Original Research Article

Effect of boron and gibberellic acid on growth, yield and quality of tuberose (*Polianthes tuberosa* L.) cv. Arka Nirantara

UNDER PEER REVIEW

ABSTRACT

An experiment entitled "Effect of boron and gibberellic acid on growth, yield, and quality of tuberose (*Polianthes tuberosa. L*) cv. Arka Nirantara" was conducted in Horticulture Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj during April, 2023 to March, 2024 with an aim to identify the most suitable treatment combination with boron and gibberellic acid under agroclimatic conditions of Prayagraj. The experiment was conducted in Randomized Block Design with nine treatments replicated thrice. Treatments consisted of two levels of boron (10 ppm and 15 ppm) and GA_3 (100 ppm and 150 ppm) each and their different concentration with water spray as control. Treatment combination (Boron @ 15 ppm + GA_3 @ 150 ppm) performed better in parameters like plant height (21.8 cm), plant spread (44 cm), rachis length (38.5 cm), spike length (88.4 cm), number of florets/plant (50.5), diameter of florets (16.3 mm), florets weight (13.2 g), shelf life of florets (6 days), number of spike/plant (2.8) whereas days required for first flower spike (70 days) was lesser in sole treatment (GA_3 @ 100 ppm).

Keywords: *Arka Nirantra, Boron@15ppm+GA3@150ppm, Evolution, Flowering, Growth*

1. INTRODUCTION

Tuberose (*Polianthes tuberosa* L.) is one of the most important tropical ornamental bulbous flowering plants cultivated for the production of long-lasting flower spikes. It is popularly known as Rajanigandha or Nishigandha. It belongs to the family Amaryllidaceae and is native to Mexico. It is an important commercial cut as well as a loose flower crop due to its pleasant fragrance, longer vase-life of spikes, higher returns, and wide adaptability to varied climates and soil. It is grown commercially in several countries including India, Kenya, Mexico, Morocco, France, Italy, Hawaii, South Africa, Taiwan, North Carolina, USA, Egypt, China, and many other tropical and subtropical areas in the world. It can be grown on wide variety of soils ranging from light, sandy loam to a clay loam. There is high demand for tuberose concrete and absolute in international markets which fetch a very good price. They are valued much by the aesthetic world for their beauty and fragrance. The flowers are attractive and elegant with a sweet fragrance. Flowers of the single type are commonly used for extraction of essential oil, loose flowers, making garlands, etc., while that of double varieties are used as cut flowers, garden display and interior decoration. It is also popular cut flower, not only for use in arrangements but also for the individual florets that can provide fragrance to bouquets and boutonnieres. Application of plant growth regulators is being practiced by the commercial growers as a part of cultural practice to improve the different economically important and market desirable characteristics of this flower plants. Micronutrients are essential for better growth of tuberose. They are responsible in activating several enzymes (catalase, peroxidase, alcohol dehydrogenase, carbonic dehydrogenase, tryptophan synthases, etc.) and involve them self in chlorophyll synthesis and various physiological activities by which plant growth and development are encouraged (**Kumar and Arora, 2000**).

Boron plays an important role in the development and differentiation of tissue, carbohydrate metabolism and translocation of sugar in plant. It helps in the normal growth of plant and absorption of nitrogen in soil. It helps in root development and flower formation. Gibberellic acid is known as an essential growth hormone for controlling various physiological activities such as growth, flowering, ion transport, mediator for acclimatization of leaf area expansion, stimulate elongation.

2. MATERIALS AND METHODS

The field experiment was carried out in the Department of Horticulture, Sam Higginbottom University of Agriculture, Technology And Sciences, Naini, Prayagraj, during May, 2023 to May, 2024. The trial was laid out in a Randomized Block Design with three replications and 9 treatments comprising of T1- Control (Water Spray), T2 – Boron @ 10 ppm, T3- Boron @ 15 ppm, T4- GA_3 @ 100 ppm, T5 – GA_3 @ 150ppm, T6 – Boron @ 10 ppm + GA_3 @ 100 ppm, T7 – Boron @10 ppm + GA3 @ 150 ppm, T8 – Boron @ 15 ppm + GA3 @ 100 ppm, T9 – Boron @15 ppm + GA3 @150 ppm.

3. Results And Discussion

3.1 Vegetative parameters of tuberose

Among all the treatments, significant variation in vegetative parameters were observed in table 1.

