Effect of bio-regulators on growth and flowering of gladiolus cv. 'Red Beauty' under different growth conditions

DIGENDRA SINGH, B. D. BHUJ, RANJAN SRIVASTAVA and SATISH CHAND

Department of Horticulture, College of Agriculture, G. B. Pant University of Agriculture and Technology, Pantnagar-263145 (U. S. Nagar, Uttarakhand),

ABSTRACT: Gladiolus corms were soaked with different growth regulators each at three levels *viz*., ethrel (250, 500 and 750 ppm), gibberellic acid (75, 100 and 125 ppm) and thiourea (250, 500 and 1000 ppm) along with control used as treatment. Gibberellic acid was found better than other growth regulators in both the conditions. Soaking of corms with gibberellic acid hastened the corm sprouting, number of leaves per plant and spike length. Maximum plant height was recorded in high concentration of thiourea treatment at 45 days after planting (DAP) but at 60 days after planting, the maximum plant height was found in high concentration of gibberellic acid treatment. Application of ethrel @ 250 ppm was found significantly higher than other treatments in rachis length under shade net conditions. Soaking of corms with, gibberellic acid at higher levels resulted in the earliest sprouting of corm as well as plant height at 60 days after planting in both condition; maximum number of leaves, rachis length in open condition and spike length in both the conditions. All the parameters are recorded significantly improved over the control except plant height at 45 days after planting in open condition.

Key words: Dormancy, Ethrel, Gibberellic acid, Gladiolus, Thiourea

Gladiolus is an important commercial cut flower of the world. It is known as queen of bulbous flowers. In the hills, majority of the cultivars perform exceedingly well at a height of 1000 - 2000 meters above mean sea level (msl). It is excellent cut flowers as it lasts long in flower vase and has magnificent florets with variety of colours (Singh, 2006). The growth and development of plant is governed by internal factors like hormonal and nutritional balance. The proper development of gladiolus plant is governed by the growth regulators, which are being used to manipulate the growth habit and flowering. Freshly harvested corm and cormels of gladiolus do not sprout immediately due to period of dormancy which is regulated by changes in the levels of endogenous promotory or inhibitory substances (Misra and Singh, 1998). Dormancy period of the freshly harvested gladiolus corms ranges from 2 to 4 months under natural storage conditions depending on the cultivars and the temperature during storage (Gonzales, 1996). And some plant growth regulators are useful to produce flowering in off season by breaking the dormancy of gladiolus. GA_3 is very effective for germination, growth promotion, flowering and senescence inhibition (Murti and Upreti, 1995). Dormancy is the physiological state of the living cells, which blocks the visible growth. But still, only a handful of information is available on the physiological mechanism regulating bulb dormancy. The multiplication through corms & cormels is slow. Certain plant bio-regulators such as gibberellic acid (GA_3), thiourea and ethrel have been successfully used to break the dormancy of gladiolus.

MATERIALS AND METHODS

The experiment was conducted at Model Floriculture Centre, G. B. Pant University of Agriculture and Technology, Pantnagar, District -Udham Singh Nagar (Uttarakhand) during summer season 2014. Medium sized (4-6 cm diameter) corms of 'Red Beauty' were collected from University germplasm. Three growth regulators *viz*; ethrel, gibberellic acid (GA_3) and thiourea, each at three levels *viz*., (ethrel 250, 500 and 750 ppm), (gibberellic acid 75, 100 and 125 ppm) and (thiourea 250, 500 and 1000 ppm) including a water control were used as treatment in this experiment. The corms were dipped in the bavistin @ 0.2 per cent for 30 minutes, dried in shade for 24 hours and then soaked in the bio-regulators solutions for 24 hours and again dried in shade for 24 hours then finally, these treated corms from each treatment were planted in plastic pots, soils of each pot were fertilized with 1.064 g urea, 1.197 g triple super phosphate, 1.01 g muriate of potash and 53.20 g cow-dung corresponding to 200 kg urea, 225 kg triple super phosphate and 190 kg muriate of potash and 10 tonnes cow-dung per ha as suggested by Woltz (1976). After

planting, the half numbers of pots of each treatment were kept in a shade net to protect from heavy sun rays and rest of half kept in open condition. The experiment was laid out in randomized block design (RBD) with three replications separately for both the conditions (shade net and open field). Twenty four corms were included in each treatment. Full dose of cow-dung, triple super phosphate and muriate of potash were applied as basal dose and the urea was applied in two installments, first at three leaves stage and second at spike initiation stage. Intercultural operations like weeding, watering, etc. were done as and when necessary. After recorded different data, the spikes of gladiolus were harvested when the first floret show colour in the rachis. Data on different growth and yield parameters from all plants of each pot were recorded and analyzed statistically by using STPR3 computer package program.

