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Effect of micronutrients on growth, flowering and corm yield parameters in gladiolus cv. Nova Lux

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Abstract

This study investigated the impact of macronutrients on growth, flowering and corm yield parameters in gladiolus cv. Nova Lux over two consecutive years. Different concentration of boron and iron were applied and various growth, flowering and corm yield parameters, including number of leaves per hill at 60 DAP, length of longest leaf at 60 DAP, plant height at 60 DAP, days to spike emergence, days to colour show and days to opening of 1st floret, number of corms per hill and number of cormels per hill were assessed. Specifically, treatments with boron 0.4% + iron 0.4% dose demonstrate the maximum number of leaves per hill at 60 DAP, days to spike emergence, days to colour show, days to opening 1st floret, number of corm per hill and number of cormels per hill. Additionally, treatments with boron 0.2% + iron 0.4% consistently exhibited the maximum longest leaf length at 60 DAP, longest leaf width at 60 DAP and plant height at 60 DAP indicating enhanced leaf growth. Moreover, higher doses of these micronutrients resulted in longer and wider leaves at different growth stages. The findings suggest that optimal nutrient management, particularly higher doses of boron 0.4% + iron 0.4%, significantly influence the growth, flowering, corm yield and development in gladiolus cv. Nova Lux. Additionally, the study emphasizes how crucial it is to comprehend the complex relationships that exist between micronutrients and growth, flowering, and corm yield parameters in order to maximize cultivation techniques and raise the cultivar's attractiveness and commercial success. This study advances sustainable cultivation methods in floriculture by offering useful suggestions for nutrient management specific to gladiolus cv. Nova Lux.

Keywords: Nova Lux, growth, flowering and corm yield parameters, micronutrients, nutrient management

1. Introduction

Gladiolus grandiflorus L., also known as sword lily is one of the most important commercial cut flowers all over the world. Gladiolus belongs to family Iridaceae and a leading bulbous flower crop in the world with basic chromosome number X= 15 (2n=30). A native of South Africa, gladiolus flower due to its magnificent inflorescence with variety of colours, attractive petals and macules (throats) is known as “Queen of bulbous ornamental flowers” amongst the bulbous ornamentals in the world. It is used in different purposes like in herbaceous borders, beddings, rockeries, in pots, bouquets, floral arrangement and other aesthetic purposes. Large scale production of gladiolus for cut flowers has been seen in USA, The Netherlands, Italy, France, Poland, Bulgaria, Brazil, Australia, Israel, etc.

Additionally, foliar fertilization can minimize ground water pollution by preventing fertilizer loss through leaching, which is another benefit of this technique over traditional soil application. Micronutrients are particularly helpful when quick growth seasons are required for responses. According to Ganesh *et al.* (2013) [1], plants are known to experience physiological disorders in the absence of micronutrients, which ultimately result in uneven growth and low yield. Since gladiolus is a crop with a short growing season, it has been discovered that aqueous foliar enrichment with micronutrients can effectively control plant growth.

For photosynthesis and mitochondrial respiration, iron (Fe) is an essential micronutrient. As part of the electronic transport system, it also carries oxygen. Iron is an essential component of enzymes that catalyzes a variety of reactions, including respiration, photosynthesis, nitrate and phosphate reduction, and the synthesis of chlorophyll. It facilitates the production of plant tissues George and Manuel (2013) [2].

According to Hussain *et al.* (2020) [4], iron plays a significant role in physiological growth, floral development, and lowering abscisic acid and ethylene. These actions have improved flower support and aesthetic appeal. Iron is essential to the structure and operation of chloroplasts in plants. Protein metabolism is aided by iron as well. In the event of an iron deficiency, the amount of soluble organic N compounds increases while the protein fraction decreases. About 80 percent of iron is found in photosynthetic cells, which are essential for the synthesis of Fe-S clusters, cytochromic biosynthesis, chlorophyll, and the transport system.