Significantly taller plant (21.8 cm) was observed in treatment T9 (Boron @ 15 ppm + GA_3 @ 150 ppm), which was followed by treatment T3 (Boron @ 15 ppm, 18.7 cm), whereas, shorter plants (3 cm) were observed in treatment T2 (Boron @ 10 ppm). The increase in plant height may be attributed to combined effect of GA_3 and boron. GA_3 plays important role of cell elongation whereas boron is involved in plant processes such as sugar translocation and membrane permeability, leaf photosynthesis, cell elongation and division, cell wall biosynthesis and nitrate metabolism Thereby resulting in taller plants which were treated with optimum dose of GA_3 and boron. Similar results were also obtained in **Reddy *et al.*, (2009)** in gladiolus and **Mishra *et al.*, (2001)** in chrysanthemum and **Rajput *et al.*, (2020)** in African marigold.

Significantly wider plant spread (44cm^2) was observed in treatment T9 (Boron @ 15 ppm + GA_3 @ 150 ppm), which was followed by treatment T6 (Boron @10 ppm + GA_3 @ 100 ppm, 38.9 cm^2), whereas, the lesser plant spread (33.9 cm^2) was observed in treatment T1 (control). The increase in plant spread may be attributed to combined effect of GA_3 and boron. GA_3 plays important role of cell elongation whereas boron might be stimulating metabolic activity with stimulating effect on cell wall loosing, increased cell elongation along with cell enlargement and cell differentiation. Thereby resulting in wider plant spread which were treated with optimum dose of GA_3 and boron. Similar results were also obtained by **Bashir *et al.***, (2013) and **Pal. *et al.***, (2016) in Gerbera.

Table 1: Vegetative Parameters of tuberose

	Treatment	Plant Height(cm)	Plant Spread(cm^2)
T1	Control (Water Spray	18.6	33.9
T2	Boron @10 ppm	15.5	38.4
T3	Boron @ 15 ppm	18.7	36.0
T4	GA3@100 ppm	16.2	34.4
T5	GA3 @150ppm	18.5	36.9
T6	Boron @10 ppm+GA3 @100ppm	18.3	38.9
T7	Boron @10 ppm+ GA3 @150ppm	18.3	35.7
T8	Boron @15 ppm+ GA3 @ 100 ppm	16.4	36.7
T9	Boron @15 ppm+ GA3 @ 150 ppm	21.8	44
	F- Test	S	S
	SE(d)±	1.61	1.63
	C D $_{(0.05)}$	3.45	3.50

3.2 Floral Parameter

Among all treatments, significant variation in floral parameters were observed in table 2.

Significantly lesser number of days required to first flower spike (70 days) was observed in treatment T4 (GA_3 @ 100 ppm) which was followed by treatment T1 (control, 72 days) whereas maximum days required to first flower spike (81 days) was observed in treatment T8 (Boron @15 ppm+GA_3 @ 100 ppm). The lesser time in days required to first flower spike might be due to prompt flower primordial development, improved cell differentiation and proper utilisation of nutrients. Gibberellic acid regulates flower initiation and its development and is essential for male and female fertility. Higher concentration of GA3 might have reduced vegetative period, resulting in induction of early flower development in tuberose. Similar result was obtained by (**Arsha *et al.*, 2021, Asil *et al.* 2011**) in tuberose.

Significantly taller rachis length (49.7 cm) was observed in treatment T9 (Boron @15 ppm+GA_3 @ 150 ppm) followed by treatment T5 (GA_3 @ 100 ppm, 46.8 cm), whereas, shorter rachis length (33.1 cm) was observed in treatment T1 (control). Significantly longer spike length (88.4 cm) was observed in treatment T9 (Boron @15 ppm+GA_3 @ 150 ppm) which was followed by treatment T6 (Boron @10 ppm+GA_3 @100 ppm, 85.9 cm), whereas, shorter spike length (74.9 cm) was observed in treatment T1 (control). The taller rachis length and longer spike length can be attributed that gibberellic acid increases significantly intercalary meristem cell division and elongation. GA3 stimulates cell division and expansion in response to light on day while boron has a significant role in sugar translocation and membrane permeability. Similar result was also obtained by **Maurya *et al.*, (2011)** in gladiolus

