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Short communication

Response of various chemicals on mature pollen grain for effective pollination in gladiolus

L.N. Mahawer*, R.L. Misra and A.K. Shukla**
Department of Horticulture, Maharana Pratap University of Agriculture and Technology, Udaipur 313 001, Rajasthan

Gladiolus is an important cut flower belongs to family Iridaceae, native form South Africa in the cape region. It has the chromosome number of 2n = 30-120 and among the bulbous ornamental grown commercially in India and abroad for its colorful spikes having long vase-life. It is also used in making bouquets and flower arrangement. There are different opinion of scientists about the best performing hybrid and cultivar of gladiolus, which could not set seeds and cannot be utilized effectively as female parent. Cultivars like Dhanvantari with another cv. Viola as male parent in hybridization programme does not set. Keeping in view the present investigation was carried out to see the effect of different chemicals/ treatments on seed set in sterile female parent genotype.

The study was carried out during 2005-06 and 2006-07 at Research Farm of the Department of Horticulture, Maharana Pratap University of Agriculture & Technology, Udaipur, which is situated at an elevation of 559.65 m above mean sea level at latitude of 24°N and longitude of 75°E. Experiment was planned with 12 treatments in randomized block design with four replications having seven corms of cv. Dhanvantari. This was chosen as female parent as it could not set seed under natural conditions. Cultivar Viola was utilized as a male parent for mature pollen grains, which were collected after anther dehiscence. The flowers were emasculated at bud stages before anthesis and covered with perforated butter paper bags for pollination. Hand pollination was carried out 24 h after anthesis (at receptive stage of stigma) after treating the mature pollen grains with three different chemicals like; GA_3, proline and sucrose. Details of the treatments used were T_0 = control, T_1 = 0.03% proline, T_2 = 0.3% proline, T_3 = 3.0% proline, T_4 = 500 ppm GA_3, T_5 = 1000 ppm GA_3, T_6 = 1500 ppm GA_3, T_7 = 6.0% sucrose, T_8= 8.0% sucrose, T_9= 10% sucrose, T_{10} = 12% sucrose, and T_{11}= 15% sucrose.

After hand pollination the spikes were covered with perforated butter paper bags to avoid undesirable pollination. Observations were recorded on number of capsule set per spike, number of seeds per capsule and weight of seeds per capsule. The experimental data were analyzed statistically following randomized block design by partitioning sum of square of treatments as suggested by (Snedecor and Cochran, 6). The significance of the treatments was tested by 'F' test (variance ratio). The critical difference was calculated at 5% level of significance.

Perusal of data presented in Table 1 reveal that during 2005-06, 1000 ppm GA_3 (T_5) resulted in maximum number of capsule set per spike (0.79) followed by 12% sucrose (T_{10}), *i.e.*, 0.62 and it was minimum under control. During the second year (2006-07), GA_3 1000 ppm (T_5) and 1500 ppm GA_3(T_6) gave maximum number of capsule set per spike, *i.e.*, 1.00 followed by GA_3 500 ppm (T_4), whereas 6% sucrose (T_7) gave minimum number of capsule sets per spike, *i.e.*, 0.33 as compared to control. The treatment GA_3 @ 1,000 ppm provided significantly better capsule setting (0.79 per spike) as compared to other treatments except 12% sucrose (T_{10}), 3% proline (T_3), 0.03% proline (T_1) and GA_3 1,500 ppm (T_6), respectively, which were statistically at par. However, control (T_0) gave very poor response where the number of capsule setting was only 0.16 per spike during 2005-06 and 0.20 per spike in 2006-07. Some treatments of GA_3, *i.e.*, T_5 and T_6 (1,000 & 1,500 ppm) resulted in 33 to 50 per cent parthenocarpic fruits. This character was found to be statistically significant as capsule set ranged from 20 (T_{11} in 2005-06) to 100% (T_6 in 2006-07). The number of capsule set was more with GA_3 treatment @ 1,000 ppm. It was noted that GA_3 application accelerated the pollen tube growth which affect fertilization and seed production. Although 33 to 50% parthenocarpic fruits were also formed under 1,000 and 1,500 ppm GA_3 during 2005-06. Parthenocarpic fruit development has been earlier reported by Mahawer (3) at higher concentration of GA_3 in gladiolus, and Pandey and Sinha (5) in *Solanum melongena* and *Psidium gujava*. Such results have also been reported by Mahawer (3) in *Gladiolus*. Abe *et al*. (1), found that when they used matured pollen extract in *Lilium longiflorum*, which is known to contain high content of GA_{24} and low of GA_{12} probably being a precursor of GA_{24}.

*Corresponding author's E-mail: mahawer68yahoo.co.in
**Ex Project Coordinator, AICRP (Floriculture), Division of Floriculture & Landscaping, IARI, New Delhi 110012

Table 1. Pollination of receptive stigma with various chemically treated pollen grains in gladiolus.

