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EFFECT OF GROWTH REGULATORS AND CORM SIZE ON GROWTH AND CORM PARAMETERS IN GLADIOLUS CV. MALAVIYA KUNDAN

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ABSTRACT

A field experiment on gladiolus cv. Malaviya Kundan consisted of thiourea 0.5%, thiourea 1.5%, thiourea 2.0%, GA_3 50 ppm, GA_3 100 ppm, GA_3 150 ppm, control and four levels of corm sizes (1.0, 1.5, 2.0, 2.5 cm) in a Randomized Block Design. GA_3 at 150 ppm recorded significantly maximum number of leaves/plant (4.76), plant height (39.70 cm), length of longest leaf (37.35 cm) at 60 days after planting (DAP), weight of corms/hill (17.60 g) and diameter of corm (3.43 cm). Whereas, thiourea at 1.5% resulted maximum number of cormels/hill (42.98) and weight of cormels/hill (5.90 g). Among various grades of corm grade 2.5 cm recorded maximum number of leaves/plant (4.63) at 60 DAP, number of corms/hill (1.07), weight of corms/hill (18.74 g) and diameter of corm (3.50 cm). Whereas, corm size 2.0 cm resulted maximum plant height (39.83 cm), length of longest leaf (35.11 cm) at 60 DAP, number of cormels/hill (37.31) and weight of cormels/hill (5.75 g). Whereas, interaction of GA_3 150 ppm with corm size 2.5 cm recorded maximum number of leaves/plant (5.00), plant height (42.26 cm) and length of longest leaf (39.86 cm) at 60 DAP, weight of corms/hill (24.03 g) and diameter of corms/hill (3.84 g).

INTRODUCTION

Gladiolus is one of the most important bulbous ornamental plant grown worldwide for its fascinating and beautiful flowers which belongs to family Iridaceae and sub family Ixiodeae. As a commercial flower, gladiolus is gaining importance in India due to its longer vase life, sequential opening of flowers and variously coloured delicate florets. Commercially it is propagated by underground corm and cormel (Singh and Sisodia, 2017). Freshly harvested corms have a dormancy period of 2-4 months which also depends upon cultivar and the storage condition (Gonzales, 1996). Dormancy in corms act as a major hindrance for their immediate use in commercial cultivation and also results in increased cost of the corms. And also due to lack of information regarding various factors such as cultivation practices, size of propagating materials, use of growth regulators among farmers, the commercial cultivation is still at the initial stage. Bulbous plants are influenced by the size of bulbs/corms. As the size increases the assimilation of food also increases which resulted in accelerated growth, flowering and yield. According to various studies there is a direct relationship between the corm size and vegetative, flowering and corm yield of the plant (Bankar and Mukhopadhyay, 1980 and Sharma and Gupta, 2003). Exogenous application of growth regulators boosts the growth and yield in various plants (Singh and Karki, 2003, Kumar *et al.*, 2012, Gurung *et al.*, 2014, Nazir *et al.*, 2017, Kapri *et al.*, 2018 and Thapa *et al.*, 2019). GA_3 is well known for its role in influencing various physiological processes such as seed germination, leaf expansion, stem elongation and flower development. Thiourea is primitively known for its significant role in breaking the seed and bud dormancy (Chang and Sung, 2000). It can be successfully implicated to break both the innate and environmentally imposed seed dormancy and promotes seed germination (Aldasoro *et al.*, 1981). Thiourea application stimulated shoot and root growth and enhanced biomass in gladiolus cormels (Padhi *et al.*, 2018). Therefore, an experiment was carried out to find out the influence of growth regulators *i.e.* GA_3 and thiourea and corm size on growth and corm parameters in gladiolus.