The synthesis of amino acids and proteins, the development of phloem, the translocation of sugar, starch, nitrogen, phosphorus, certain hormones, new cell division in meristematic tissue, and the regulation of carbohydrate metabolism are all dependent on boron. When there is insufficient supply, phloem tubes degrade and the middle lamella of newly formed cells develop poorly. In plants, boron primarily serves to enhance calcium metabolism, increase the solubility and mobility of calcium, and facilitate the uptake of nitrogen. According to Shukla *et al.* (2009) [11], it is involved in root elongation, DNA synthesis, pollen formation, pollination, phenol metabolism and membrane integrity, regulation of meristematic tissue cell synthesis, lignification's, growth regulatory metabolism, and the metabolism and transport of carbohydrates.

2. Materials and Methods

The experiment titled "Effect of micronutrients on growth, flowering and corm yield parameters in gladiolus cv. Nova Lux was conducted during the year 2020-2021 to 2021-2022 at the Horticulture Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India. Homogeneous, disease free and insect-free corms of gladiolus variety Nova Lux were planted with a uniform spacing of 30 cm × 20 cm and a planting depth of 10-15 cm. The study investigated different concentration of boron (0.2% and 0.4%) and iron (0.2% and 0.4%) supplied by borax and ferrous sulphate, respectively. Employing a combination of Randomized Block Design (RBD) with 8 treatments and 3 replications, the experiment aimed to determine the effect of micronutrients on the growth, flowering and corm yield parameters of gladiolus cv. Nova Lux. The field plots were oriented in a north-south direction, and standard agricultural practices were followed to ensure optimal crop development. Data were recorded and analyzed statistically on various parameters, like number of leaves per hill, longest leaf length, plant height, width of the longest leaf, days to spike emergence, days to colour show and days to opening 1st floret, number of corm per hill and number of cormels per hill.

3. Result

3.1 Morphological characters

The data on number of leaves per hill at 60 DAP stage as influenced by micro nutrients and their interaction between boron and iron have been well presented (Table-1). The impact of boron and iron on the number of leaves per hill at 60 DAP was significant during both the year 2020-21 and 2021-22. The maximum number of leaves per hill ranged from 7.16 to 7.22 under T_7 (B 0.4% + Fe 0.4%). The minimum number of leaves per hill ranged from 5.06 to 5.95 under T_0 treatment for control. The maximum length was observed under T_6 (B 0.2% + Fe 0.4%) treatment (54.25 cm and 37.31 cm), while the minimum length was found under T_0 treatment (50.97 cm and 31.65 cm).

The maximum width was observed under T_6 (B 0.2% + Fe 0.4%) treatment (3.35 cm and 2.90 cm), while the minimum width was found under T_0 treatment (3.00 cm and 2.32 cm). The maximum plant height was recorded Under T_6 (B 0.2% + Fe 0.4%) treatment (61.77 cm and 45.70 cm) while the minimum plant height was found under T_0 treatment (58.25 cm and 41.36 cm).

3.2 Flowering parameter

The data (Table-2) indicate the effect of micro nutrients, specifically boron and iron on days to spike emergence during both the year 2020-21 and 2021-22. The impact of micro nutrients on days to spike emergence was non-significant in 2020-21 but significant in 2021-22. Under boron and iron treatment, the minimum days to spike emergence were observed with T_7 (B 0.4% + Fe 0.4%), taking approximately 87.61 days and 77.00 days for the respective years, while the maximum days were recorded with T_0 (control), requiring approximately 90.33 days and 81.55 days. Similarly, days to colour show was also found non-significant in 2020-21 but significant in 2021-22. Under boron and iron treatment, the minimum days to colour show were observed with T_7 (97.22 days and 86.25 days), while the maximum days were recorded with T_0 (101.00 days and 89.50 days). Whereas, the minimum days to opening of 1st floret were observed with T_7 (100.00 days and 89.00 days), while the maximum days were recorded with T_0 (104.33 days and 93.11 days).