Treatment	Av. No. of capsule set/ spike		Av. No. of seeds/ capsule		Av. wt. of seeds/ capsule (mg)	
	2005-06 (Mean)	2006-07	2005-06 (Mean)	2006-07	2005-06 (Mean)	2006-07
T_0 (control)	0.16 (0.18)	0.20	7.50 (6.50)	5.50	50.0 (9.72)	23.0
T_1 (0.03% proline)	0.54 (0.51)	0.49	9.30 (9.72)	10.12	110.0 (9.72)	58.0
T_2 (0.3% proline)	0.44 (0.63)	0.83	5.47 (9.72)	10.68	80.0 (9.72)	85.0
T_3 (3% proline)	0.58 (0.51)	0.45	6.64 (9.72)	9.19	90.0 (9.72)	42.0
T_4 (500 ppm GA_3)	0.37 (0.66)	0.96	13.39 (9.72)	9.36	130.0 (9.72)	85.0
*T_5 (1,000 ppm GA_3)	0.79 (0.89)	1.00	10.58 (9.72)	9.19	60.0 (9.72)	73.0
*T_6 (1,500 ppm GA_3)	0.54 (0.77)	1.00	5.80 (9.72)	8.65	60.0 (9.72)	65.0
T_7 (6% sucrose)	0.28 (0.30)	0.33	14.55 (9.72)	1.75	80.0 (9.72)	18.0
T_8 (8% sucrose)	0.41 (0.43)	0.45	6.25 (9.72)	4.57	30.0 (9.72)	28.0
T_9 (10% sucrose)	0.41 (0.57)	0.74	14.50 (9.72)	6.04	90.0 (9.72)	46.0
T_{10} (12% sucrose)	0.62 (0.74)	0.87	5.61 (9.72)	7.30	30.0 (9.72)	72.0
T_{11} (15% sucrose)	0.20 (0.30)	0.41	6.37 (9.72)	10.27	30.0 (9.72)	48.0
CD at 5%	0.32	0.28	NS	NS	53.0	47.0

Values in parentheses are mean value of 2005-07.

*These two treatments were observed with parthenocarpic capsules (fruits). The percentage of such fruits was 33% in T_5 and 50% in T_6.

Number of seeds per capsule was found to be non-significant. However, the maximum seed set per capsule was observed in 6.0% sucrose (T7), 10 % sucrose (T9), GA_3 @ 500 ppm (T4), GA_3 @ 1,000 ppm (T5) and 0.03% proline (T1), resulting in 14.55, 14.50, 13.39, 10.58 and 9.30 seeds per capsule, respectively, which were superior over control (7.5 seeds per capsule). However, the seed set was found to be poorer in 6% sucrose (T7) as compared to control (T0) in second year. Maximum seed set per capsule was observed with 0.3% proline (T2) followed by 15% sucrose (T11) and 0.03% proline (T1), respectively. Although the number of seeds per capsule was found non-significant during both the years of investigation. Treatments 500 ppm GA_3 and 10% sucrose were found most effective as they gave better seed set. This could be due to the active metabolic rate or supplementing the deficient metabolites at the time of requirement, particularly pollen tube growth, which may have caused better seed setting. For instance, during cloudy hours, the amount of sucrose for pollen germination and pollen tube growth may be insufficient and external sucrose supply compensated the requirement. Mahawer (2), and Mahawer and Misra (4) reported 5 and 10% sucrose resulted in 20.70 and 20.85%, whereas and 10% sucrose + 75 ppm boric acid gave slightly better response (21.28%) under *in-vitro* conditions in gladiolus for pollen germination. Similar findings were obtained in gladiolus by Mahawer (3) with GA application.

Proline plays an important role during stress condition especially when temperature is too high, hence was effective during 2006-07 (9.19 to 10.68 seeds per capsule) as the weather during flowering

stage was very hot. Proline treatment negates the adverse effect of high temperature helping in better pollen germination, affecting fertilization and consequently higher seed set. Similar findings were also obtained Mahawer (3) on gladiolus.

During both the years of investigation, GA_3 @ 500 ppm (T4) resulted in higher seed weight, i.e. 130 and 85 mg, respectively during two years. Further, during 2005-06 GA_3 @ 500 ppm (T4) was statistically much superior among many of the treatment but at par to 0.03% proline (T1), 3.0% proline (T3), 10.0% sucrose (T9), 0.3% proline (T2) and 6.0% sucrose (T7). Whereas, during 2006-07 GA_3 @ 500 ppm (T4) was found significantly superior over sucrose 6% (T7) and 8% sucrose (T8) and also over control. However, other treatments during 2006-07 found statistically at par to T4 (500 ppm GA_3). The seed weight per capsule was found to be significant with regard to different pollen treatments except 10% sucrose. However, GA_3 @ 500 ppm, followed by proline @ 0.03% proved highly favourable. GA_3 is a known growth promoter and proline compensates the adverse effects of high temperature, the weight of seeds increased as the size of such seeds was quite bigger. The difference during both the years for this trait was mainly due to seasonal variations at the time of pollination, *i.e.* too high or too low temperature, high relative humidity and cloudy days, all individually and in combination affected seed set adversely. During cloudy weather or poor sunshine, there is very poor photosynthetic activity hence application of sucrose might have compensated this deficiency to some extent. Similarly, proline might have nullified the high temperature effects hence to some extent seed set was restored. It is concluded on the basis of two years mean that the maximum number of capsule set per spike was obtained in 1000 ppm GA_3; number of seeds per capsule and seed weight was registered with 500 ppm GA_3. These treatments would assist in enhancing fruit set in crosses where seeds are obtained in low frequencies.

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