18.0	9.0	14.5	38.21
7.	Misthi + 0.1 % boron foliar application	1.45	589.4	13.28	66.4	17.7	8.9	14.4	38.03
8.	Misthi + 0.2 % boron foliar application	1.69	614.3	14.14	68.0	18.3	9.4	15.2	38.04
9.	Misthi + 0.3 % boron foliar application	1.81	617.7	14.37	68.4	18.5	9.5	15.4	38.10
10.	Control - N:P: K-120:60:40(kg/ ha)	1.14	577.3	12.34	64.8	16.9	8.5	13.9	38.07
	F test	S	S	S	S	S	S	S	NS
	S. Em (±)	0.02	1.19	0.07	0.18	0.07	0.04	0.15	0.28
	CD (P = 0.05)	0.08	3.54	0.20	0.55	0.21	0.15	0.47	-

3.5 Yield

Significantly higher grain yield (9.5 t/ha) and stover yield (15.40 t/ha) were found in treatment 9 Misthi + 0.3% boron foliar application. However, the treatment 8 Misthi + 0.2 % boron foliar application (9.4 t/ha) which was found to be statistically at par with treatment 9 Misthi + 0.3 % boron foliar application. Highest Harvest Index (38.23 %) was recorded with the treatment 1 Sugar-75 + 0.1 % boron foliar application whereas, minimum Harvest Index (37.95 %) was recorded with treatment 5 Madhuri + 0.2 % boron foliar application.

In terms of grain production, the performance of sweet corn varieties was excellent and exhibited a comparable pattern to yield attributes. The little millet variety Misthi outperformed other varieties in terms of seed and straw output, which may be attributable to the higher production efficiency that was evident in the improvement of various yield-attributing characters. Scaria et al. [13] reported similar results. Because zinc and boron are involved in many physiological processes of plants, including chlorophyll formation, stomatal regulation, and starch utilisation, which improve seed output, boron is essential for boosting seed yield. In addition to being essential for many physiological processes and plant development, nutrition is also important for boosting crop yields and quality. These findings corroborate the findings of Alimuddin et al. [14].

4. CONCLUSION

According to my study, the 0.3% Boron foliar application treatment combined with the variety Misthi was found to be more effective. Although the results are based on a single season, more study is required to support the conclusions and their suggested solutions.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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