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Genetic variability studies in gladiolus (*Gladiolus grandiflora* L.)

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Abstract

The present investigation on “Genetic variability studies in Gladiolus [*Gladiolus grandiflora* (L.)]” was carried out during the year 2018-19. The experiment was conducted at Departmental research field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) during 2018-19. The experiment was conducted in Randomised Block Design (RBD), with 10 treatments representing the cultivars of gladiolus. The varieties are V₁: American Beauty, V₂: Souvenir, V₃: Ecohonder, V₄: Little Prince, V₅: Her Majesty, V₆: Candymon Dark Vermilion, V₇: Thumbelina Pure White, V₈: Summer Sunshine, V₉: Chipper White, V₁₀: Orange. The genotypes Little prince followed by Her Majesty, Orange, Ecohonder produced higher spikes yield per plot. The high magnitude of heritability (in broad sense) coupled with high genetic gain was observed for most of traits exhibiting additive genetic effect. Highest GCV and PCV were corded for spike yield per plot (86.73, 86.74 respectively), high GCV and PCV for days taken for sprouting of corms (15.57, 19.64 respectively).

Keywords: Gladiolus, genetic variability, heritability and correlation

Introduction

The beauty of flowers has attracted attention of mankind from very beginning of the civilization. In an ancient and religious country like India, flowers are intricately associated with almost all social celebrations and festivals in one or the other way. They embody love, beauty, purity, respect and homage. It is a popular saying that flowers are associated with human being from birth to death. Flowers are frequently used as cut-flowers for bouquets, vases and flower arrangements for interior decorations, and as loose flowers for garland, *gajra*, *wangoli* and *veni* making along with uses in worshipping, flower showers in receptions, weddings, etc. In the modern era, floriculture is gaining importance as a good source of income apart from giving pleasure and happiness. In this regard, gladiolus (*Gladiolus* spp.) has gained much importance as a cut flower or for garden display.

Gladiolus is very rich in its varietal wealth and exhibits enormous variability (Kumar and Yadav, 2005)^[7]. The main objective of gladiolus growers is to find out the suitable variety to a particular region to produce best quality spikes, corms and cormels at the time when the market demand is high.

A knowledge of the estimates of genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2) and genetic advance as percentage of mean (GAM) would help the breeder in selection of appropriate breeding methods. The interaction of number of component characters may result in boosting the yield of the crop. Considering all these points, an attempt has been made on different Gladiolus varieties for variability studies

Materials and Methods

The experiment was conducted in Randomised Block Design (RBD) with 10 treatments representing the cultivars of gladiolus with three replications in the research field of Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) during October to March 2018-19. The number of treatments are 10 viz V₁-American beauty, V₂- Souvenir, V₃-Ecohonder, V₄- Little prince, V₅-Her Majesty, V₆-Candymon dark vermilion, V₇-Thumbelina pure white, V₈ - Summer sunshine, V₉- Chipper white, V₁₀- Orange were used.

Climatic condition in the experimental site

The area of Prayagraj district comes under subtropical belt in the South east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46 °C- 48 °C and seldom falls as low as 4 °C-5 °C.

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The relative humidity ranges between 20 to 94%. The average rainfall in this area is around 1013.4 mm annually. However, occasional precipitation is also not uncommon during winter months.

Results and Discussion

The present investigation entitled “Genetic variability studies in gladiolus (*Gladiolus grandiflora* L.)” cultivars at departmental field, Department of Horticulture, SHUATS, Prayagraj. The results obtained along with necessary results is presented are Growth parameters, Flowering and yield parameters, Corm parameters.

Early days taken for corm sprouting was observed in Her Majesty (v5) (8.00days) and Thumbalina Pure White (8.00 days) followed by Candymon Dark Vermilion (V6) (9.67 days), whereas maximum number of days taken for corm sprouting where observed in Orange (v10) (12.67 days) followed by American Beauty (V1) (12days). Jamil *et al.* (2002) [2] reported that gladiolus cultivar Wine and Roges showed earlier sprouting of corms (19.50 days), whereas Victor Broge (29.80 days) was late.

Maximum plant height at 60 DAP was observed in Thumbalina Pure White (V7) (72.79cm) followed by Chipper White (V9) (70.95cm), where the minimum height in Summer Sunshine (v8) (60.45cm) followed by Souvenir (V2) (60.47cm).