MATERIALS AND METHODS

The experiment was carried out at Horticulture Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India during the year 2018-19. Gladiolus corms of newly developed cultivar Malaviya Kundan from Banaras Hindu University, Varanasi were taken for this experiment to standardize corm size for planting and see its response on growth promoting chemicals. Dehusked corms of various grades (1.0 cm, 1.5 cm, 2.0 cm, 2.5 cm) were treated with different concentrations of thiourea (0.5%, 1.5%, 2.0%) and GA_3 (50 ppm, 100 ppm, 150 ppm) solution and also in distilled water (Control) for 24 hrs (Padhi *et al.*, 2018). The soaked corms were then dried and planted in well levelled beds with a spacing of 30 × 20 cm. Intercultural operations like weeding, earthing up and watering were done as and when necessary. The experiment was laid out in Randomized Block Design with 3 replications

(Panse and Sukhatme, 1985). The observations were recorded at 30, 45 and 60 DAP with respect to growth parameters. The corm attributes were also recorded after digging of corms and cormels and analysis of variance was done as suggested by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Effect of growth regulators and corm size on growth parameters

A significant effect was observed due to the exercise of growth regulators *i.e.* thiourea and GA_3 at different concentrations on growth parameters in case of number of leaves per plant at 30, 45 and 60 DAP, plant height (cm) at 30, 45 and 60 DAP and length of the longest leaf (cm) at 30, 45 and 60 DAP (Table 1). Maximum number of leaves/plant at 30 DAP and 45 DAP was recorded with the treatment GA3 at 150 ppm (2.93 and 4.11) which was statistically at par with treatment of GA3 at 100 ppm (2.85 and 4.01) and GA3 at 50 ppm (2.81 and 3.92). While, minimum was in case of thiourea at 2.0% (1.31 and 2.19). Maximum number of leaves at 60 DAP was obtained in case of thiourea at 0.5% (5.16) while GA3 at 100 ppm (4.78) was at par with the results. Minimum was obtained in case of thiourea at 2.0% (3.17). Plant height (cm) at 30 DAP was recorded maximum in GA3 at 50 ppm (30.30 cm) which was statistically at par with GA3 at 100 ppm (29.88 cm) and GA3 at 150 ppm (29.76 cm). Among various treatments, maximum plant height at 45 DAP and 60 DAP was obtained with GA3 at 150 ppm (36.04 cm and 39.70 cm) which was statistically at par with GA3 at 100 ppm (35.12 cm and 38.45 cm) and GA3 at 50 ppm (35.63 cm and 38.35 cm). Maximum length of longest leaf (cm) at 30 DAP was obtained in GA3 at 50 ppm (25.75 cm) which was statistically at par with GA3 at 100 ppm (25.68 cm), thiourea at 0.5% (25.48 cm) and GA3 at 150 ppm (25.17 cm). Length of longest leaf (cm) at 45 DAP and 60 DAP was found to be maximum in GA3 at 150 ppm (31.37 cm and

Table 1: Effect of growth regulators and corm size on growth parameters in gladiolus.