Significantly more number of florets per spike (50.5) in treatment T9 (Boron @15 ppm+GA_3 @ 150 ppm), which was followed by treatment T7 (Boron @10 ppm+GA_3 @ 150 ppm, 45.3), whereas, lesser number of florets per spike (37.0) was observed in treatment T1 (control). Significantly maximum floret diameter (16.3 mm) was observed in treatment T9 (Boron @15 ppm + GA_3 @ 150 ppm), which was followed by treatment T4 (GA_3 @ 100 ppm, 16.1 mm), whereas, minimum floret diameter (9.2 mm) was observed in treatment T2 (Boron @10 ppm).The more number of florets per spikes and maximum floret diameter may be attributed that GA3 helps in greater carbohydrate accumulation and higher metabolic activities, improved physiological efficiency, selective ion absorption, sufficient water absorption resulting in higher storage deposition rate while boron is responsible for enhancing translocation of carbohydrates, minerals and amino-acids from the site of synthesis to flowering tissues. Thus, both GA3 and boron had positive impact on source to sink flowers mobilisation of carbohydrates, minerals and amino- acids, thereby increasing number of florets. Similar result was obtained by **Arshil *et al*., (2007)** in tuberose. These results are in consonance with findings of **Kumar *et al*. (2019)** in carnation and **Rana *et al.* (2005)** in gladiolus.

Significantly longer shelf life (7 days) was observed in treatment T9 (Boron @ 15 ppm + GA_3 @ 150 ppm), which was at per with treatment T2 (Boron @ 10 ppm, 6 days), T3 (Boron @ 15 ppm, 6 days), T4 (GA3 @ 100 ppm, 6 days), T5 (GA3 @ 100 ppm, 6 days), T8 (Boron @ 15 ppm + GA3 @ 100 ppm, 6 days) whereas, shorter shelf life (4 days) was observed in treatment T1 (control). The longer shelf life may be attributed that GA3 helps in greater carbohydrate assimilation and boron also enhances higher carbohydrate, amino -acids and minerals in flowers, thus improving the floret quality with higher carbohydrate substrate available for respiration during post-harvest life, thereby increasing shelf life of florets. Similar result ware found by **Baskaran *et al.* and Misra *et al.* (2007)** in gladiolus and **Katakar *et al*. (2005**) in China aster.

Significantly maximum number of spikes per plant (2.8) was observed in treatment T9 (Boron @15 ppm + GA_3 @ 150 ppm), which was followed by treatment T4 (GA_3 @ 100 ppm, 2.07), whereas, minimum number of spikes per plant (1.5) was observed in treatment T1 (control). The maximum number of spikes per plant boron and gibberellic acid treated treatment may be attributed combined effect of optimum doses of both these treats. Gibberellic acid is known to increase vegetative parameters like plant height, number of leaves, leave weight which might have late to enhance rate of photo. As a result, availability of photosynthesis to developing bulbs and bulblets might have increase thereby leading to increasing in spike yield. Role of boron and mobilising photosynthesis minerals and ammino-acid from source(leaves) to sink (spike) might have increase spike yield. Similar result was found by **Mahajan *et al.*** (2012) in Tuberose.

Table 2: Floral Parameters

Treatment		Days required To flower spike	Rachis length	Spike length	Number of florets per Spike	Diameter of floret	Floret Weight	Self life of floret	Number of per plant
T1	Control (Water Spray)	72	33.1	74.9	40.5	13.3	1.6	4	13.6
T2	Boron@10 ppm	75	34.7	75	37.0	9.3	1.6	6	14.5
T3	Boron @15 ppm	74	35	75.1	44.1	10.9	1.5	6	15.9
T4	GA3 @100 ppm	70	35.8	78.3	43.8	16.3	1.6	6	16.5
T5	GA3 @150 ppm	76	39.8	80.2	44.6	16.1	1.5	6	15.7
T6	Boron@10 ppm + GA3 @100ppm	77	37.5	81.3	42.4	12.9	1.7	5	15.5
T7	Boron @10 ppm + GA3@150 ppm	79	37	77.1	45.3	14.9	1.9	5	14.6
T8	Boron @15 ppm + GA3 @100 ppm	81	38.9	80.5	44.8	15.1	1.9	6	13.5
T9	Boron @15ppm + GA3 @150ppm	76	35.5	81.1	41.8	14.3	1.9	7	14.3
	F – Test	S	S	S	S	S	S	S	S
	SE(d)	2.52	3.49	3.27	2.71	1.72	0.23	0.53	1.5
	CD $_{0.05}$	5.30	7.49	6.87	5.69	3.62	18.04	1.12	.15

4. Conclusion

It was concluded from the present observation that 9 treatments under study showed significant variation in all the parameters. Treatment T9 (Boron @15 ppm +GA_3 @ 150 ppm) significantly showed better performance in growth parameters like plant height, plant spread and floral parameters like rachis length, spike length, number of florets per spike, diameter of floret, floret weight, shelf life of floret and number of spikes per plant. As for economics concerned in treatment T9 (Boron @15 ppm +GA_3 @ 150 ppm) found best in maximum net returns with B:C Ratio 4.00

6.References

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