International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(7): 570-573
www.biochemjournal.com
Received: 25-04-2024
Accepted: 28-05-2024

Mashkoor Hamidi
Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Anil K Singh
Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Anjana Sisodia
Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Kalyan Barman
Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

SS Vyas
Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Corresponding Author:
Anil K Singh
Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Influence of various doses of iron on flowering and post-harvest characters in gladiolus cv. Malaviya Shatabdi

Mashkoor Hamidi, Anil K Singh, Anjana Sisodia, Kalyan Barman and SS Vyas

DOI: https://doi.org/10.33545/26174693.2024.v8.i7g.1540

Abstract
The current study was carried out at the Horticulture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India, during the year 2023-2024. The experiment was laid in a Randomized Block Design with 3 replications of 11 treatments applied to gladiolus plants. These treatments included various concentrations of $FeSO_4$ such as control (distilled water), 0.1%, 0.2%, 0.3%, 0.4%, 0.5%, 0.6%, 0.7%, 0.8%, 0.9%, and 1.0%. Iron was applied as foliar spray at the 3rd and 6th leaf stages. In terms of flowering characters, $FeSO_4$ 0.4% showed the best results for the number of days to spike emergence (68.65 days), the opening of 1st (86.58 days), 3rd (89.85 days), 5th (92.29 days), and last florets (98.02 days), as well as the diameter of 1st (7.76 cm), 3rd (7.38 cm) and 5th (7.47 cm) florets. In terms of post-harvest characters, $FeSO_4$ 0.4% showed best result for flowering duration of 1st (5.62 days), 3rd (5.38 days), 5th (5.41 days) and last florets (5.07 days), length of 1st (9.62 cm), 3rd (8.98 cm) and 5th (9.27 cm) florets, no. of florets/spike (12.21), no. of opened florets/spike (9.26), no. of opened florets at a time (4.97) and vase life (9.05 days) whereas, $FeSO_4$ 0.5% showed best results for weight of spike at 1st (36.65 g), 3rd (39.39 g) and 6th (35.53 g) day but $FeSO_4$ 0.4% on 9th (32.8 g) day. $FeSO_4$ 0.4% influenced water uptake by spike at 3rd (17.17 ml), 6th (39.00 ml) and 9th (44.33 ml) day.

Keywords: Foliar spray, iron, gladiolus, post-harvest, flowering

Introduction

Gladiolus is a popular flowering plant with sword-shaped leaves, that originates from South Africa. There are over 30,000 varieties and 260 species (Singh, 2014) [18], with basic chromosome number fifteen, some varying depending on the ploidy levels. Gladiolus is nicknamed the queen of bulbous flowers (Reddy *et al*., 2014) [17] due to its importance as a cut flower, not just globally but especially in India. Gladiolus cultivation spread from Greece to Europe and North America over time. Different species were introduced at various points in history, with some notable examples being Gladiolus grandis and Gladiolus tristis. Due to its year-round availability and variable floret colours that complement any flower arrangement, it is widely grown in India. Its flowers are available in every other colour except black and brown.

The deficiency of iron (Fe), zinc (Zn) and manganese (Mn) in the soil is a global problem. Deficits can be found in around one-third of the agricultural soil on Earth. The usage of fertilizers based on calcium and phosphate has also contributed to its deficiency in the soil (Mousavi *et al*., 2011) [15]. Iron is one among them. Micronutrient deficiency creates a negative impact on the productivity of plants, which could be caused due to intensive cropping, leaching and erosion (Fageria *et al*., 2002) [4]. Its deficiency leads to unbalanced growth and lower yield due to physiological abnormalities (Ganesh *et al*., 2013) [5]. Beneficial effect of iron was found in flowering and post-harvest life of lilium (Hembrom and Singh, 2015, Singh *et al*., 2015) [17, 19]. Due to the above cited context and reasons, a field study was done to investigate the influence of various doses of iron on flowering and post-harvest characters in gladiolus cv. Malaviya Shatabdi.

