International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(3): 579-582
www.biochemjournal.com
Received: 18-12-2023
Accepted: 28-01-2024

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Effect of benzyl adenine and gibberellic acid on corm and cormels production of gladiolus

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DOI: https://doi.org/10.33545/26174693.2024.v8.i3g.787

Abstract
A field experiment was conducted at the Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere, during 2017-18 to investigate the impact of benzyl adenine (BA) and gibberellic acid (GA3) on corm and cormels production in gladiolus. The experiment was arranged in a Randomized Complete Block Design with 16 treatments and 3 replications. The treatments consisted of varying concentrations of BA (100, 200, and 300 ppm), GA3 (150, 200, and 250 ppm), and their combinations, along with a control group. The results revealed that BA at 300 ppm exhibited the highest corm yield per plant (3.41), per plot (102.00), and per hectare (13,416.67 Kg/ha), as well as the highest cormels yield per plant (47.14), per plot (644.67), and per hectare (1250.00 Kg/ha). Additionally, BA at 300 ppm resulted in the highest corm weight per plot (2.68 Kg), cormels weight per plant (28.08 g), and cormels weight per plot (251.33 g). In contrast, the control group recorded the lowest values for corm yield per plant (1.16), per plot (34.70), and per hectare (7083.33 Kg/ha), as well as cormels yield per plant (17.92), per plot (261.00), and per hectare (466.67 Kg/ha). Moreover, the control group exhibited the lowest corm weight per plot (1.42 Kg), cormels weight per plant (11.59 g), and cormels weight per plot (92.33 g). GA3 at 250 ppm demonstrated the highest corms weight per plant (171.18 g), corm diameter (7.99 cm), and cormels diameter (7.19 mm). Conversely, the control group exhibited the minimum values across all parameters studied.

Keywords: Gladiolus, BA, GA_3, corm and cormels

Introduction

Gladiolus is a flower of glamour and perfection which is known as the queen of bulbous flowers due to its flower spikes with florets of massive form, brilliant colours, attractive shapes, varying size and excellent shelf life. Gladiolus is commercially propagated in the world through its corms which is an underground modified stem that provides nutrients during sprouting (Sajjad *et al*. (2015) [16]. Typically, a single bud emerges from a mother corm, but when multiple buds sprout, it promotes the production of propagules, thereby enhancing propagation efficiency. The size of the corm significantly impacts vegetative growth, development, and the yield of spikes, flowers, and corms. According to several scientists, challenges in gladiolus cultivation include the availability of high-quality planting material, a low multiplication rate (with each corm yielding only 1-2 new corms), and a dormancy period of 3-4 months in corms, which can hinder cultivation efforts (Janakiram and Prasad, 2010) [9]. Plant growth regulators play an important role in breaking dormancy and promotes more number of corm production in gladiolus (Bhattacharjee, 1983) [7]. In case of bulbous ornamental plants, gibberellins stimulate the height of the plant, length of flower stalk, flower size, duration of flowering, induce early flowering, corm size, corm weight and also lengthening the life of the stalk to a significant extent. Cytokinin increases the chlorophyll development and synthesis and promotes axillary branching and shoot differentiation which ultimately increases the corm and cormels production. Hence, the present investigation was undertaken to study the effect of benzyl adenine and gibberellic acid on corm and cormels production of gladiolus cv. Summer Sunshine.

Materials and Methods

The experiment conducted at the Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere (under the University of Agricultural and Horticultural

Sciences, Shivamogga) during 2017-18 focused on investigating the effect of benzyl adenine (BA) and gibberellic acid (GA_3) on corm and cormels production of gladiolus cv. Summer Sunshine. The experimental design utilized a Randomized Complete Block Design comprising 16 treatments with 3 replications each. Pre-plant corms of medium size were subjected to soaking for 24 hours in different concentrations of growth regulators, including BA (100, 200, and 300 ppm) and GA_3 (150, 200, and 250 ppm), both individually and in various combinations. These treatments were compared against a control group to evaluate their impact on corm and cormels production. After soaking, the corms were dried under shade for 2 hours and promptly planted at a spacing of 30 × 20 cm on flat beds. The crop received fertilization with 100:60:60 kg/ha of NPK, as per Anon., 2013 guidelines. Intercultural operations such as weeding, irrigation, and earthing up were carried out as required throughout the growth period. Harvesting of corms took place when the leaves were completely dried, followed by recording observations and conducting statistical analysis.

