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Effect of boron on growth and flowering in gladiolus (*Gladiolus* sp.)

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ABSTRACT

The experiment was conducted to find out the optimum dose of boron in maximizing growth and improving flowering attributes in gladiolus (*Gladiolus sp.)* cv. Malaviya Shatabdi at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh during 2020-21. The treatments were given as: the control (distilled water), 0.1% boron, 0.2% boron, 0.3% boron, 0.4% boron, 0.5% boron, 0.6% boron, 0.7% boron, 0.8% boron, 0.9% boron and 1.0% boron, applied at 60 and 75 days after planting. There was maximum number of leaves/plant (13.94), maximum width of scape (2.67 cm) was noted at 0.3% of B, maximum plant height was recorded with foliar application of 0.5% B (70.42 cm), whereas leaf length (65.50 cm) and leaf width (2.63 cm) were maximum at 0.6% of B as compared to other treatments. The earliest spike emergence and colour were noted in 68.44 days and 77.88 days respectively at 0.2% of B spray. Earliest opening of first and fifth florets was seen with 0.6% of B (85.06 and 90.00 days respectively). Maximum length (9.72 cm) and diameter (7.81cm) of first floret was observed in 0.2 % and 0.3% B treatments, whereas, maximum length (8.62 cm) and diameter (7.40 cm) of fifth floret was detected in 0.6% and 0.5% B treatments respectively. Results also showed that application of B significantly reduced flowering duration among all the treatments as compared to the control.

Key Words: Corms, Boric acid concentrations, Foliar spray, Vegetative and floral characters.

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Gladiolus (*Gladiolus* sp.*)* is highly valued for its elegant flowers. The productivity needs standard cultural practices at different growth stages. It needs proper nutrients for high yield. Among different micronutrients, boron (B) is important for normal growth of plants (Shireen *et al*., 2018). The essential minerals are required in trace amounts for better growth, development and metabolic activity of plants (Gowthami *et al*, 2022). As a cut-flower, it should have better shelf life. The genetic variability is observed among genotypes (Swaroop *et al*., 2019). Varieties with novel colours and new adaptive characters are developed every year (Rocktim and Sunil, 2022). Keeping in view, a field experiment was conducted.

MATERIALS AND METHODS

The experiment was conducted at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, during 2020-2021. The experiment was laid out in randomized block design with four replications and eleven treatments of different boric acid (B) concentrations. Manure and fertilizers were given as per the recommendation. Gladiolus corms (cv. Malaviya Shatabdi) of uniform shape and size were selected as planting material. Corms were planted at a uniform spacing of 30 cm × 20 cm and depth of 10-15 cm in furrows. Intercultural operations, earthing-up, weeding, hoeing and irrigation were done according to need.

Boron was used in the form of boric acid and applied through foliar spray. Different concentrations of boric acid, i.e. 0.1% B, 0.2% B, 0.3% B, 0.4% B, 0.5% B, 0.6% B, 0.7% B, 0.8% B, 0.9% B and 1.0% B were used. Lime was used for neutralizing boric acid solutions. The boron solutions of different concentrations were sprayed twice, at 3 and 6 leaf stages. Statistical analysis was done at 5% level of significance. Growth parameters were recorded 75 days after planting, i.e., at 6 leaf stage. The number of plants/hill, number of leaves/plant, plant height, leaf length, leaf width and width of scape were recorded. The observations were taken for each tagged plant in respective replication.

Flowering parameters, viz. days to spike emergence, days to colour show, opening and withering of first, third, fifth and last florets, length and diameter of first, third and fifth florets, spike

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length, rachis length, inter nodal length, number of florets/spike, number of opened florets/spike, flowering duration of first, third, fifth and last florets and total duration of flowering. These parameters were recorded timely.

RESULTS AND DISCUSSION

There was maximum number of plants/hill with 0.4% B treatment (2.56). It may be as a result of assemblage of photosynthates in soil owing to presence of boron. (Muthanna *et al.,* 2017). Maximum number of leaves/plant (13.94) was recorded in 0.3% B. This may be due to transport of starch and sugars by boron affecting physiological processes. These findings supported to those of Singh *et al*. (2018); Reddy and Chaturvedi (2009) and Halder *et al*. (2007a) (Table 1). Maximum plant height (70.42 cm) was attained with foliar application of 0.5% B. This finding contradict those of Chopde *et al*. (2016). It may be due to different climatic and soil conditions prevailing in the region. Leaf length was maximum (65.50 cm) with treatment of 0.6% B and was significant with other treatments.

Maximum leaf width was obtained in plants treated with 0.6% B (2.63 cm) and was significant to other treatments. This may be the result of accumulation of boron in leaf tissues causing cell elongation. Maximum width of scape was obtained with treatment of 0.3% B (2.67 cm). Also, cell wall synthesis and stability increases with components of cell wall like pectins, polyols and polyhydroxyl polymers. This finding is in accordance with those of Muthanna *et al.* (2017).

Boron (0.2%) resulted in earliest spike emergence (68.44 days) and colour show (77.88 days), while plants treated with 0.8% B resulted in late spike emergence (77.25 days) and colour show (84.19 days). This might be due to toxic effects of boron causing late spike emergence and colour show at higher concentrations. Similar findings were obtained by Singh *et al*. (2018) and Kumar *et al*. (2010). Earliest opening of first, third, fifth and last florets was observed with treatments of 0.6% B (85.06 days), 0.2% B (87.56 days), 0.6% B (90.00 days) and 0.2% B (95.38 days) respectively. On the contrary, withering of first floret was earliest with 0.6% B treatment (90.69 days), while withering of third, fifth and last floret was earliest with treatment 0.2% B each (93.00 days, 94.44 days and 94.44 days respectively). The results are in confirmation with those of Fahad *et al*. (2014), Chopde *et al*. (2016) and Ahmad *et al*. (2010).