Materials and Methods

The study was conducted at the Horticulture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India, during the winter season of 2023-2024. The experiment utilized a Randomized Block Design with 3 replications. Disease-free and insect-resistant corms of the gladiolus variety Malaviya Shatabdi were obtained from the Department of Horticulture, Banaras Hindu University. These corms were planted with a spacing of 30 cm × 20 cm and a depth of 8 cm. Ferrous sulphate was used to supply iron, and lime was added to neutralize it. The 11 treatments consisted of a control (distilled water) and 10 $FeSO_4$ concentrations: 0.1%, 0.2%, 0.3%, 0.4%, 0.5%, 0.6%, 0.7%, 0.8%, 0.9% and 1.0%. Iron was applied as foliar spray at the 3rd and 6th leaf stages using a hand sprayer to run-off stagee. Intercultural operations such as hoeing, irrigation, earthing up, weeding and plant protection were carried out as needed. Flowering parameters, such as no. of days to spike emergence, opening of 1st, 3rd, 5th and last floret and diameter of 1st, 3rd and 5th flor*et al*ong with post-harvest parameters such as flowering duration of 1st, 3rd, 5th and last floret, length of 1st, 3rd and 5th floret, no. of florets per spike, no. of opened florets per spike, weight of spike at 1st, 3rd, 6th and 9th day, water uptake by spike at 3rd, 6th and 9th day, no. of opened florets at a time and vase life were recorded and statistically analyzed.

Results and Discussion

Flowering characters

Flowering characters in gladiolus were greatly influenced with the application of various doses of iron which is depicted in Table 1. Iron application notably affected the timing of spike emergence, plants treated with $FeSO_4$ 0.4% had the fastest spike emergence (68.65 days), which was at par with treatments 0.3% (70.22 days) and 0.8% (70.79 days). This outcome can be attributed to the enhanced reproductive growth facilitated by the optimal application of micronutrient concentrations. These results are in line with the research conducted by Ganesh *et al*. (2013) [5] in tuberose and Kumar *et al*. (2022) [11] in gladiolus. Regulation of optimal hormonal level in plants promotes early maturation and consequently early opening of florets, it was evident with the study results which indicated that different iron treatments significantly affected the timing of the opening of the 1st (86.58 days), 3rd (89.85 days), 5th (92.29 days) and last florets (98.02 days) in plants treated with 0.4% $FeSO_4$ opening the earliest. This result was consistent with the findings of Kumar *et al*. (2010) [12] in marigold and by Memon *et al*. (2013) [13] in gladiolus. Similarly, diameter of 1st (7.76 cm), 3rd (7.38 cm) and 5th (7.38 cm) florets were influenced by $FeSO_4$ 0.4% which corroborates with research findings of Balakrishnan *et al.* (2007) [2] in marigold and Bhandari *et al.* (2022) [3] in calendula.

Table 1: Effect of various doses of iron on flowering characters in gladiolus cv. Malaviya Shatabdi

Treatment	Days to spike emergence	Opening of 1st, 3rd, 5th and last floret				Diameter of 1st, 3rd and 5th floret		
		1st floret	3rd floret	5th floret	Last floret	1st floret	3rd floret	5th floret
Control	71.18	91.63	94.34	97.50	103.54	6.62	6.97	6.36
0.1% $FeSO_4$	72.37	91.25	93.20	97.21	102.57	7.18	6.95	6.59
0.2% $FeSO_4$	71.69	90.99	93.19	96.63	101.78	6.67	6.66	6.26
0.3% $FeSO_4$	70.22	90.38	92.95	96.12	100.89	6.71	6.88	6.35
0.4% $FeSO_4$	68.65	86.58	89.85	92.29	98.02	7.76	7.38	7.47
0.5% $FeSO_4$	71.45	90.24	92.96	96.07	101.47	7.03	6.85	6.79
0.6% $FeSO_4$	72.51	89.70	90.68	94.29	99.47	6.47	6.32	6.29
0.7% $FeSO_4$	71.85	90.32	91.79	96.71	101.56	6.37	6.54	6.33
0.8% $FeSO_4$	70.79	90.88	93.68	96.74	100.45	6.66	6.38	6.12
0.9% $FeSO_4$	72.99	89.85	92.52	95.31	101.51	6.38	6.49	6.46
1.0% $FeSO_4$	73.25	90.29	92.65	95.72	100.47	6.32	6.16	6.06
CD at 5%	1.38	1.65	1.85	1.91	1.78	0.67	0.58	0.59