At maturity the highest plant height (98.74 cm) was recorded by Candymon Dark Vermilion followed by Her Majesty (98.59cm). The minimum plant height was recorded by Ecohonder (70.13 cm) at maturity. Kishan (2010) [5,6] reported that maximum plant height was recorded in Dhanvantri (130.21 cm), followed by Anjali (123.88 cm) genotypes of gladiolus, whereas „Sylvia“ was the shortest with a plant height of 76.11 cm.

At maturity the maximum number of leaves per plant was recorded by chipper white (12.44) followed by Orange (12.11) whereas, the minimum number of leaves per plant was observed in Her Majesty (9.55) followed by American Beauty (10.11).

The minimum number of days taken for spike initiation was observed in Little Prince (70.33 days) followed by Her Majesty (70.33 days). The highest number of days taken for spike initiation was observed in *American Beauty* (80.67 days) which was on par with Summer Sunshine (75 days). Lepcha *et al.* (2007) [8] reported that gladiolus cultivar Charms Flow was the earliest to give first spike (56.75 days) followed by cultivar Pacifica (65.75 days); while the cultivar Priscilla took maximum duration (81.00 days) for spike initiation.

The least number of days taken for basal floret to fully open was observed in Candymon Dark Vermilion (79 days) which was statistically on par with Her Majesty (80 days). The maximum number of days taken for basal floret to fully open was recorded in *American Beauty* (91 days) which is followed by Orange (86 days). An experiment was undertaken by Kamble *et al.* (2004) [4] to evaluate gladiolus cultivars for flowering and flower quality and among the nine cultivars studied cv. Snow White (66.70) takes less number of days to first floret opening followed by American Beauty (68.13) while cv. Magic (98.13) took more number of days.

Among the cultivars evaluated spike length was highest in Candymon Dark Vermilion (78.31cm) followed by Little

Prince (77.07cm). The lowest spike length was observed in *American Beauty* (62.24cm) followed by Souvenir (63.93cm). Gupta *et al.* (2001) [1] evaluated eleven cultivars of gladiolus (*Gladiolus floribundas* L.) in Randomized Block Design with three replications and found that maximum spike length was recorded for cultivar Pacific white (72.5 cm) and minimum for Interpit Bicolor (38.2 cm).

Among the cultivars Orange was observed maximum rachis length (48.96cm) followed by Chipper White (47.96cm). Least rachis length was recorded (40.33cm) in *American Beauty* followed by Summer sunshine (42.70cm). Rao and Janakiram (2006) [12] evaluated the performance of Orchidias along with IIHR- developed cultivars under open field conditions and reported that maximum rachis length was observed in Dhiraj (46.83 cm) and lowest in Taltal (32.94 cm).

Among the gladiolus cultivars under study in respect of number of florets per spike Candymon Dark Vermilion recorded the highest number of florets per spike (17.03) followed by Little Prince (15.44). The least number of florets per spike was recorded in *Ecohonder* (12.11) followed by *American Beauty* (12.22).

Among the various cultivars Orange (2.10) was recorded the maximum number of spikes per plant followed by Thumbalina Pure White (2.00). The minimum number of spikes per plant was observed in *Ecohonder* (1.33) followed by *American Beauty* (1.37). Kamble (2001) [3] revealed that more number of spikes per plant (2.93) was noticed in cultivar Vedanapoli and followed by Syalvia (2.67). The cultivar Trust recorded the least number of spikes plant (1.07).

Among the different cultivars Little Prince (10.70cm) was recorded maximum floret diameter followed by Orange (10.57cm). The minimum floret diameter was recorded by Summer Sunshine (8.23cm) followed by *American Beauty* (8.45cm). According to Pandey *et al.* (2010) [10] gladiolus cultivar Advance Red recorded the maximum (9.67 cm) floret diameter. Minimum was recorded in Sylvia (6.67 cm).

The highest number of corms per plant was recorded by *Ecohonder* (3.00) followed by Thumbalina Pure White (2.50). The minimum number of corms per plant was observed in Orange (1.00). Nair and Shiva (2003) [9] conducted an experiment at Port Blair, to evaluate gladiolus cultivars for cut flower production and recorded that the maximum number of corms per plant were produced by Green Willow (1.60).

Among the various cultivars Little Prince was recorded highest (46.38g) corm weight per plant followed by Her Majesty (44.03g). The minimum corm weight per plant was observed in *American beauty* (35.17g) followed by Thumbalina Pure White (38.14g). Ramachandrudu and Thangam (2008) [11] reported that the weight of the corms per plant was highest (95.87 g) in Wigs Sensation followed by Rose Supreme (45.13 g). The cultivar Dhiraj recorded least corm weight (25.50 g).