Results and Discussion

Corms treated with benzyl adenine and gibberellic acid showed the significant differences with respect to the corm and cormels yield parameters (Table 1). Plants treated with BA at 300 ppm (T_3) exhibited the maximum number of corms (3.41) per plant (Fig. 1) and per plot (102.00), it was statistically on par with (T_2) BA at 200 ppm (3.20 and 96.00) and (T_1) BA at 100 ppm (2.90 and 87.00), respectively. The minimum number of corms per plant (1.16) and per plot (34.70) was recorded in the control. The maximum number of corm yield per hectare (13,416.67 Kg/ha) was observed in the treatment (T_3) BA at 300 ppm, it was found statistically on par with the (T_6) GA_3 at 250 ppm, (T_5) GA_3 at 200 ppm and (T_2) BA at 200 ppm (12,600.00 Kg/ha and 12,316.67 Kg/ha and 12,133.33 Kg/ha, respectively). The control group yielded the minimum corm yield per hectare at 7083.33 kg/ha. It's known that BA (Benzyladenine) promotes cell division and anabolism, and higher concentrations of BA have been observed to enhance multiple shooting and accelerate corm production. It's possible that BA promoted the sink activity of developing corms and cormels at the expense of flower spikes, which could explain the increase in the number of corms and cormels alongside the poor quality of flower spikes. Additionally, BA tends to induce more splitting rather than an increase in the size of the corms. Similar results were also observed by Tawar *et al.* (2007) [19], Baskaran *et al.* (2009) [4], Aier *et al*. (2015) [1], Chopde *et al*. (2015) [8] and Manasa *et al*. (2017) [13] in gladiolus.

The highest number of cormels per plant (47.14) was observed in the treatment (T_3) using BA at 300 ppm solution, statistically comparable to (T_2) BA at 200 ppm, (T_1) BA at 100 ppm, (T_{15}) BA at 300 ppm + GA3 at 250 ppm, and (T_{14}) BA at 300 ppm + GA3 at 200 ppm, with values of 44.42, 43.05, 41.65, and 40.16, respectively. Conversely, the lowest number of cormels per plant (17.92) was recorded in the control treatment (T_{16}). In terms of cormels per plot and per hectare, the treatment (T_3) with BA at 300 ppm demonstrated the highest numbers, registering 644.67 cormels per plot and 1250.00 Kg/ha, respectively. This treatment significantly outperformed others and was statistically comparable to (T_2) BA at 200 ppm, which recorded 635.00 cormels per plot and 1133.33 Kg/ha. Conversely, the lowest number of cormels per plot (261.00) and per hectare (466.67 Kg/ha) was observed in the control treatment (T_{16}). The application of BA likely contributed to increased cormel splitting and multiple shooting, resulting in the highest number of cormels per plot and per hectare. These findings align with previous studies by Arora et al. (1992) [3] and Khan et al. (2011) [10] in gladiolus.

Table 2 illustrates that the maximum weight of corms per plant (171.18 g) was observed in treatment (T_6) using GA3 at 250 ppm, statistically comparable to treatment (T_5) using GA_3 at 200 ppm (165.92 g). Conversely, the minimum weight of corms per plant (95.11 g) was recorded in the control treatment (T_{16}). Regarding the weight of corms per plot, treatment (T_3) with BA at 300 ppm exhibited the highest value (2.68 Kg), statistically superior to other treatments and statistically comparable to treatments (T_6) GA3 at 250 ppm, (T_5) GA3 at 200 ppm, and (T_2) BA at 200 ppm, which recorded 2.52 Kg, 2.46 Kg, and 2.43 Kg respectively. The control treatment registered the lowest weight of corms per plot (1.42 Kg). The increase in weight, size, and volume of the corms with the application of GA3 can be attributed to the increase in the number of leaves per plant, which enhances carbon assimilation. These assimilates are then transported to the resulting daughter corms, thereby increasing their weight, size, and volume. Similar results were reported by Arora et al. (1992) [3], Maurya and Nagada (2002) [14], and Baskaran et al. (2014) [5] in gladiolus.

Among all the treatments (T_3) BA at 300 ppm exhibited the maximum weight of cormels per plant (28.08 g) and per plot (251.33 g). It was statistically on par with the (T_2) BA at 200 ppm (25.67 g and 227.67 g, respectively). The minimum weight of cormels per plant (11.59 g) and per plot (92.33 g) was recorded in the control (Table 2). BA might have caused more splitting and cell division which produces highest number of corms and cormels per plant. Another reason might be the less plant vigour and shorter spikes which may resulted in availability and translocation of more metabolites towards the development of cormels per corm, these results are conformity with earlier study by Leena *et al.* (1992) [12], Pal and Chowdhury (1998) [15], Tawar *et al.* (2007) [19] and Khan *et al.* (2013) [10] in gladiolus.

