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Effect of humic acid and salicylic acid on growth and yield of gladiolus

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Abstract

A field experiment entitled "Effect of humic acid and salicylic acid on growth, yield and quality of gladiolus" was conducted during *rabi* season of 2025-26 at Satpuda Botanic Garden, College of Agriculture, Nagpur (M.S.). The experiment was carried out to evaluate the influence of foliar application of humic acid and salicylic acid on the growth, flowering and yield of gladiolus and to find out the suitable treatment combination. The experiment was laid out in a Factorial Randomized Block Design (FRBD) with sixteen treatment combinations comprising four levels of humic acid (0, 1.0, 1.5 and 2.0 ml L⁻¹) and four levels of salicylic acid (0, 50, 100 and 150 ppm).

The result revealed that, application of humic acid and salicylic acid significantly influenced the growth, flowering and yield of gladiolus. Among the humic acid treatments, foliar application of humic acid at 2.0 ml L⁻¹ (H₄) recorded early spike initiation and maximum plant height, leaf area, leaves plant⁻¹, spikes plant⁻¹, spikes hectare⁻¹, florets spike⁻¹ and corms plant⁻¹. Similarly, salicylic acid at 150 ppm (S₄) was found superior in respect of growth, flowering and yield attributes. An interaction effect of humic acid and salicylic acid was significant for leaves plant⁻¹, spikes hectare⁻¹ and florets spike⁻¹. Thus, combined application of 2.0 ml L⁻¹ humic acid and 150 ppm salicylic acid, showed better performance and can be considered effective for improving the growth, flowering, spike production and corm production of gladiolus.

Keywords: Gladiolus, humic acid, salicylic acid, vegetative growth, spike, corm and yield

Introduction

Gladiolus (*Gladiolus grandiflorus* L.) is one of the most important commercial bulbous ornamental crops belonging to the family Iridaceae. It is widely cultivated for its attractive arrangement of spikes, brilliant colour florets and excellent vase life, making it a preferred cut flower in both domestic and international markets. The crop is valued for its wide range of colours, long flowering spikes and suitability for floral arrangements, bouquets, exhibition displays and landscape gardening. Owing to its high economic returns and year-round demand, gladiolus occupies a prominent position in the floriculture industry.

Among the various cultural practices, the balanced use of plant growth promoters plays a significant role in improving vegetative growth, flowering, spike quality, corm production and post-harvest performance of gladiolus. Humic acid enhances nutrient availability, root growth, soil microbial activity and physiological processes, thereby promoting vigorous plant growth and higher flower yield. Similarly, salicylic acid acts as an important plant signalling molecule that regulates growth, flowering, photosynthesis, antioxidant activity and stress tolerance, ultimately improving flower quality and productivity.

Therefore, the combined application of humic acid and salicylic acid has the potential to enhance the growth, flowering, yield, and quality of gladiolus. However, information on the optimum concentration of these biostimulants for gladiolus cultivation under the Vidarbha region of Maharashtra is limited. Hence, keeping this as a view the present research work was planned to find out suitable treatment combination for improving crop performance and flower quality.

Materials and Methods

The experiment entitled "Effect of Humic Acid and Salicylic Acid on Growth, Yield and Quality of Gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty" was undertaken during the *Rabi* season of 2025-26 at the Experimental Unit, Horticulture Section, College of Agriculture, Nagpur, Maharashtra.

The trial was conducted at Satpuda botanic garden, using a Factorial Randomized Block Design (FRBD) comprising 16 treatment combinations formed by four concentrations of humic acid (0, 500, 1000 and 1500 ppm) and four concentrations of salicylic acid (0, 100, 150 and 200 ppm), with three replications.

Uniform and disease-free 4-5 cm diameter corms were selected for planting, before planting, corms were treated with 0.3% captan. Later, corms were planted at a spacing of 45 × 15 cm under recommended cultivation practices. Foliar applications of humic acid and salicylic acid were given as per the treatment, while all other cultural operations were fulfilled whenever required throughout the experiment. The recommended NPK dose of 500:200:200 kg ha⁻¹ was applied to the crop. Growth, flowering, yield and quality observations were recorded from five randomly selected plants in each experimental plot. The experimental data were analysed statistically as per method suggested by Panse and Sukhatme (1967) [9].

