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Effect of Intervarietal Crosses on Seed Setting of Gladiolus (*Gladiolus hybrida* L.) under southern Rajasthan

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ABSTRACT

Thirty- five intervarietal crosses of gladiolus were tested separately in RBD, each with 3 replication in the ACRIP Floriculture, Department of Horticulture, RCA, Horticulture farm Udaipur from 2019-20. The objective of the study was to find the potentially of seed set in different crosses. Under intervarietal crosses, high capsule set per spike resulted in 'H₁₁ - ♀ GS-2 × ♂ Arka Amar (5.42), H₁₂ - ♀ GS-2 × ♂ Priscella (5.35), H₁ - ♀ Anglia × ♂ Priscella (5.16), H₁₃ - ♀ GS-2 × ♂ Punjab Beauty (5.14), H₉ - ♀ Chandani × ♂ Punjab Beauty (5.10), H₂₄ - ♀ Pusa Gunjan × ♂ Arka Kesar (5.10) and H₂₅ - ♀ Pusa Gunjan × ♂ Arka Pratham (5.00) per spike., but 'H₃ - ♀ Arka Amar × ♂ Arka Kesar (1.34), H₁₈ - ♀ Punjab Beauty × ♂ GS-2 (1.40) and H₃₃ - ♀ Pusa Subham × ♂ Nathan Red (1.50) produced the lowest capsule set per spike. 'H₁₃ - ♀ GS-2 × ♂ Punjab Beauty' resulted the highest weight of capsule per spike (70.22 g) followed by 'H₁₁ - ♀ GS-2 × ♂ Arka Amar' (61.75g). While the lowest in cross 'H₃ - ♀ Chandani × ♂ Arka Amar' (13.91 g). 'H₂₅ ♀ Pusa Gunjan × ♂ Arka Pratham' produced maximum number of seed per capsule (55.00) followed by 'H₁₁ - ♀ GS-2 × ♂ Arka Amar' (54.00). While 'H₃ - ♀ Arka Amar × ♂ Arka Kesar' the poor seed setting (9.00). The maximum number of seed set per spike in 'H₁₁ - ♀ GS-2 × ♂ Arka Amar' (298.10) followed by the cross H₂₄ - ♀ Pusa Gunjan × ♂ Arka Kesar (239.70), whereas lowest number of seed set per spike in 'H₃ - ♀ Arka Amar × ♂ Arka Kesar' (12.06). 'H₂₅ - ♀ Pusa Gunjan × ♂ Arka Pratham' gave highest seed weight per capsule (2.10 g), while lowest in 'H₃₀ ♀ Pusa Kiran × ♂ Punjab Beauty (0.30)'. 'H₂₅ - ♀ Pusa Gunjan × ♂ Arka Pratham' produced highest seed weight per spike (10.6 g) followed by 'H₁₁ - ♀ GS-2 × ♂ Arka Amar' (8.8 g) and 'H₁₈ - ♀ Punjab Beauty × ♂ GS-2' produced lowest seed weight per spike (0.9 g)

Key words: Capsule, Seed, Spike, Intervarietal hybrid

Introduction

Gladiolus (*Gladiolus hybrida* L.) is also known as sword lily belongs to the family Iridaceae and sub family Ixoideae is an ornamental bulbous plant native from South Africa. It is one of the most popular ornamental bulbous plants grown commercially for its fascinating cut flowers in many parts of the

world. This is a slender herbaceous perennial with sword shaped leaves, grown in pots, beds, borders, gardens and floral decorations due to its majestic cut spikes, varied florets number, shape, size and colour grown for cut flower and corm production. Genus gladiolus contains basic chromosome number is n=15. Ploidy levels ranges from diploid (2n=30) to dodecaploid (2n=180). The modern garden gladi-

olus is a complex hybrid from at least 12 species and most of the cultivars are tetraploids ($2n=60$) and highly heterozygous, they will not breed true to type if grown from seeds due to cross pollination by honey bees. The genus gladiolus has 255 species over the world. (Goldblatt and Manning 1998). In the cut flower trade, gladiolus rank fourth in the International market after the rose, carnation and chrysanthemum (Rathod *et al.* 2011).