Post-harvest characters

Table 2 and 3 depicts the effect of iron on post-harvest characters in gladiolus. Iron treatments significantly impacted the lifespan of florets. 1st (5.62 days), 3rd (5.38 days), 5th (5.41 days) and last (5.07 days) florets exhibited the longest flowering duration when treated with 0.4% $FeSO_4$. This could have been possible as iron is essential for enhancing respiration rates and generating reactive oxygen species. These findings are in line with the research of Singh *et al*. (2017) [20] in lilium. The greatest length of 1st (9.62 cm), 3rd (8.98 cm) and 5th (9.27 cm) florets were found with $FeSO_4$ 0.4% which could have been possible due to iron's pivotal role in regulating nitrate and sulphate reductions, crucial for proper plant growth, development and reproduction, contributed to enhanced flower length. These findings align with the research of Pirzad and Shokrani (2012) [16] and Bhandari *et al*. (2022) [3] in Calendula and Tayade *et al*. (2018) [22] on Tuberose. The highest number of florets per spike was recorded with the $FeSO_4$ 0.4% (12.21) treatment which was statistically similar to the 0.6% (11.99), 0.2% (11.65) and 0.8% (9.88) $FeSO_4$ treatments and significantly higher than other treatments. The highest no. of opened florets per spike was recorded with $FeSO_4$ 0.4% (9.26) followed by 0.1% (8.70), 0.2% (8.59) and 0.5% (8.57). Iron is vital for protein synthesis, hormone regulation and plant growth which can lead to increased number of florets per spike. This observation is consistent with the findings of Ganesh *et al*. (2013) [5] in tuberose and Hembrom *et al*. (2015) [7] in gladiolus. There was significant variation in spike weight across the different iron treatment concentrations. $FeSO_4$ 0.5% treatment resulted in the highest spike weight on the 1st (36.65 g), 3rd (39.39 g), and 6th (35.53 g) days, while $FeSO_4$ 0.4% treatment had the greatest spike weight on the 9th (32.80 g) day. Nutrients play a crucial role in regulating cell wall semi-permeability and water circulation within flowers, which contributes to increased spike weight. These findings align with the research of Erao (2005) [23], Singh *et al*. (2016) [21] and Mishra *et al*. (2018) [14] in gladiolus. Similarly, water uptake by the plants was highly influenced by $FeSO_4$ 0.4% concentration at 3rd (17.17 ml), 6th (39.00 ml) and 9th (44.33 ml) day. As the durability and quality of flowers is highly determined by the quantity of solution absorbed, hence it could be said that the water uptake as well as vase life of the flower gets influenced with various concentrations of iron. Vase life was found to be most prolonged with $FeSO_4$ 0.4% (9.05 days) followed by 0.2% (8.57 days), 0.5% (8.33 days) and 0.8% (8.00 days). This corroborates with the research findings of Bala *et al*. (2006) [1] and Kashyap and Tikey (2020) [10] in gladiolus, Kakade *et al*. (2009) [9] in China aster and Ganga *et al*. (2009) [6] in dendrobium.

Table 2: Effect of various doses of iron on post-harvest characters in gladiolus cv. Malaviya Shatabdi