Treatments	Number of leaves/plant			Plant height (cm)			Length of longest leaf (cm)		
	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP
Control	2.2	3.38	4.74	26.98	33.11	37.44	23.56	30.53	36.36
Thiourea, 0.5%	2.36	3.23	5.16	28.92	33.28	37.5	25.48	29.97	32.77
Thiourea, 1.5%	1.68	2.61	3.61	20.07	28.45	34.76	17.53	27.5	29.7
Thiourea, 2.0%	1.31	2.19	3.17	14.61	24.04	31.18	12.53	22.03	26.52
GA_3, 50 ppm	2.81	3.92	4.74	30.3	35.63	38.35	25.75	30.76	33.63
GA_3, 100 ppm	2.85	4.01	4.78	29.88	35.12	38.45	25.68	30.93	35.06
GA_3, 150 ppm	2.93	4.11	4.76	29.76	36.04	39.7	25.17	31.37	37.35
CD at 5%	0.25	0.25	0.38	1.8	1.81	1.63	1.94	1.37	1.3
Corm size 1.0 cm	1.83	2.74	3.82	22.34	28.15	32.21	20.62	26.4	29.7
Corm size 1.5 cm	2.31	3.32	4.33	25.03	31.58	35.88	21.47	29.2	32.8
Corm size 2.0 cm	2.52	3.61	4.91	27.82	34.76	39.83	24.02	30.43	35.11
Corm size 2.5 cm	2.56	3.74	4.63	27.97	34.47	39.15	22.86	30.03	34.62
CD at 5%	0.19	0.19	0.29	1.36	1.37	1.23	1.47	1.04	0.98
Control × 1.0 cm	1.33	2.67	3.67	16.77	24.17	30.23	15.57	21.27	28.65
Control × 1.5 cm	2.14	3.53	5.36	28.09	34.76	39.62	24.16	32.19	38.97
Control × 2.0 cm	2.72	3.72	5.39	31.1	36.19	40.4	27.64	33.78	38.37
Control × 2.5 cm	2.61	3.61	4.56	31.94	37.32	39.5	26.86	34.89	39.47
Thiourea 0.5% × 1.0 cm	2	2.5	4.78	27.22	29.72	30.23	26.53	28.63	30.68
Thiourea 0.5% × 1.5 cm	2.17	3.17	5.33	26.23	30.43	39.62	23.01	28.42	30.66
Thiourea 0.5% × 2.0 cm	2.47	3.64	5.19	30.29	36.08	40.4	26.86	31.1	34.63
Thiourea 0.5% × 2.5 cm	2.78	3.61	5.33	31.92	36.89	39.5	25.52	31.71	35.13
Thiourea 1.5% × 1.0 cm	1.33	2	3.43	17.57	26.27	31.07	15.27	26.27	28.2
Thiourea 1.5% × 1.5 cm	1.83	2.67	3	20.43	28.78	34.82	17.38	28.78	30.3
Thiourea 1.5% × 2.0 cm	1.89	3	4.11	22.49	30.28	37.5	20.41	28.57	30.68
Thiourea 1.5% × 2.5 cm	1.67	2.78	3.89	19.79	28.47	35.64	17.04	26.37	29.63
Thiourea 2.0% × 1.0 cm	1	2	2.67	14.93	24.13	30.4	12.77	23.67	25.67
Thiourea 2.0% × 1.5 cm	1	2	2.67	10.4	22.17	27.33	8.3	20.23	24.4
Thiourea 2.0% × 2.0 cm	1.56	2.5	3.89	16.84	25.17	35.15	15.41	22.67	29.33
Thiourea 2.0% × 2.5 cm	1.69	2.28	3.44	16.28	24.68	31.84	13.65	21.54	26.69
GA_3 50 ppm × 1.0 cm	2	3	3.5	26.78	30.1	33.08	24.98	27.43	30.42
GA_3 50 ppm × 1.5 cm	3	4	4.81	30.2	35.62	38.17	25.82	30.64	32.9
GA_3 50 ppm × 2.0 cm	3	4	5.19	31.47	37.97	39.58	26.51	32.05	35.14
GA_3 50 ppm × 2.5 cm	3.22	4.67	5.44	32.75	38.83	42.56	25.68	32.92	36.07
GA_3 100 ppm × 1.0 cm	2.5	3.67	4.33	26.75	30.28	33.18	24.5	26.85	30.42
GA_3 100 ppm × 1.5 cm	3	3.94	4.55	30.57	35.6	40.06	26.53	33.72	36.53
GA_3 100 ppm × 2.0 cm	3	4	5.5	31.52	38.51	41.04	26.27	32.72	37.78
GA_3 100 ppm × 2.5 cm	2.92	4.45	4.75	30.69	36.09	39.49	25.42	30.43	35.5
GA_3 150 ppm × 1.0 cm	2.67	3.33	4.33	26.33	32.37	35.73	24.7	30.7	33.87
GA_3 150 ppm × 1.5 cm	3	3.94	4.61	29.28	33.66	37.41	25.1	30.37	35.83
GA_3 150 ppm × 2.0 cm	3	4.39	5.11	31.01	39.14	43.39	25.04	32.09	39.85
GA_3 150 ppm × 2.5 cm	3.06	4.78	5	32.41	38.99	42.26	25.84	32.33	39.86
CD at 5%	NS	NS	NS	3.6	3.62	3.26	3.89	2.75	2.61

Table 2: Effect of growth regulators and corm size on corm parameters in gladiolus.