The cultivar *Ecohonder* (5.81cm) and Thumbalina Pure White (5.81cm) was recorded the maximum corm diameter. The minimum corm diameter was observed in Orange (3.91cm) followed by Souvenir (4.17cm).

The cultivar Little Prince (46.38) and Her Majesty (44.03) was recorded the maximum spike yield per plot. The minimum spike yield per plot was observed in *American Beauty* (35.17).

Table 1: Mean Performance

Genotypes	Days taken for sprouting	Plant height 30 DAS	Plant height 60 DAS	Plant height 90 DAS	Number of leaves 30 DAS	Number of leaves 60 DAS	Number of leaves 90 DAS	First floret opening	Days taken for spikes emergence	Spikes Length	Rachis length	Number of florets per spike	Floret diameter	Number of spikes per plant	Number of cormels per plant	Corm diameter	Corms weight	Spike yield per plot
American Beauty	12.00	26.60	57.08	72.91	4.27	6.22	10.11	91.00	80.67	62.24	40.33	12.22	8.45	1.37	25.11	6.61	35.17	35.17
Souvenir	11.00	36.34	60.47	74.11	4.22	6.18	10.55	81.67	74.33	63.93	43.87	13.66	9.81	1.40	27.67	4.17	38.55	38.55
Ecohonder	9.67	34.21	64.05	70.13	4.33	6.22	9.55	82.67	74.33	69.76	43.53	12.11	8.54	1.33	31.34	5.81	42.69	42.69
Little Prince	9.67	34.17	63.14	87.37	5.00	7.00	12.00	83.67	73.33	77.07	45.61	15.44	10.70	1.78	34.83	4.91	46.38	46.38
Her Majesty	8.0s0	44.45	67.35	98.59	4.33	6.22	10.33	80.00	70.33	76.87	43.98	14.66	9.82	1.44	32.93	6.35	44.03	44.03
Candymon Dark Vermilion	9.67	42.34	69.79	98.74	4.27	6.21	10.33	79.00	70.33	78.31	44.12	17.03	9.59	1.70	28.67	5.79	39.25	39.25
Thumbelina Pure White	8.00	46.56	72.79	97.23	5.78	6.66	11.89	80.67	72.00	85.79	44.21	14.89	8.49	2.00	32.96	5.81	38.14	38.14
Summer Sunshine	9.00	36.07	60.45	88.35	4.33	6.01	10.22	84.33	75.00	65.82	42.70	13.66	8.23	1.44	29.93	5.75	40.27	40.27
Chipper WSShite	8.00	37.36	70.95	98.53	4.89	7.98	12.44	80.00	70.67	83.30	47.24	15.33	9.75	1.81	31.10	4.91	40.31	40.31
Orange	12.67	34.76	61.92	82.98	4.77	7.11	12.11	86.00	74.00	71.13	48.96	14.89	10.57	2.10	32.12	3.91	43.44	43.44
Mean	9.77	37.29	64.80	86.89	4.62	6.58	10.95	82.90	73.50	73.42	44.46	14.39	9.40	1.64	30.67	5.40	40.82	40.82
SE	0.95	1.37	2.78	7.22	0.42	0.53	0.55	1.59	1.87	2.77	1.99	0.98	0.75	0.23	0.55	0.34	1.03	1.03
CD5%	2.01	2.88	5.84	15.18	0.89	1.12	1.15	3.35	3.92	5.82	4.18	2.06	1.58	0.49	1.16	0.71	2.17	2.17
CV	11.97	4.51	5.26	10.18	11.26	9.92	6.10	2.35	3.11	4.62	5.48	8.35	9.80	17.48	2.20	7.70	3.10	3.10
Max	12.67	46.56	72.79	98.74	5.78	7.98	12.44	91.00	80.67	85.79	48.96	17.03	10.70	2.10	34.83	6.61	46.38	46.38
Min	8.00	26.60	57.08	70.13	4.22	6.01	9.55	79.00	70.33	62.24	40.33	12.11	8.23	1.33	25.11	3.91	35.17	35.17