The maximum diameter (7.99 cm) of corm (Fig. 1) and cormels (7.19 mm) was recorded by plants treated with (T_6) GA_3 at 250 ppm, which was statistically on par with the (T_5) GA_3 at 200 ppm (7.73 cm and 7.19 mm). The minimum diameter of corms (3.36 cm) and cormels (1.78 mm) was observed in the control (Table 2). It might be due to GA_3, which increases the plant height, leaf length and leaf width that might have led to enhance the rate of photosynthesis. Hence availability of metabolites to the developing corms and cormels might be increased, thereby resulted in increase in the size of corm and cormels. The GA_3 might have enhance the cell elongation rather than cell differentiation and increased diameter of corm and cormels. The present results are in agreement with findings of Shankar *et al.* (2011) [17] in tuberose, Singh *et al*. (2002) [18] and Bhalla and Kumar (2007) [6] in gladiolus.

Table 1: Effect of benzyl adenine and gibberellic acid on corm and cormels yield in gladiolus

Treatment details	Corm yield			Cormels yield		
	Per plant (Nos.)	Per plot (Nos.)	Per hectare (Kg)	Per plant (Nos.)	Per plot (Nos.)	Per hectare (Kg)
T_1- BA @ 100 ppm	2.90	87.00	11733.33	43.05	602.33	1083.33
T_2- BA @ 200 ppm	3.20	96.00	12133.33	44.42	635.00	1133.33
T_3- BA @ 300 ppm	3.41	102.00	13416.67	47.14	644.67	1250.00
T_4-GA_3 @ 150 ppm	1.50	45.00	11583.33	24.41	335.00	583.33
T_5- GA_3 @ 200 ppm	1.62	48.60	12316.67	25.93	359.00	633.33
T_6- GA_3 @ 250 ppm	1.89	56.60	12600.00	31.01	437.67	716.67
T_7- BA @ 100 ppm + GA_3 @ 150 ppm	1.91	57.30	7116.67	26.59	341.33	750.00
T_8- BA @ 100 ppm + GA_3 @ 200 ppm	2.05	61.40	7966.67	30.36	401.00	816.67
T_9- BA @ 100 ppm + GA_3 @ 250 ppm	2.06	61.70	8583.33	31.19	416.33	816.67
T_{10}- BA @ 200 ppm + GA_3 @ 150 ppm	2.12	63.50	8816.67	33.14	426.00	816.67
T_{11}- BA @ 200 ppm + GA_3 @ 200 ppm	2.22	66.50	10066.67	34.16	430.67	850.00
T_{12}- BA @ 200 ppm + GA_3 @ 250 ppm	2.27	68.10	10716.67	36.22	433.67	866.67
T_{13}- BA @ 300 ppm + GA_3 @ 150 ppm	2.30	69.00	10916.67	39.01	440.33	883.33
T_{14}- BA @ 300 ppm + GA_3 @ 200 ppm	2.32	69.50	11150.00	40.16	444.00	900.00
T_{15}- BA @ 300 ppm + GA_3 @ 250 ppm	2.36	70.90	11566.67	41.65	448.00	916.67
T_{16}- Control	1.16	34.70	7083.33	17.92	261.00	466.67
S. Em ±	0.26	7.65	547.76	2.47	14.31	46.80
C D @ 5%	0.74	22.11	1582.04	7.13	41.34	135.16

Table 2: Effect of benzyl adenine and gibberellic acid on corm and cormels characteristics in gladiolus