RESULTS AND DISCUSSION

Sprouting (days)

Sprouting of corms was influenced significantly due to treatment with growth regulators (Table 1). Sprouting was earlier by 19.00 days when treated with 125 ppm GA_3 followed by 100 ppm GA_3 (20.42 days) and maximum days taken to sprouting with control (25.75 days) in shade net condition. In case of open condition, first sprout was also recorded in 125 ppm GA_3 (22.50 days) which is statistically similar to thiourea @ 1000 ppm (22.56 days) and ethrel @ 250 ppm (23.25 days) but significantly different over rest of the treatments. The effect of gibberellic acid in inducing the formation of hydrolytic enzymes may be a factor, which regulates the mobilization of reserves, ultimately resulting in early sprouting (Groot and Karssen, 1987). Similar results were also obtained by Khan *et al.* (2013) and Suresh *et al*. (2009) whereas, corms of 'American Beauty' treated with 125 ppm GA_3 solution which took less number of days (17 days) to sprout and in case of ethrel (Mukhamed, 1985) reported that application of ethephon with 500 ppm played an important role to shortened dormancy period of corms.

Plant height (cm)

The plant height was affected by different concentrations of different plant growth regulators as shown in Table 1. Highest vegetative growth characters were observed under thiourea @ 1000 ppm in shade and open condition (59.23 cm and 34.10 cm) respectively, at 45 DAP. But after 60 days, maximum plant height was recorded in GA_3 @ 125 ppm in case of shade and open condition (95.12 cm and 67.94 cm) respectively, and minimum plant height was recorded in control condition of both the cases. It might be due to low temperature availability in summer season in shade net as well as higher concentration of thiourea in the treatment which enhanced plant height and similar finding with Padmalatha *et al*. (2014) reported 2% thiourea more effective in increasing the vegetative growth. Chahal *et al*. (2013) claimed that 500 ppm thiourea solution

Table 1: Effect of bio-regulators on growth of gladiolus cv. 'Red Beauty' under different growth conditions

Treatments	Sprouting (days)		Plant height (cm)				Number of leaves			
	Shade	Open	Shade net		Open		Shade net		Open	
			45 DAP	60 DAP	45 DAP	60 DAP	45 DAP	60 DAP	45 DAP	60 DAP
GA_3 @ 75ppm	22.83	30.75	51.66	87.41	22.73	56.78	3.33	4.47	2.28	3.83
GA_3 @ 100ppm	20.42	27.17	53.93	87.54	24.66	60.88	3.56	4.93	2.33	4.48
GA_3 @ 125ppm	19.00	22.50	55.08	95.12	30.29	67.94	3.87	5.10	3.00	4.67
Thiourea @ 250ppm	22.10	27.83	51.93	83.45	25.55	62.04	3.08	4.63	2.42	4.21
Thiourea @ 500ppm	20.75	25.00	56.63	92.75	31.01	62.24	3.25	4.88	2.60	4.43
Thiourea @ 1000ppm	20.67	22.56	59.23	93.58	34.10	62.78	3.42	5.04	2.85	4.47
Ethrel @ 250ppm	20.45	23.25	57.18	92.12	28.53	66.18	3.53	5.00	2.87	4.43
Ethrel @ 500ppm	21.00	27.00	56.83	91.65	28.16	62.86	3.33	4.83	2.17	3.83
Ethrel @ 750ppm	22.75	27.08	48.63	85.96	24.99	56.63	3.33	4.50	2.00	3.75
Control	25.75	30.83	47.05	81.07	23.56	53.86	3.01	4.20	1.90	2.98
Mean	21.57	26.40	53.82	89.07	27.36	61.22	3.37	4.76	2.44	4.11
S. Ed. (±)	0.25	0.38	0.69	1.16	0.34	1.06	0.55	0.74	0.45	0.58
C.D. at 5%	0.75	1.13	2.03	3.44	1.02	3.16	0.16	0.21	0.13	0.17

significantly increased the plant height. Plant height was increased at 60 DAP in GA_3 @ 125 ppm which may be due to GA_3 which play a vital role in improvement of vegetative growth. This may be due to enhancement of cell division by promoting DNA synthesis in cells. The plant height influenced by GA_3 application is in close agreement with the findings of Misra *et al*. (1993); Nagarajaih and Reddy (1986); Negi and Raghava (1986) and Gowda (1985).

Number of leaves

The number of leaves per plant was affected significantly by both the growing conditions in Table 1. Planting in shade condition resulted in more number of leaves per plant at 45 and 60 DAP (3.87 and 5.10) respectively, as compared to open condition. A significantly different data was recorded over both the control treatments. The number of leaves per plant was increased with increasing level of GA_3 in both the cases at 60 DAP which can be explained due to favourable low temperature availability in shade net during summer as compared to open condition. Similar results have been reported by Kumar and Singh (2005) whereas corms treated with GA_3 @ 150 ppm produced more number of leaves per plant. These results are in agreement with the findings of Kumar and Singh (2008); Negi and Raghava (1986) and Misra *et al*. (1993).