Results and Discussion

Effect of humic acid

Growth and flowering parameters

At 60 days after planting, humic acid significantly improved vegetative growth. The early first spike emergence (61.83 days), maximum plant height (69.38 cm), leaf area (69.90 cm²) and leaves plant⁻¹ (15.59) were recorded in treatment 2 ml L⁻¹ humic acid (H₄), which were statistically at par with 1.5 ml L⁻¹ humic acid i.e H₃, (63.67 days, 66.84 cm, 68.05 cm² and 15.16 respectively). However, late spike emergence, minimum plant height, leaf area and leaves plant⁻¹ were recorded in control treatment i.e water spray (H₁). The improvement may be attributed to enhanced nutrient uptake and photosynthetic activity. Similar results were reported by Ahmad *et al.* (2013) [1] in gladiolus.

Yield parameters

Humic acid significantly influenced spike and corm yield attributes of gladiolus. The maximum spikes plant⁻¹ (2.58), spikes ha⁻¹ (2.17), florets spike⁻¹ (8.80) and corms plant⁻¹ (3.37) were recorded with 2 ml L⁻¹ humic acid (H₄), which were statistically at par with 1.5 ml L⁻¹ humic acid H₃ (2.52,

2.11, 8.43 and 3.24 respectively). However, minimum spike plant⁻¹, spike ha⁻¹, florets spike⁻¹ and corms plant⁻¹ was recorded in control treatment i.e water spray (H₁). The superior performance of H₄ may be attributed to the beneficial effects of humic acid on root development and nutrient availability, which assimilate production and its translocation towards developing spikes and corms. Similar findings were reported by Iftikhar *et al.* (2013) [3] in gladiolus and Nikbakht *et al.* (2008) [7] in gerbera.

Effect of salicylic acid

Growth and flowering parameters

Salicylic acid application significantly improved the vegetative growth of gladiolus. The early spike emergence (60.83 days) and maximum plant height (70.65 cm), leaves plant⁻¹ (15.59) and leaf area (69.12 cm²) at 60 DAP were recorded with 150 ppm salicylic acid (S₄), which were statistically at par with 100 ppm salicylic acid i.e S₃, (64.41 days, 68.12 cm, 15.14 and 68.05 cm², respectively). However, maximum days to spike emergence, minimum plant height, leaf area and leaves plant⁻¹ was recorded in control treatment i.e water spray (H₁). The superior performance of S₄ may be attributed to enhanced photosynthetic efficiency, nutrient uptake and cell division. Similar findings were reported by Pal *et al.* (2015) [8] and Kumar *et al.* (2012) [5] in gladiolus.

Yield parameter

Salicylic acid significantly influenced spike and corm yield attributes of gladiolus. Maximum spikes plant⁻¹ (2.51), spikes ha⁻¹ (2.17 lakh), florets spike⁻¹ (8.50) and corms plant⁻¹ (3.52) were recorded in the treatment 150 ppm salicylic acid (S₄). Spikes plant⁻¹, spikes ha⁻¹, florets spike⁻¹ and corms plant⁻¹ were statistically at par with 100 ppm salicylic acid i.e S₃, (2.41, 2.08 lakh, 8.36, and 3.25). However, minimum Spikes plant⁻¹, spikes ha⁻¹, florets spike⁻¹ and corms plant⁻¹ was recorded in control treatment i.e water spray (S₁). The superior performance of S₄ may be attributed to enhanced physiological activity, photosynthesis and efficient assimilate partitioning towards spikes and corms. Similar findings were reported by Pawar *et al.* (2018) [10] and Suresh Kumar *et al.* (2017) [11].