Gladiolus genotypes exhibit great variability in respect of days to flower, time of anthesis, anther dehiscence and stigma receptivity. The anthers dehisce within 3-4 hours after unfurling of the perianth with most of the pollen falling down on the ground or landing on the lower tepals or lip of the floret. The position of the stigma is above anther and is not receptive until it becomes feathery. Asynchrony in such flower characteristics could be an impediment to plant breeders for hybridization. Therefore, the knowledge of floral biology is the pre-requisite for undertaking hybridization programme so that maximum number of viable seeds in capsule may be produced in shortest possible time (Poon *et al.*, 2009; Mahawer and Misra, 1993). Hybridization in gladiolus is carried out to develop new cultivars with improved trait like spike length, novel colour, desired size florets per spike, compactness and vase life. Symmetrical arrangements of the florets on spike, high rate of corm, cormels multiplication, resistance to biotic and abiotic stress with desirable traits. Gladiolus is propagated both sexually by seeds and asexually by corm and cormels. Seed propagation is followed to evolve new cultivars. The plants raised from seeds require four seasons to come to bloom under ordinary conditions and under the best cultural treatments it may be reduced to two seasons (Misra, 1978). Commercially F_1 hybrid cultivars become popular and important for better flower production. Hybrids generally show vigorous growth, uniformity, distinctness, stability behaviour, earliness, resistance to biotic and abiotic stress with other desirable traits. The study on the potentiality of seed set in intervarietal crosses is one of the most important prerequisites for successful breeding program, for extremely low seed set in a few intervarietal crosses are apparently realized major problems in bulbous flowers including gladiolus (Van Tuyl, 1997).

Nowadays, most of the gladiolus cultivars are developed from inter-varietal hybridization among

several varieties. Hence, wide variation is exhibited among the cultivars for their growth, shape, spike length, floret colour and corm multiplication ability.

Materials and Methods

The experiment was conducted under field condition in Rajasthan College of Agriculture, Horticulture farm, MPUAT, Udaipur, from February 2020 to July 2021. A total thirty-five intervarietal crosses: Anglia \times Pricella, Anglia \times Punjab Beauty, Arka Amar \times Arka Kesar, Chandani \times GS-2, Chandani \times Pusa Gunjan, Chandani \times Praha, Chandani \times Pricella, Chandani \times Punjab Beauty, Green Spire \times Australian Fair, GS-2 \times Arka Amar, GS-2 \times Pricella, GS-2 \times Punjab Beauty, Mohini \times GS-2, Punjab Beauty \times Anglia, Punjab Beauty \times Arka Kesar, Punjab Beauty \times Friendship, Punjab Beauty \times GS-2, Punjab Beauty \times Punjab Glad-2, Punjab Beauty \times Pusa Gunjan, Punjab Beauty \times Praha, Punjab Dawn \times Praha, Pusa Gunjan \times Anglia, Pusa Gunjan \times Arka Kesar, Pusa Gunjan \times Arka Pratham, Pusa Gunjan \times Dhanvantri, Pusa Gunjan \times Mohini, Pusa Gunjan \times Punjab Beauty, Pusa Gunjan \times Pricella, Pusa Kiran \times Punjab Beauty, Pusa Kiran \times Pusa Gunjan, Pusa Subham \times Arka Pratham, Pusa Subham \times Nathen Red, Pusa Subham \times Pusa Sinduri, Pusa Subham \times Pusa Srijan were carried out in Randomized Complete Block Design with three replication in the consecutive years 2019-20. Emasculation was carried out by removal of unwanted petals, buds and anthers, keep only six emasculated bud show colour stage start unfurling. It was done on 6 floral bud on spike in morning 9 AM to 11 AM. Emasculated floral bud have cover with perforated butter bags to avoid contaminated pollinated. After 24 hours of emasculation pollen grains were dusted on receptive stigma by means of continuous pollination. After pollination, the flower were bagged with perforated butter bags and tagged with labels mentioning the ♀ and ♂ parents and date of pollination on attempted crosses. The covers were removed after ensuring proper capsule set. The F_1 capsule were harvested at full physiological maturity, when capsule turn green to brown colour each individual cross was harvest by hand. Observation were recorded on established parameter: capsule set per spike, capsule weight per spike (g), seed set per capsule, seed set per spike, seed weight per capsule and seed weight per spike.

Results and Discussion

The data on capsule set per spike, capsule weight per spike (g), seed set per capsule, seed set per spike, seed weight per capsule and seed weight per spike were significant due to the effect on intervarietal crosses, in the year 2019-20 (Table 1).