Maximum diameter of first floret (7.81 cm) was observed with 0.3% B treatment, maximum diameter of third floret (7.74 cm) at 0.2% B and maximum diameter of fifth floret (7.40 cm) with 0.5% B treatment (Table 2). Maximum length of first floret (9.72 cm) was observed with plants treated with 0.2% B, maximum length of third floret (9.36 cm) was in 0.3% B and highest length of fifth floret (8.62 cm) was noted in plants of

Table 1. Effect of boron on number of plants/hill, number of leaves/plant, plant height, leaf length, leaf width and width of scape

Treatment	Number of plants/hill	Number of leaves/ plant	Plant height (cm)	Leaf length (cm)	Leaf width (cm)	Width of scape (cm)
Control (distilled water)	1.19	7.06	64.15	59.82	2.28	2.34
0.1% B	2.44	12.00	64.03	60.20	2.28	2.29
0.2% B	1.94	10.75	63.52	59.39	2.38	2.55
0.3% B	2.50	13.94	69.67	64.84	2.47	2.67
0.4% B	2.56	12.94	68.41	62.32	2.49	2.53
0.5% B	2.50	13.38	70.42	64.44	2.62	2.63
0.6% B	2.25	10.94	70.07	65.50	2.63	2.53
0.7% B	1.88	11.19	63.03	58.94	2.43	1.66
0.8% B	1.81	9.19	59.10	56.02	2.28	2.04
0.9% B	1.94	11.31	65.04	61.48	2.53	2.45
1.0% B	2.00	10.81	61.69	58.35	2.25	2.10
CD (5%)	0.30	1.55	2.53	1.86	0.26	0.28

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Table 2. Effect of boron on flowering duration of first, third, fifth and last florets, total duration of flowering, length and diameter of first, third, fifth and florets, spike length, rachis length and inter nodal length

Treatment	Flowering duration of floret (days)				Total duration of flowering (days)	First floret (cm)		Third floret (cm)		Fifth floret (cm)		Spike length (cm)	Rachis length (cm)	Internodal length (cm)
	1st	3rd	5th	last		Length	Diameter	Length	Diameter	Length	Diameter			
Control (distilled water)	5.69	5.56	5.38	2.94	4.00	9.40	7.57	8.52	6.96	8.55	6.37	69.63	31.43	3.48
0.1% B	4.63	5.00	4.13	4.00	4.00	9.41	7.38	8.59	6.64	8.30	6.28	67.32	30.85	3.39
0.2% B	5.50	5.44	4.38	4.00	4.00	9.72	7.64	8.96	7.74	8.20	6.83	63.40	30.45	3.24
0.3% B	5.25	4.88	4.25	4.00	4.69	9.46	7.81	9.36	7.04	8.57	6.65	68.54	29.67	3.46
0.4% B	4.88	4.88	4.13	3.75	3.75	9.22	7.48	8.37	6.67	8.09	6.41	62.47	29.52	3.33
0.5% B	5.56	5.19	3.88	3.81	3.81	8.39	7.57	8.92	7.31	8.42	7.40	71.05	30.90	3.41
0.6% B	5.63	5.69	5.13	3.75	3.75	8.46	7.48	8.88	7.21	8.62	6.78	73.50	34.30	3.46
0.7% B	4.75	5.25	4.63	4.00	4.00	9.02	6.74	8.40	6.39	8.54	6.76	61.25	27.77	2.72
0.8% B	4.69	4.25	3.88	2.75	2.50	8.73	7.46	7.94	6.38	7.41	6.28	65.44	28.52	3.16
0.9% B	5.38	4.88	4.75	3.94	3.94	9.13	7.20	9.08	7.46	7.54	6.52	70.17	34.18	3.63
1.0% B	4.56	5.44	4.63	3.63	3.38	9.00	7.37	8.51	6.83	8.24	6.43	68.83	33.54	3.50
CD (5%)	0.86	0.81	0.85	0.75	0.87	0.71	0.70	0.75	0.78	0.63	0.54	7.31	4.18	0.45

0.6% B treatment. The element stimulates, inhibits, or stabilize enzymes; it is involved in transport of sugars across the membrane, lignin and flavonoid synthesis, and metabolism of auxins, nitrogen compounds, and phenols (Milka *et al*., 2020). These results may be due to increased activity of boron in cell division and cell elongation of florets, resulting in increased length and diameter. The number of florets/spike and opened florets/spike were maximum with 0.9% B (13.13 and 11.81, respectively). Appearance of the spike is also determined by number of florets opened at a time. Opened florets at a time was maximum with 0.2% B (6.88) treatment.

Longest spikes and rachis were obtained with treatment of 0.6% B each (73.50 cm and 34.30 cm respectively) (Table 2). It might be due to effect of boron when applied at higher concentration, resulting in cell division and elongation, whereas longest inter nodal length was obtained with 0.9% B (3.63 cm). This was in accordance with those of Devi *et al*. (2017). Maximum flowering duration of first, third, fifth and last florets was attained with application of 0.6% B (5.69 days), 0.6% B (5.69 days), 0.6% B (5.38 days) and 0.7% B (4.00 days). Total duration of flowering was higher with 0.3% B treatment (4.69 days).

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