Treatment details	Corms weight		Cormels weight		Diameter of corms (cm)	Diameter of cormels (mm)
	Per plant (g)	Per plot (Kg)	Per plant (g)	Per plot (g)		
T_1- BA @ 100 ppm	112.70	2.35	24.99	216.67	3.47	3.96
T_2- BA @ 200 ppm	124.08	2.43	25.67	227.67	3.56	4.68
T_3- BA @ 300 ppm	132.58	2.68	28.08	251.33	3.73	5.34
T_4-GA_3 @ 150 ppm	153.26	2.32	14.38	114.67	7.08	6.14
T_5- GA_3 @ 200 ppm	165.92	2.46	16.86	127.33	7.73	6.84
T_6- GA_3 @ 250 ppm	171.18	2.52	19.91	145.00	7.99	7.19
T_7- BA @ 100 ppm + GA_3 @ 150 ppm	99.98	1.42	18.28	148.33	3.81	3.18
T_8- BA @ 100 ppm + GA_3 @ 200 ppm	102.09	1.59	18.46	161.00	4.27	3.39
T_9- BA @ 100 ppm + GA_3 @ 250 ppm	103.51	1.72	20.61	161.33	4.40	3.64
T_{10}- BA @ 200 ppm + GA_3 @ 150 ppm	104.19	1.76	20.85	163.33	4.45	4.15
T_{11}- BA @ 200 ppm + GA_3 @ 200 ppm	107.79	2.01	21.53	169.00	4.55	4.45
T_{12}- BA @ 200 ppm + GA_3 @ 250 ppm	117.23	2.14	21.67	175.33	4.64	4.56
T_{13}- BA @ 300 ppm + GA_3 @ 150 ppm	124.59	2.18	22.64	178.00	4.72	4.60
T_{14}- BA @ 300 ppm + GA_3 @ 200 ppm	127.93	2.23	23.57	179.33	4.79	4.75
T_{15}- BA @ 300 ppm + GA_3 @ 250 ppm	128.70	2.31	23.86	183.67	4.89	4.95
T_{16}- Control	95.11	1.42	11.59	92.33	3.36	1.78
S. Em ±	5.14	0.11	1.32	9.09	0.17	0.21
C D @ 5%	14.85	0.32	3.80	26.25	0.48	0.60

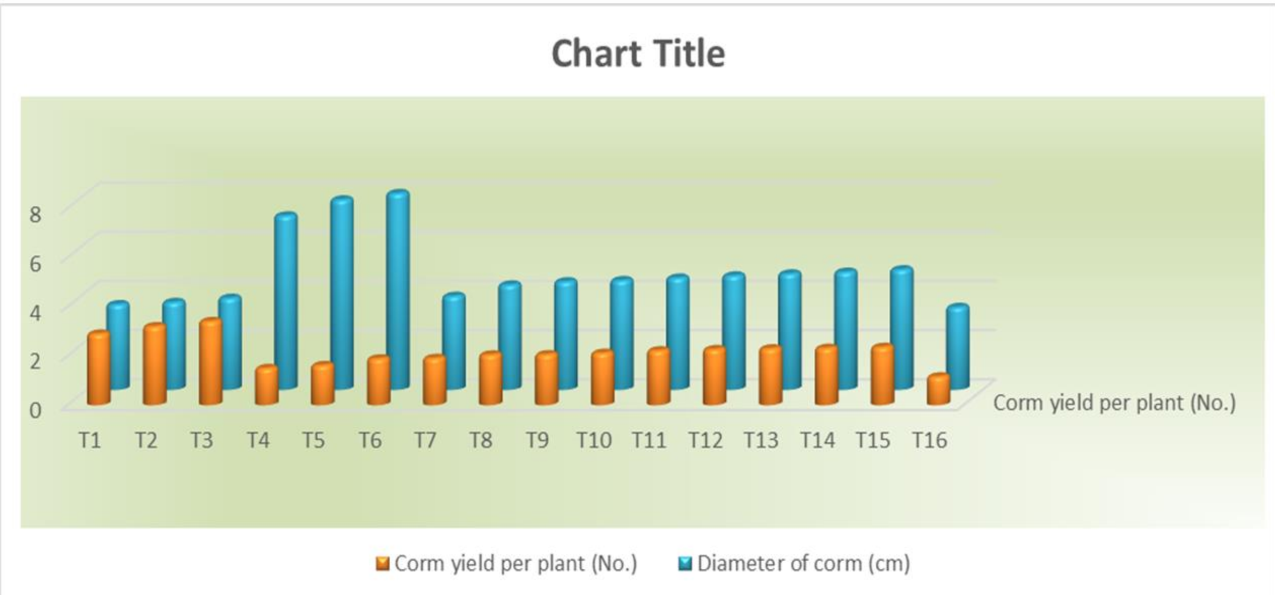

Fig 1: Effect of benzyl adenine and gibberellic acid on corm yield per plant and diameter of corm (cm) in gladiolus cv. Summer Sunshine

Conclusion
From the findings of the present investigation, it can be inferred that the treatment utilizing BA at 300 ppm resulted in the highest number of corms and cormels per plant, per plot, and per hectare, as well as the highest cormels weight per plant and per plot. On the other hand, GA3 at 250 ppm demonstrated the highest corms weight per plant, as well as the maximum diameter of corm and cormels.

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