Capsule set per spike 'H₁₁ (GS-2 × Arka Amar)' recorded maximum number of capsule set, i.e. (5.42) followed by 'H₁₂ (GS-2 × Pricella)' 5.35, 'H₁ (Anglia

× Pricella)' 5.16, 'H₁₃ (GS-2 × Punjab Beauty)' 5.14, 'H₉ (Chandani × Punjab Beauty)' 5.10, 'H₂₄ (Pusa Gunjan × Arka Kesar)' 5.10 and 'H₂₅ (Pusa Gunjan × Arka Pratham)' 5.00 per spike whereas, 'H₃ (Arka Amar × Arka Kesar)' recorded minimum number of capsule set per spike i.e. 1.34, followed by 'H₁₈ (Punjab Beauty × GS-2)' 1.40 and 'H₃₃ (Pusa Subham × Nathan Red)' 1.50. Capsule weight per spike among the crosses the highest weight of capsule per spike was observed in H₁₃ (GS-2 × Punjab

Table 1. Performance of the crosses among different varieties on capsule set, capsule weight, seed set and seed weight in gladiolus

Sr. No.	Intervarietal Crosses	Capsule per spike	Capsule wt. spike ⁻¹ (g)	Seed set per capsule	Seed set per spike	Seed wt ⁻¹ capsule (g)	Seed w ⁻¹ spike (g)
1	Anglia × Pricella	5.16	25.00	26.00	135.20	0.70	4.00
2	Anglia × Punjab Beauty	3.20	17.70	19.00	60.80	0.60	2.00
3	Arka Amar × Arka Kesar	1.34	14.14	9.00	12.06	0.75	1.00
4	Chandani × Arka Amar	3.15	13.91	18.00	56.70	0.48	1.50
5	Chandani × GS-2	2.50	14.85	11.00	27.50	1.00	2.50
6	Chandani × Pusa Gunjan	2.30	15.46	10.00	23.00	0.65	1.50
7	Chandani × Praha	2.15	14.69	9.00	19.35	0.45	1.00
8	Chandani × Pricella	2.24	15.50	17.00	38.08	0.90	2.00
9	Chandani × Punjab Beauty	5.10	17.29	28.00	142.80	0.58	3.00
10	Green Spire × Australian Fair	3.10	18.51	19.00	59.09	0.85	2.70
11	GS-2 × Arka Amar	5.42	61.75	54.00	298.10	0.62	8.80
12	GS-2 × Pricella	5.35	39.19	50.00	187.25	1.50	8.00
13	GS-2 × Punjab Beauty	5.14	70.22	49.00	210.74	1.36	7.00
14	Mohini × GS-2	4.04	20.55	27.00	109.08	0.36	1.50
15	Punjab Beauty × Anglia	4.00	17.56	23.00	92.00	0.32	1.30
16	Punjab Beauty × Arka Kesar	2.80	20.82	25.00	70.00	0.54	1.50
17	Punjab Beauty × Friendship	3.20	18.32	33.00	105.60	0.88	2.80
18	Punjab Beauty × GS-2	1.40	14.14	11.00	15.40	0.64	0.90
19	Punjab Beauty × Punjab Glad-2	4.08	40.74	54.00	220.32	1.22	5.00
20	Punjab Beauty × Pusa Gunjan	2.20	18.03	23.00	50.60	0.60	1.40
21	Punjab Beauty × Praha	3.20	20.60	22.00	70.40	0.56	1.80
22	Punjab Dawn × Praha	2.80	18.08	22.00	61.60	0.52	1.50
23	Pusa Gunjan × Anglia	4.23	22.34	45.00	190.35	0.52	2.20
24	Pusa Gunjan × Arka Kesar	5.10	44.07	47.00	239.70	1.12	5.70
25	Pusa Gunjan × Arka Pratham	5.00	58.50	55.00	200.00	2.10	10.60
26	Pusa Gunjan × Dhanvantri	4.30	31.23	37.00	160.20	0.92	4.00
27	Pusa Gunjan × Mohini	4.45	39.56	27.00	120.15	1.24	5.50
28	Pusa Gunjan × Punjab Beauty	4.70	36.65	23.00	108.10	1.03	4.80
29	Pusa Gunjan × Pricella	1.90	15.31	20.00	38.00	1.11	2.10
30	Pusa Kiran × Punjab Beauty	4.20	16.21	25.00	105.00	0.30	1.20
31	Pusa Kiran × Pusa Gunjan	3.56	17.81	21.00	74.76	0.34	1.10
32	Pusa Subham × Arka Pratham	4.34	22.76	31.00	134.54	0.40	1.80
33	Pusa Subham × Nathan Red	1.50	14.17	19.00	28.50	0.95	1.40
34	Pusa Subham × Pusa Sinduri	2.24	15.62	17.00	38.08	0.54	1.20
35	Pusa Subham × Pusa Srijan	3.58	18.93	28.00	100.24	0.32	1.10
	SEM±	0.05	0.34	0.37	1.77	0.01	0.13
	CD (P=0.05)	0.13	0.96	1.04	5.00	0.04	0.36
	CV (%)	2.24	2.35	2.34	2.98	3.15	7.41