3.3 Corm parameters

The impact of micro nutrients boron and iron on the number of corms per hill was recorded during both the year 2020-21 and 2021-22. Under boron and iron treatment, the maximum number of corms per hill was observed with T_7 (1.77 and 1.78), while the minimum was with T_0 (1.11 and 1.11). However, number of cormels per hill was found non-significant where they influenced by boron and iron levels, with higher concentrations resulting in more cormels. Specifically, under boron and iron treatment, the maximum number of cormels per hill was observed with T_6 (28.44 and 32.33), while the minimum was with T_0 (9.22 and 16.44).

4. Discussion

The study examined the effects of boron and iron combinations on plant growth parameters. Results showed significant impacts on leaf count at 60 DAP with treatment T_7 (B 0.4% + Fe 0.4%) consistently producing the maximum number of leaves per hill. While treatment T_6 (B 0.2% + Fe 0.4%) resulted in longer and wider leaves, differences were not significant. Therefore, for maximizing leaf production, treatment T_7 appears to be the most effective option. The results suggest that the enhancement in leaf characteristics is likely due to the improved availability of both macro and micronutrients in the soil. This improvement in plant vigour facilitates better uptake of nutrients and water, as noted by Khanam *et al.* (2017) [5]. Conversely, Kumar and Arora (2000) [8] highlighted that micronutrients play a crucial role in stimulating various enzymes, such as catalases and peroxidases and are involved in vital processes like chlorophyll production, thereby promoting overall plant growth and development. These findings align with the observations made by Singh *et al.* (2013) [12] in gladiolus, further emphasizing the significant impact of both macro- and micronutrients on plant physiology and growth.

At 60 days after planting (DAP), the study revealed that boron and iron did not significantly influence plant height across both years. However, treatment T_6 (B 0.2% + Fe 0.4%) consistently resulted in the maximum plant height, while the minimum height was observed under the control treatment (T_0). This increase in plant height with the integrated application of nutrients containing iron and boron aligns with previous research by Kumar (2014) [6], Kumar (2015) [7], Singh *et al.* (2012) [13] in various flowering crops. These nutrients play crucial roles in photosynthesis, protein synthesis, and food storage, ultimately promoting optimal plant growth. Therefore, treatment T_6 emerges as the most effective in enhancing plant height at 60 DAP.

The effects of boron and iron on flowering parameters, specifically days to spike emergence, days to colour show, and days to opening of the first floret, were investigated over a span of two years, with a focus on the 60 days after planting (DAP) stage. Treatment T_7 (B 0.4% + Fe 0.4%) consistently demonstrated the minimum durations across all parameters, suggesting accelerated flowering. The variations in micronutrient responses regarding flowering features can be attributed to the involvement of these nutrients, particularly iron and boron, in chlorophyll synthesis and other physiological processes crucial for plant growth and development. These processes also facilitate the activation of several enzymes, such as catalase, peroxidases, and alcohol dehydrogenase, as outlined by Mishra *et al.* (2018) [9]. Similar findings were reported by Singh *et al.* (2013) [12] in gladiolus and Tayade *et al.* (2018) [15] in tuberose. This highlights the pivotal role of iron and boron in regulating these traits, as they contribute significantly to various physiological processes essential for flower development and maturation Pandey *et al.* (2010) [10]. Consequently, treatment T_7 emerges as the most effective in promoting early flowering.