Treatment	Flowering duration (days)				Length of floret (cm)			No. of florets per spike	No. of opened florets per spike
	1st floret	3rd floret	5th floret	Last floret	1st floret	3rd floret	5th floret		
Control	4.41	4.01	4.21	3.67	7.45	7.46	7.33	9.23	8.26
0.1% $FeSO_4$	5.17	4.54	4.71	4.94	8.27	7.56	7.95	9.87	8.70
0.2% $FeSO_4$	3.85	5.07	5.13	4.02	8.70	8.12	8.25	11.65	8.59
0.3% $FeSO_4$	4.03	4.06	4.14	4.07	7.91	8.25	8.02	9.12	8.62
0.4% $FeSO_4$	5.62	5.38	5.41	5.07	9.62	8.98	9.27	12.21	9.26
0.5% $FeSO_4$	4.71	4.03	4.13	4.06	8.41	8.06	7.82	9.24	8.57
0.6% $FeSO_4$	3.80	4.17	3.98	3.97	8.74	8.22	8.63	11.99	8.40
0.7% $FeSO_4$	4.62	4.13	4.03	4.01	8.02	8.13	7.96	9.14	8.33
0.8% $FeSO_4$	5.06	4.37	3.87	4.14	8.52	8.16	7.43	9.88	8.45
0.9% $FeSO_4$	3.74	3.83	4.23	4.03	8.73	7.97	7.62	9.56	8.31
1.0% $FeSO_4$	3.14	3.10	4.17	3.40	7.47	7.32	7.65	8.27	8.24
CD at 5%	0.37	0.235	0.42	0.37	0.45	0.51	0.64	0.547	0.43

Table 3: Effect of various doses of iron on post-harvest characters in gladiolus cv. Malaviya Shatabdi

Treatment	Weight of spike (g)				Water uptake by spike (ml)			No. of opened florets at a time	Vase life (days)
	1st day	3rd day	6th day	9th day	3rd day	6th day	9th day		
Control	31.05	33.69	28.28	25.49	13.17	23.83	31.00	4.00	7.62
0.1% $FeSO_4$	34.39	39.29	33.81	32.00	13.33	26.67	30.92	4.33	8.12
0.2% $FeSO_4$	35.68	38.66	31.27	31.05	14.02	29.87	35.00	3.98	8.57
0.3% $FeSO_4$	31.14	34.11	34.54	31.21	14.50	28.50	38.57	4.63	7.56
0.4% $FeSO_4$	34.36	37.86	33.33	32.80	17.17	39.00	44.33	4.97	9.05
0.5% $FeSO_4$	36.65	39.39	35.53	28.19	16.67	33.50	41.17	4.12	8.33
0.6% $FeSO_4$	32.25	34.21	30.21	27.58	16.25	27.25	32.33	4.29	7.67
0.7% $FeSO_4$	35.54	36.78	33.04	26.54	15.33	34.17	36.42	3.94	7.95
0.8% $FeSO_4$	31.48	34.48	27.97	23.61	6.33	23.33	25.40	4.14	8.00
0.9% $FeSO_4$	29.83	32.95	25.12	19.87	7.00	18.00	22.20	3.87	8.28
1.0% $FeSO_4$	15.73	18.25	11.12	6.85	5.33	14.17	17.00	3.63	7.24
CD at 5%	10.90	11.43	9.90	7.87	2.57	4.34	6.05	1.14	1.12

Conclusion

From the above study it was observed that the concentration of iron at 0.4% achieved best results for flowering characters whereas, in case of post-harvest characters 0.4% in most cases as well as 0.5% in weight of spike exhibited the best results.

Acknowledgement

This research was made possible by the support and facilities provided by the Institute of Agricultural Sciences at Banaras Hindu University, Varanasi. We are particularly grateful to the Department of Horticulture (Floriculture and Landscaping) at BHU for their valuable assistance.