Treatments	Number of cormels/hill	Weight of cormels/hill(g)	Number of corms/hill	Weight of corms/hill(g)	Diameter of corm (cm)
Control	32.94	5.76	1.07	14.6	3.19
Thiourea, 0.5%	39.15	5.78	1	15.45	3.25
Thiourea, 1.5%	42.98	5.9	1.03	13.15	3.15
Thiourea, 2.0%	26.6	4.08	1	9.35	2.81
GA_3, 50 ppm	33.16	5.46	1	17.63	3.37
GA_3, 100 ppm	28.17	4.65	1.02	16.39	3.31
GA_3, 150 ppm	24.3	4.18	1	17.6	3.43
CD at 5%	7.86	NS	NS	2.67	0.25
Corm size 1.0 cm	29.18	4.32	1	9.65	2.81
Corm size 1.5 cm	32.42	4.84	1	13.89	3.16
Corm size 2.0 cm	37.31	5.75	1	17.25	3.38
Corm size 2.5 cm	32.46	5.55	1.07	18.74	3.5
CD at 5%	NS	NS	0.04	2.02	0.19
Control × 1.0 cm	27.67	4.39	1	8.73	2.61
Control × 1.5 cm	31.33	4.49	1	11.92	2.99
Control × 2.0 cm	35.25	7.12	1	18.9	3.57
Control × 2.5 cm	37.5	7.03	1.28	18.86	3.58
Thiourea 0.5% × 1.0 cm	28.33	4.08	1	9.43	2.72
Thiourea 0.5% × 1.5 cm	35	4.35	1	11.63	2.97
Thiourea 0.5% × 2.0 cm	51.06	7.79	1	18.78	3.52
Thiourea 0.5% × 2.5 cm	42.22	6.9	1	21.94	3.77
Thiourea 1.5% × 1.0 cm	52.75	6.63	1	10.27	3.11
Thiourea 1.5% × 1.5 cm	52.83	8.32	1	16.88	3.44
Thiourea 1.5% × 2.0 cm	32.55	4.39	1	13.04	3.04
Thiourea 1.5% × 2.5 cm	33.78	4.24	1.11	12.41	3
Thiourea 2.0% × 1.0 cm	30.67	6.65	1	9.57	2.83
Thiourea 2.0% × 1.5 cm	25.33	2.54	1	6.57	2.57
Thiourea 2.0% × 2.0 cm	27.17	3.89	1	12.53	3.13
Thiourea 2.0% × 2.5 cm	23.25	3.24	1	8.71	2.69
GA_3 50 ppm × 1.0 cm	27.5	3.7	1	11.1	2.85
GA_3 50 ppm × 1.5 cm	27.56	4.94	1	18.37	3.53
GA_3 50 ppm × 2.0 cm	40.03	6.25	1	19.27	3.29
GA_3 50 ppm × 2.5 cm	37.56	6.94	1	21.78	3.79
GA_3 100 ppm × 1.0 cm	20.67	2.78	1	9.54	2.79
GA_3 100 ppm × 1.5 cm	26.11	4.45	1	16.62	3.32
GA_3 100 ppm × 2.0 cm	33.14	4.99	1	15.97	3.33
GA_3 100 ppm × 2.5 cm	32.78	6.4	1.08	23.44	3.79
GA_3 150 ppm × 1.0 cm	16.67	2.02	1	8.93	2.76
GA_3 150 ppm × 1.5 cm	28.78	4.77	1	15.21	3.3
GA_3 150 ppm × 2.0 cm	31.64	5.85	1	22.24	3.8
GA_3 150 ppm × 2.5 cm	20.11	4.08	1	24.03	3.84
CD at 5%	NS	1.07	NS	5.33	0.51

37.35 cm) while minimum was in the case of thiourea at 2.0% (22.03 cm and 26.52 cm). Present findings are corroborated with the observation made by Padhi *et al*. (2018), who noticed GA_3 and thiourea increased leaf length in gladiolus cormels in comparison to control. This result also in line with the findings of Bhalla and Kumar (2008), Sudhakar and Kumar (2012), Padmalatha *et al*. (2014), Singh *et al*. (2018b) and Parween *et al*. (2019) . It may be due to the physiological action of plant growth regulators that resulted in increased number and size of the meristematic tissue. Increased growth is attributed by application of GA_3 which increases the number of leaves that in turn accelerates photosynthesis hence increased photosynthetic assimilates. These assimilates are transported to the resulting daughter corms, thereby, increasing the plant height, number of leaves etc. (Singh *et al*., 2018a).