First floret show colour (days)

In gladiolus, first floret shown colour has been presented in Table 2. Application of different growth regulators with different concentrations on gladiolus cv. Red Beauty where as the most effective treatment has found GA_3 lower concentration (75 ppm) in shade and open, both cases (79.33 days and 87.67 days) respectively. All the treatments have observed statistically similar excluding control in shade net condition and ethrel @ 250 ppm and control in open condition. Maximum days were taken to flower shown colour in control treatment of shade net and open condition (83.02 days and 93.04 days), respectively. Earlier flowering have been found under GA_3 @ 75 ppm which may be due to early sprouting with low concentration of GA_3 to get early maturity of plant and consequently produce early flowering. Similar results were also obtained by Rana *et al*. (2005) observed the application of GA_3 at 100 ppm advanced flowering and minimum days (108.04 and 108.08) were required for flowering under this treatment and agreement with the findings of Sharma *et al. (2006) and* Misra *et al*. (1993).

Rachis length (cm)

Maximum rachis length was recorded in ethrel @ 250 ppm in shade net condition and high concentration of GA_3 @ 125 ppm in open condition (32.00 cm and 26.67 cm) respectively, followed by GA_3 @ 125 ppm in shade net and higher concentration of thiourea in open field, while minimum rachis length in shade and open with control treatment (23.20 cm and 19.01 cm), respectively. Lower concentration of ethrel (250 ppm) and higher concentration of gibberellic acid (125 ppm) in shade and open condition, respectively, significantly influenced the rachis length. This might be due to higher plant height produced consequently long rachis length as compared to other treatment in both conditions. Mohanty *et al*. (1994) reported that lower dose of ethrel (250 ppm) could increase the placement and its two higher doses decreased

Table 2: Effect of bio-regulators on flowering of gladiolus cv. 'Red Beauty' under different growth conditions

Treatments	First floret show colour (days)		Rachis length (cm)		Spike length (cm)	
	Shade	Open	Shade net	Open	Shade net	Open
GA_3 @ 75ppm	79.33	87.67	26.00	20.00	123.17	94.00
GA_3 @ 100ppm	80.33	89.00	28.33	23.33	125.83	96.97
GA_3 @ 125ppm	81.02	91.67	29.67	26.67	134.47	103.83
Thiourea @ 250ppm	79.67	88.33	26.00	24.00	116.30	90.80
Thiourea @ 500ppm	80.68	90.67	28.33	25.33	127.60	93.20
Thiourea @ 1000ppm	81.00	91.01	28.67	25.33	129.83	97.87
Ethrel @ 250ppm	82.67	92.68	32.00	24.44	134.07	97.97
Ethrel @ 500ppm	81.20	91.44	29.33	24.33	120.17	91.50
Ethrel @ 750ppm	79.67	90.33	25.00	20.33	115.40	89.60
Control	83.02	93.04	23.20	19.01	113.02	88.89
Mean	80.86	90.58	27.65	23.28	123.99	94.46
S. Ed. (±)	1.24	1.42	0.52	0.41	1.77	1.47
C.D. at 5%	3.66	4.23	1.53	1.22	5.24	4.39

the distance between two florets as compared to control and agreement with Ravidas *et al*. (1992) in gladiolus.

Spike length (cm)

Maximum spike length was recorded in GA_3 @ 125 ppm in shade and open condition (134.47 cm and 103.83 cm) respectively, (Table 2) which was statistically at par with ethrel @ 250 ppm (134.07 cm) in shade net condition. Minimum spike length was noticed in both control conditions. Maximum spike length in shade net condition may be due to the availability of optimum temperature during the growing period which reduced transpiration as compared to open condition in hot summer. Among the various treatments with their different concentration gibberellic acid was obtained maximum spike length in 125 ppm. This may be because gibberellic acid might have increased auxin content in tissue as it is involved in auxin synthesis. These results might be due to early sprouting as well as maximum plant height observed with same treatment in both the conditions. The present findings are closer to the results of Moazzam *et al.* (2011) whereas, the effect of 125 ppm GA_3 resulted in increasing the spike length in tuberose and another agreement with Ravidas *et al*. (1992) in gladiolus; Bankar and Mukhopadhyay (1980).

CONCLUSION

Based on the present investigation use of various plant growth regulators that improved physiological activities of plant which enhanced the possibility of gladiolus is grown throughout the year with desirable traits. Among the different treatments, application of GA_3 @ 125 ppm may be recommended for breaking the corm dormancy and better growth and flowering for off seasonal production in gladiolus.

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