References

1. Bala TU, Sekhar RC, Reddy YN. Vase life studies of three *Gladiolus* varieties as influenced by dates of planting and iron sulphate sprays. J Res ANGRAU. 2006;34(3):8-12.
2. Balakrishnan V, Jawaharlal M, Kumar TS, Ganga M. Response of micro-nutrients on flowering, yield and xanthophyll content in African marigold (*Tagetes erecta* Linn.). J Ornamental Hort. 2007;10(3):153-156.
3. Bhandari NS, Srivastava RK, Tarakeshwari KR, Chand S. Effect of nano and macro iron sprays on growth, flowering, seed and oil yielding attributes in calendula (*Calendula officinalis* L.). J Hort Sci. 2022;17(2):353-362.
4. Fageria NK, Baligar VC, Clark RB. Micronutrients in crop production. Adv Agron. 2002;77:185-268.
5. Ganesh S, Soorianathasundaram K, Kannan M. Studies on effect of plant growth regulators and micronutrients on growth, floral characters and yield of tuberose cv. Prajwal. Asian J Hort. 2013;8(2):696-700.
6. Ganga M, Padmadevi K, Jagadeswari V, Jawaharlal M. Performance of dendrobium cv. Sonia 17 as influenced by micronutrients. J Ornamental Hort. 2009;12(1):39-43.
7. Hembrom R, Singh AK. Effect of iron and zinc on growth, flowering and bulb yield in lilium. Int. J Agric Environ Biotechnol. 2015;8(1):61-64.
8. Hembrom R, Singh AK, Sisodia A, Singh J, Asmita. Influence of application of iron and zinc on growth, corm and cormel yield in gladiolus cv. American Beauty. Environ Ecol. 2015;33(4):1544-1546.
9. Kakade DK, Rajput SG, Joshi KI. Effect of foliar application of Fe and Zn on growth, flowering and yield of China aster (*Callistephus chinensis* L.). Asian J Hort. 2009;4(1):138-140.
10. Kashyap N, Tikey T. Effect of micronutrients on plant growth, flowering and corm production of gladiolus cv. Summer Sunshine. Pharma Innovation J. 2020;11(9):2503-2506.

11. Kumar D, Sahu TL, Netam N, Patel S, Mandavi G, Kumar N, *et al*. Effect of foliar application of zinc and iron on growth, flowering and yield of gladiolus (*Gladiolus grandiflorus* L.). Pharma Innovation J. 2022;11:2587-2589.
12. Kumar P, Singh D, Kumar S. Effect of pre-harvest micronutrient foliar spray on growth, flowering and seed production in marigold. Prog Agric. 2010;10(1):182-183.
13. Memon SA, Abdul RA, Muhammad AB, Mahmooda B. Effect of zinc sulphate and iron sulphate on the growth and flower production of gladiolus (*Gladiolus hortulamus*). J Agric Technol. 2013;9(6):1621-1630.
14. Mishra A, Singh A, Kumar A. Effect of foliar feeding of zinc and iron on flowering and yield attributes of gladiolus (*Gladiolus grandiflorus* L.) cv. Novalux. Plant Arch. 2018;18:1355-1358.
15. Mousavi SR, Shahsavari M, Rezaei M. A general overview on manganese (Mn) importance for crops production. Aust J Basic Appl. Sci. 2011;5(9):1799-1803.
16. Pirzad A, Shokrani F. Effects of iron application on growth characters and flower yield of *Calendula officinalis* L. under water stress. World Appl Sci J. 2012;18(9):1203-1208.
17. Reddy GVS, Rao MBN, Sekhar RC. Studies on the effect of foliar application of zinc on vegetative growth, flowering, corm and cormel production in gladiolus cv. White Prosperity. Int. J Environ Sci. 2014;6:35-39.
18. Singh AK. Breeding and Biotechnology of Flowers, Vol I: Commercial Flowers. New Delhi: New India Publishing Agency; c2014. p. 705.
19. Singh AK, Hembrom R, Singh J, Sisodia A, Pal AK. Effect of iron and zinc on growth and postharvest life in Lilium cv. Tresor. Environ Ecol. 2015;33(2):625-628.
20. Singh AK, Hembrom R, Sisodia A, Pal AK. Effect of foliar application of zinc and iron growth, flowering and post-harvest life in lilium cv. Navona. Indian J Hort. 2017;74(3):418-422.
21. Singh AK, Hembrom R, Sisodia A, Pal AK, Asmita. Effect of iron and zinc on flowering and postharvest life in gladiolus (*Gladiolus* spp.). Indian J Agric Sci. 2016;86(10):1316-1319.
22. Tayade M, Badge S, Nikam B. Foliar application of zinc and iron as influenced on flowering and quality parameters of tuberose. Int. J Curr Microbiol Appl Sci. 2018;7(1):2239-2243.
23. Erao KS. Influence of iron nutrition on growth, flowering and corm yield in gladiolus. Journal of Ornamental Horticulture. 2005;8(4):293-295.