Various grades showed significant results in case of growth parameters. Maximum number of leaves/plant at 30, 45 and 60 DAP was resulted in grade 2.5 cm (2.56, 3.74 and 4.63) which was statistically at par with grade 2.0 cm (2.52, 3.61 and 4.91). Plant height (cm) at 30 DAP was found to be maximum in grade 2.5 cm (27.97 cm) while grade 2.0 cm (27.82 cm) was statistically at par with the results. Maximum plant height (cm) at 45 and 60 DAP was recorded with grade 2.0 cm (34.76 cm and 39.83 cm) which was statistically at par with grade 2.5 cm (34.47 cm and 39.15 cm). Regarding the parameter length of longest leaf (cm) at 30 DAP, 45 DAP and 60 DAP, maximum leaf length was obtained with grade 2.0 cm (24.02 cm, 30.43 cm and 35.11 cm) which was statistically at par with grade 2.5 cm (22.86 cm, 30.03 cm and 34.62 cm). It might be due to more food assimilates in large size corms resulting in accelerated growth. These results are in close agreement with the findings of Bankar and Mukhopadhyay (1980), Singh (2000), Singh and Karki (2003), Sharma and Gupta (2003), Bhat *et al*. (2009), Kareem *et al*. (2013) and Methela *et al*. (2019).

Interaction effect

The interaction between plant growth regulators and corm size was found to be significant in plant height (cm) at 30 DAP, 45 DAP and 60 DAP and length of longest leaf (cm) at 30 DAP, 45 DAP and 60 DAP and non-significant in number of leaves/plant at 30 DAP, 45 DAP and 60 DAP. Significantly maximum number of leaves/plant at 30 DAP (3.22), 60 DAP (5.44) was registered with GA_3 50 ppm × 2.5 cm while minimum was observed with thiourea 2.0% × 1.0 cm (1.00 and 2.67) and thiourea 2.0% ×1.5 cm (1.00 and 2.67). Maximum number of leaves at 45 DAP was recorded with GA_3 150 ppm × 2.5 cm (4.78) while minimum was in thiourea 2.0% × 1.0 cm (2.00) and thiourea 2.0% × 1.5 cm (2.00). Maximum plant height (cm) was recorded with GA_3 50 ppm × 2.5 cm (32.75 cm) and minimum was in thiourea 2.0% ×1.5 cm (10.40 cm). Plant height (cm) at 45 DAP and 60 DAP was found to be maximum in GA_3 150 ppm × 2.0 cm (39.14 cm and 43.39 cm) while minimum was recorded with thiourea 2.0% × 1.5 cm (22.17 cm and 27.33 cm). Maximum length of the longest leaf (cm) at 30 DAP was recorded in control × 2.0 cm (27.64 cm) while maximum leaf length (cm) at 45 DAP and 60 DAP was obtained in control × 2.5 cm (34.89 cm) and GA_3 150 ppm × 2.5 cm (39.86 cm) respectively. Whereas, minimum length of longest leaf (cm) at 30 DAP, 45 DAP and 60 DAP was recorded in thiourea 2.0% × 1.5 cm (8.30 cm, 20.23 cm and 24.40 cm), respectively. It may be due to increased biomass production due to application of plant growth regulators. On the other hand, increased sink capacity in large sized corms resulted in increased number and size of corm and cormels. These results are in line with the findings of Dogra *et al.* (2012), Sarkar *et al.* (2014) and Singh *et al.* (2019).