Table 2: Analysis of variance

Characters	Mean Sum of Squares		
	Replications	Treatments	Error
	(df= 2)	(df= 9)	(df=18)
Days taken for sprouting	1.033	8.300**	1.367
Plant height 30 DAS	1.775	101.658**	2.822
Plant height 60 DAS	3.91	80.62**	11.60
Plant height 90 DAS	20.077	392.300**	78.264
Number of leaves 30 DAS	0.408	0.743*	0.271
Number of leaves 60 DAS	0.622	1.148*	0.426
Number of leaves 90 DAS	1.009	3.221**	0.446
First floret opening	6.400	38.819*	3.807
Days taken for spikes emergence	7.300	28.537**	5.226
Spikes Length	5.418	197.100**	11.521
Rachis length	5.027	17.014**	5.938
Number of florets per spike	1.497	6.831**	1.442
Floret diameter	1.304	2.460**	0.848
Number of spikes per plant	0.02	0.23*	0.08
Number of cormels per plant	0.90	24.95**	0.46
Corm diameter	0.471	2.397*	0.173
Corms weight	3.600	32.955**	1.600
Spike yield per plot	3.600	32.955**	1.600

Characters	Vg	Vp	GCV	PCV	HERTI	GA	GA AS %
Days taken for sprouting	2.31	3.68	15.57	19.64	62.84	2.48	25.42
Plant height 30 DAS	32.95	35.77	15.39	16.04	92.11	11.35	30.43
Plant height 60 DAS	23.01	34.61	7.40	9.08	66.48	8.06	12.43
Plant height 90 DAS	104.68	182.94	11.77	15.57	57.22	15.94	18.35
Number of leaves 30 DAS	0.16	0.43	8.59	14.16	36.76	0.50	10.72
Number of leaves 60 DAS	0.24	0.67	7.46	12.41	36.11	0.61	9.23
Number of leaves 90 DAS	0.92	1.37	8.78	10.69	67.45	1.63	14.86
First floret opening	11.67	15.48	4.12	4.75	75.40	6.11	7.37
Days taken for spikes emergence	7.77	13.00	3.79	4.90	59.79	4.44	6.04
Spikes Length	61.86	73.38	10.71	11.67	84.30	14.88	20.26
Rachis length	3.69	9.63	4.32	6.98	38.34	2.45	5.51
Number of florets per spike	1.80	3.24	9.31	12.51	55.47	2.06	14.29
Floret diameter	0.54	1.39	7.80	12.53	38.79	0.94	10.01
Number of spikes per plant	0.05	0.13	13.69	22.21	38.03	0.28	17.40
Number of cormels per plant	8.1653	8.6209	9.32	9.57	94.72	5.73	18.68
Corm diameter	0.7412	0.9144	15.94	17.70	81.07	1.60	29.56
Corms weight	32.421	34.021	13.95	14.29	95.30	11.45	28.05
Spike yield per plot	1333.74	1334.17	86.73	86.74	99.97	75.22	178.63

Table 3: Phenotypic Correlation

	Days taken for sprouting	Plant height 30 DAS	Plant height 60 DAS	Plant height 90 DAS	Number of leaves 30 DAS	Number of leaves 60 DAS	Number of leaves 90DAS	First floret opening	Days taken for spikes emergence	Spikes Length	Rachis length	Number of florets per spike	Floret diameter	Number of spikes per plant	Number of cormels per plant	Corm diameter	Corms weight	Spike yield per plot	
Days taken for sprouting	1.000	-0.610**	-0.522**	-0.488**	-0.127	-0.057	-0.103	0.684**	0.625**	-0.574**	-0.033	-0.26	0.075	0.046	-0.395*	-0.304	-0.154	-0.044	
Plant height 30 DAS		1.000	0.703**	0.646**	0.305	-0.054	0.17	-0.767**	-0.722**	0.695**	0.154	0.551**	0.092	0.284	0.461*	0.099	0.105	0.276	
Plant height 60 DAS			1.000	0.598**	0.381*	0.204	0.370*	-0.579**	-0.562**	0.791**	0.13	0.431*	0.129	0.286	0.432*	0.02	0.09	0.296	
Plant height 90 DAS				1.000	0.283	0.145	0.391*	-0.460*	-0.606**	0.692**	0.128	0.530**	0.146	0.253	0.375*	0.051	0.143	0.27	
Number of leaves 30 DAS					1.000	0.344	0.449*	-0.058	-0.161	0.571**	0.144	0.222	0.086	0.584**	0.430*	-0.116	0.066	0.387*	
Number of leaves 60 DAS						1.000	0.505**	-0.126	-0.303	0.399*	0.614**	0.226	0.181	0.399*	0.311	-0.343	0.122	0.341	
Number of leaves 90DAS							1.000	-0.146	-0.269	0.444*	0.415*	0.400*	0.331	0.590**	0.449*	-0.547**	0.164	0.492**	
First floret opening								1.000	0.869**	-0.615**	-0.293	-0.501**	-0.156	-0.115	-0.36	0.113	-0.172	-0.056	
Days taken for spikes emergence									1.000	-0.697**	-0.452*	-0.534**	-0.329	-0.319	-0.508**	0.177	-0.323	-0.058	
Spikes Length										1.000	0.396*	0.610**	0.26	0.462*	0.590**	0.017	0.236	0.319	
Rachis length											1.000	0.525**	0.412*	0.548**	0.468**	-0.468**	0.400*	0.253	
Number of florets per spike												1.000	0.396*	0.463**	0.308	-0.16	0.182	0.183	
Floret diameter													1.000	0.422*	0.359	-0.463*	0.480**	0.166	
Number of spikes per plant														1.000	0.420*	-0.264	0.116	0.397*	
Number of cormels per plant															1.000	-0.185	0.781**	0.054	
Corm diameter																1.000	-0.247	-0.247	
Corms weight																	1.000	-0.272	
Spike yield per plot																			1.000