Beauty) 70.22g followed by H₁₁ (GS-2 × Arka Amar) 61.75g and H₂₅ (Pusa Gunjan × Arka Pratham) 58.50g. Whereas, the lowest weight of capsule per spike was recorded in cross H₃ (Chandani × Arka Amar) 13.91 g, H₃ (Arka Amar × Arka Kesar) 14.14 g, H₁₈ (Punjab Beauty × GS-2) 14.14 g, H₃₃ (Pusa Subham × Nathan Red) 14.17 g, H₇ (Chandani × Praha) 14.69, H₅ (Chandani × GS-2) 14.85g. Seed set per capsule. Among the crosses the highest number of seed per capsule produced by the cross H₂₅ ♀ Pusa Gunjan × ♂ Arka Pratham (55.00) followed by H₁₁ ♀ GS-2 × ♂ Arka Amar (54.00), H₁₉ ♀ Punjab Beauty × ♂ Punjab Glad-2 (54.00), respectively. While the poor seed setting was observed by the cross H₃ ♀ Arka Amar × ♂ Arka Kesar (9.00), H₇ ♀ Chandani × ♂ Praha (9.00), H₅ ♀ Chandani × ♂ GS-2 (11.00) and H₁₈ ♀ Punjab Beauty × ♂ GS-2 (11.00). Among the crosses the highest number of seed set per spike produced by the cross H₁₁ ♀ GS-2 × ♂ Arka Amar (298.10) followed by the cross H₂₄ ♀ Pusa Gunjan × ♂ Arka Kesar (239.70), H₁₉ ♀ Punjab Beauty × ♂ Punjab Glad-2 (220.32), H₁₃ ♀ GS-2 × ♂ Punjab Beauty (210.74) and H₂₅ ♀ Pusa Gunjan × ♂ Arka Pratham (200.00), Whereas lowest number of seed set per spike produced by the cross H₃ ♀ Arka Amar × ♂ Arka Kesar (12.06) and ♀ Punjab Beauty × ♂ GS-2 (15.40) respectively during 2019-20. Among the crosses highest seed weight per capsule was produced by the cross H₂₅ ♀ Pusa Gunjan × ♂ Arka Pratham (2.10 g) followed by H₁₂ ♀ GS-2 × ♂ Pricella (1.50 g), H₁₃ ♀ GS-2 × ♂ Punjab Beauty (1.36 g), Whereas lowest seed weight per capsule was produced by the cross H₃₀ ♀ Pusa Kiran × ♂ Punjab Beauty (0.30), H₃₅ ♀ Pusa Subham × ♂ Pusa Srijan (0.32 g), H₃₄ ♀ Pusa Kiran × ♂ Pusa Gunjan (0.34 g). Among the crosses between ♀ & ♂ parents for the character seed weight per spike. Among the crosses highest seed weight per spike was recorded the cross H₂₅ ♀ Pusa Gunjan × ♂ Arka Pratham (10.6 g) followed by H₁₁ ♀ GS-2 × ♂ Arka Amar (8.8 g), H₁₂ ♀ GS-2 × ♂ Pricella (8.0 g) and H₁₃ ♀ GS-2 × ♂ Punjab Beauty (7.0 g). While the lowest seed weight per spike was observed by the cross H₁₈ ♀ Punjab Beauty × ♂ GS-2 (0.9 g) and H₃ ♀ Arka Amar × ♂ Arka Kesar (1.0 g). Poon *et al.* (2009) are quite different from that of the recent study most presumably due to the inclusion of different genotypes as male parents in crosses, As low temperature and low light intensity leading to the activation of inhibitors in pollen tube, occurrence of flower abortion, and inclusion of variety are responsible factors to cause

impediments in getting success of capsule and seed set in intervarietal crosses of flower bulbs. The success of hybridization depends on the selection of parents and their genotype Michurinsk (2014). During cloudy weather or poor sunshine, there was very poor photosynthetic activity hence the amount of sucrose for pollen germination and pollen tube growth may be insufficient Mahawer *et al.* (2011). Limited resources availability within the plant could also cause very low fruit set (Pyke, 1982). Poor sink capacity leading to improper translocation of resources and lack of fertilization despite abundant pollen grains could be a reason for low or no fruit set.

Poon *et al.* (2012) found similar results in capsule harvest and seed setting per capsule in gladiolus. Anandhi *et al.* (2013) corroborate the findings same as pod setting in *Gloriosa superba*. Mahato and Gantait (2020) demonstrated similar results on seed setting behaviour of some gladiolus genotypes through cross pollination. Takatsu *et al.* (2005) reported the germination rates of the gladiolus F₁ seeds ranged from very low to high percentage. Hossain *et al.* (2012) also observed variations for number of seed per capsule and weight of thousand seed.

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