Table 1: Effect of humic acid and salicylic acid on plant growth, flowering and yield in gladiolus

Treatment	Plant height (cm)	Leaves plant ⁻¹	Leaf area (cm ²)	Days to first spike emergence	Spikes plant ⁻¹	Spikes ha ⁻¹	Florets spike ⁻¹	Corms plant ⁻¹
A) Humic acid (H)								
H1-Water spray	62.64	13.61	64.98	68.33	1.95	1.86	7.44	2.73
H2-1 ml/lit	64.73	14.63	66.46	64.42	2.27	1.95	8.04	2.99
H3-1.5 ml/lit	66.84	15.16	68.05	63.67	2.52	2.11	8.43	3.24
H4-2 ml/lit	69.38	15.59	69.90	61.83	2.58	2.17	8.80	3.37
F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	1.32	0.23	1.09	1.30	0.05	0.02	0.12	0.10
CD at 5%	3.83	0.67	3.15	3.77	0.16	0.08	0.37	0.29
B) Salicylic acid (S)								
S1-Water Spray	61.28	13.65	64.84	67.50	2.15	1.90	7.75	2.57
S2-50 ppm	63.53	14.58	67.04	65.50	2.23	1.93	8.09	2.96
S3-100 ppm	68.12	15.14	68.37	64.41	2.41	2.08	8.36	3.25
S4-150 ppm	70.65	15.59	69.12	60.83	2.51	2.17	8.50	3.52
F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	1.32	0.23	1.09	1.30	0.05	0.02	0.12	0.10
CD at 5%	3.83	0.67	3.15	3.77	0.16	0.08	0.37	0.29
C) Interaction effect (H S)								
F' test	NS	Sig.	NS	NS	NS	Sig.	Sig.	NS
SE (m)±	2.65	0.46	2.18	2.61	0.11	0.05	0.25	0.20
CD at 5%	-	1.34	-	-	-	0.17	0.74	-

Interaction effect

The interaction effect of humic acid and salicylic acid levels was found to be significant for growth, flowering and yield parameters of gladiolus. Foliar application of 2 ml/l humic acid with 150 ppm salicylic acid (H4S4) recorded the maximum leaves plant⁻¹ (16.25) at 60 DAP, highest spikes hectare⁻¹ (2.43) and maximum florets spike⁻¹ (8.90). However, minimum leaves plant⁻¹, spikes ha⁻¹ and floret spike⁻¹ was recorded in control treatment i.e water spray (H1S1). The superior performance of this treatment combination may be attributed to the synergistic effect of humic acid and salicylic acid in enhancing nutrient availability, root growth, photosynthetic activity and assimilate accumulation. Humic acid promotes nutrient uptake and root development, whereas salicylic acid enhances photosynthetic efficiency and physiological activities. Their combined application may have resulted in better vegetative growth, efficient assimilate translocation and improved flower initiation and development, thereby increasing spike production and florets spike⁻¹ in gladiolus. Comparable effects was reported by Kumar *et al.* (2025) [6] and Khobragade *et al.* (2019) [4].

Table 2: Interaction effect of humic acid and salicylic acid on plant growth and quality of gladiolus

Treatments	Leaves plant ⁻¹	Spikes ha ⁻¹	Florets spike ⁻¹
H1S1	11.13	1.80	6.23
H1S2	13.33	1.86	7.27
H1S3	14.68	1.87	8.00
H1S4	15.29	1.90	8.27
H2S1	13.79	1.88	7.83
H2S2	14.56	1.91	7.90
H2S3	14.79	1.98	8.13
H2S4	15.36	2.02	8.30
H3S1	14.79	1.94	8.23
H3S2	15.13	1.97	8.43
H3S3	15.24	2.21	8.50
H3S4	15.46	2.34	8.57
H4S1	14.90	1.98	8.70
H4S2	15.33	1.99	8.77
H4S3	15.86	2.27	8.83
H4S4	16.25	2.43	8.90
F' test	Sig.	Sig.	Sig.
SE (m)±	0.46	0.05	0.25
CD at 5%	1.34	0.17	0.74

Conclusion

From the present experimental trial, it is concluded that the maximum vegetative growth, flowering and yield parameters attributes were recorded under 2 ml/lit humic acid and 150 ppm of salicylic acid. The treatment combination of 2 ml/lit + 150 ppm (H4S4) was found to be superior in respect leaves plant⁻¹, spike hectare⁻¹ florets spike⁻¹.

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