Effect of plant growth regulators and corm size on corm parameters

There was a significant difference in number of cormels/hill, weight of corms/hill (g) and diameter of corm (cm) due to the use of different growth regulators and corm size (Table 2). However, these growth regulators and different grades of corm failed to exert any significant effect on weight of cormels/hill (g) and number of corms/hill. Maximum number of cormels/hill was recorded with thiourea at 1.5% (42.98) which was statistically at par with thiourea at 0.5% (39.15). Weight of cormels/hill (g) was recorded maximum in thiourea at 1.5% (5.90 g) while, minimum was recorded with thiourea at 2.0% (4.08 g). Regarding the parameter number of corms/hill, maximum was obtained with control (1.07) which was higher than all other treatments. Among various treatments, GA3 at 150 ppm resulted in maximum weight of corms/hill (17.60 g) and diameter of corm (3.43 cm) which was statistically at par with GA3 at 50 ppm (17.63 g and 3.37 cm) and GA_3 at 100 ppm (16.39 g and 3.31 cm) and minimum was obtained with thiourea at 2.0% (9.35 g and 2.81 cm). It may be due to cell division and increased level of carbohydrates due to application of plant growth regulators. Availability of longer growing period as the days for sprouting was reduced significantly also provides congenial environment conditions for corm production. These results are in accordance with findings of Bhalla and Kumar (2008), Baskaran *et al.* (2009), Sudhakar and Kumar (2012), Padmalatha *et al.* (2014), Naik and Kuchi (2019) and Thapa *et al.* (2019).

Among different grades of gladiolus, maximum weight of corms/hill (18.74 g) and diameter of corm (3.50 cm) was obtained with grade 2.5 cm which was statistically at par with grade 2.0 cm (17.25 g and 3.38 cm) and minimum was obtained with grade 1.0 cm (9.65 g and 2.81 cm). Maximum number of corms/hill was recorded with grade 2.5 cm (1.07) which was statistically higher than all other grades. Maximum number of cormels/hill and weight of cormels/hill (g) was obtained in grade 2.0 cm (37.31 and 5.75 g) while, minimum was recorded in grade 1.0 cm (29.18 and 4.32 g). It may be due to the increased sink capacity in large sized corms which resulted in increased number and size of corm and cormels. Similar results were reported by Bankar and Mukhopadhyay (1980), Singh (2000), Sharma and Gupta (2003), Bhat *et al.* (2009) and Kareem *et al.* (2013).

Interaction effect

The interaction between plant growth regulators and corm size was found to be significant in weight of cormels/hill (g), weight of corms/hill (g) and diameter of corm (cm) while non-significant in number of cormels/hill and number of corms/hill (Table 2). Significantly maximum number of cormels/hill was found in thiourea 1.5% × 1.5 cm (52.83) while minimum was in GA3 150 ppm × 1.0 cm (16.67). Regarding weight of cormels/hill (g), maximum was obtained in thiourea 1.5% × 1.5 cm (8.32 g) which was statistically at par with thiourea 0.5% ×2.0 cm (7.79 g) and minimum was in GA3, 150 ppm × 1.0 cm (2.02 g). Maximum number of corms/hill was obtained in control × 2.5 cm (1.28) which was statistically higher than other treatment combinations. Maximum weight of corms/hill (g) was obtained in GA3 150 ppm × 2.5 cm (24.03 g) which was statistically at par with GA3 100 ppm × 2.5 cm (23.44 g), GA3 150 ppm × 2.0 cm (22.24 g), thiourea 0.5% × 2.5 cm (21.94 g), GA3 50 ppm × 2.5 cm (21.78 g), control × 2.0 cm (18.90 g), control × 2.5 cm (18.86 g), thiourea 0.5% × 2.0 cm (18.78 g) and minimum was found in GA3 100 ppm × 1.0 cm (9.54 g). Diameter of corm (cm) was found to be maximum in GA3 150 ppm × 2.5 cm (3.84 cm) which was statistically at par with GA3 150 ppm × 2.0 cm (3.80 cm), GA3 100 ppm × 2.5 cm (3.79 cm), GA3 50 ppm × 2.5 cm (3.79 cm), thiourea 0.5% × 2.5 cm (3.77 cm), control × 2.5 cm (3.58 cm), control × 2.0 cm (3.57 cm), GA3 50 ppm × 1.5 cm (3.53 cm), thiourea 0.5% × 2.0 cm (3.52 cm) and minimum was in thiourea 2.0% × 1.5 cm (2.57 cm). It might be due to more dry matter accumulation and mobilization in the propagules resulting in increased number and weight of the corms and cormels. GA3 and thiourea treatment promotes extensive growth of intact plants and thereby promoting the corm characteristics. These results are in accordance with the findings of Dogra *et al.* (2012), Sarkar *et al.* (2014), Slathia *et al.* (2015) and Methela *et al.* (2019).

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