The influence of boron and iron on corm parameters, including the number of corms per hill and the number of cormels per hill, was examined at the 60 days after planting (DAP) stage. Treatment T_7 consistently exhibited the highest number of corms per hill, while treatment T_0 had the minimum count. Similarly, treatment T_6 resulted in the maximum number of cormels per hill, with treatment T_0 showing the minimum count. Micronutrients play a crucial role in enhancing seed production, and their deficiency can negatively impact bulbous plant yields. This method significantly affected corm attributes, including the number of corms and cormels per hill, compared to untreated plants. Boron contributes to increased seed number, size, and quality by aiding in auxin synthesis, which is essential for seed development. This aligns with findings by Kumar and Arora (2000) [8], Singh *et al.* (2012) [13] and Halder *et al.* (2007) [3].

Table 1: Effect of micro nutrients on Number of leaves/hill at 60 DAP, Length of longest leaf at 60 DAP, Plant height at 60 DAP and Days to spike emergence (days)

	Number of leaves/hill at 60 DAP		Length of longest leaf at 60 DAP		Plant height at 60 DAP		Days to spike emergence (days)	
Treatments	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
T0: Control	5.953	5.060	50.973	31.653	58.253	41.363	90.330	81.553
T_1: Boron (B) 0.2%	6.100	5.093	53.443	35.087	60.377	42.910	87.667	78.220
T_2: Boron (B) 0.4%	6.267	5.173	51.030	36.267	58.297	44.020	88.000	79.773
T_3: Iron (Fe) 0.2%	6.863	5.937	51.853	35.673	59.130	44.563	88.443	78.443
T_4: Iron (Fe) 0.4%	6.053	6.387	52.207	37.263	59.397	45.410	88.440	79.633
T_5: B 0.2% + Fe 0.2%	6.550	6.003	54.210	35.317	61.530	44.960	89.550	78.550
T_6: B 0.2% + Fe 0.4%	6.567	6.743	54.250	37.310	61.773	45.697	87.997	80.107
T_7: B 0.4% + Fe 0.4%	7.220	7.157	52.663	35.297	59.753	45.587	87.610	77.000
SEm±	0.249	0.592	1.847	1.463	1.851	1.535	1.483	0.780
CD (P=0.05%)	0.763	1.776	NS	NS	NS	NS	NS	2.389

Table 2: Effect of micro nutrients days to colour show, days to opening 1st floret sprouting, number of corm/hill and number of cormels/hill

	Days to colour show (days)		Days to opening 1st floret		Number of corm/hill		Number of cormels/hill	
Treatments	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
T0: Control	100.997	89.500	104.330	93.110	1.110	1.110	9.220	16.440
T_1: Boron (B) 0.2%	99.107	87.107	102.663	90.663	1.110	1.330	11.997	16.707
T_2: Boron (B) 0.4%	97.667	88.220	100.777	91.997	1.660	1.330	9.663	23.330
T_3: Iron (Fe) 0.2%	98.443	87.273	101.440	91.440	1.330	1.553	17.220	15.220
T_4: Iron (Fe) 0.4%	98.330	88.000	101.773	92.000	1.440	1.220	18.217	16.550
T_5: B 0.2% + Fe 0.2%	100.330	87.110	103.217	90.883	1.500	1.330	18.217	20.220
T_6: B 0.2% + Fe 0.4%	98.720	87.997	101.720	91.330	1.770	1.330	28.443	32.330
T_7: B 0.4% + Fe 0.4%	97.220	86.250	100.000	89.000	1.770	1.777	16.663	27.773
SEm±	1.002	0.544	0.979	0.804	0.230	0.187	5.160	4.716
CD (P=0.05%)	NS	1.667	NS	NS	NS	NS	NS	2.389

5. Conclusion

The study highlights the significant impact of boron and iron combinations on various plant growth parameters, like leaf count, plant height, flowering characteristics, and corm attributes. Treatment T_7 (B 0.4% + Fe 0.4%) consistently showed promising results in promoting leaf production, accelerating flowering, and enhancing corm parameters, indicating its effectiveness in maximizing overall plant performance. The findings underscore the importance of micronutrients in optimizing plant physiology and growth, emphasizing the potential benefits of integrated nutrient management strategies for enhancing crop productivity and quality.

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