Table 4: Genotypic Correlation

	Days taken for sprouting	Plant height 30 DAS	Plant height 60 DAS	Plant height 90 DAS	Number of leaves 30 DAS	Number of leaves 60 DAS	Number of leaves 90 DAS	First floret opening	Days taken for spikes emergence	Spikes Length	Rachis length	Number of florets per spike	Floret diameter	Number of spikes per plant	Number of cormels per plant	Corm diameter	Corms weight	Spike yield per plot	
Days taken for sprouting	1.000	-0.754**	-0.906**	-0.863**	-0.582**	-0.226	-0.097	0.755**	0.703**	-0.768**	0.08	-0.345	0.351	-0.048	-0.528**	-0.420*	-0.168	-0.121	
Plant height 30 DAS		1.000	0.911**	0.861**	0.522**	0.034	0.182	-0.883**	-0.923**	0.744**	0.286	0.638**	0.016	0.404*	0.484**	0.09	0.154	0.304	
Plant height 60 DAS			1.000	0.952**	0.774**	0.612**	0.423*	-0.974**	-1.057**	1.047**	0.597**	0.817**	0.0001	0.711**	0.509**	0.143	0.086	0.452*	
Plant height 90 DAS				1.000	0.578**	0.571**	0.491**	-0.795**	-0.930**	0.909**	0.554**	1.060**	0.258	0.758**	0.495**	0.195	0.169	0.363*	
Number of leaves 30 DAS					1.000	0.813**	1.086**	-0.322	-0.426*	0.889**	0.744**	0.451*	0.05	1.011**	0.777**	-0.199	0.122	0.771**	
Number of leaves 60 DAS						1.000	1.276**	-0.172	-0.362*	0.746**	0.960**	0.581**	0.924**	1.042**	0.521**	-0.638**	0.394*	0.789**	
Number of leaves 90DAS							1.000	-0.143	-0.404*	0.722**	1.137**	0.651**	0.788**	1.161**	0.576**	-0.591**	0.322	0.798**	
First floret opening								1.000	0.989**	-0.722**	-0.363*	-0.696**	-0.253	-0.232	-0.470**	0.095	-0.309	-0.218	
Days taken for spikes emergence									1.000	-0.856**	-0.660**	-0.951**	-0.483**	-0.493**	-0.674**	0.177	-0.534**	-0.282	
Spikes Length										1.000	0.573**	0.772**	0.219	0.839**	0.681**	0.015	0.266	0.439*	
Rachis length											1.000	0.576**	1.150**	1.063**	0.733**	-1.049**	0.735**	0.538**	
Number of florets per spike												1.000	0.761**	0.845**	0.451*	-0.335	0.335	0.256	
Floret diameter													1.000	0.505**	0.506**	-0.872**	0.786**	0.068	
Number of spikes per plant														1.000	0.627**	-0.696**	0.32	0.736**	
Number of cormels per plant															1.000	-0.242	0.847**	-0.021	
Corm diameter																1.000	-0.362*	-0.443*	
Corms weight																	1.000	-0.427*	
Spike yield per plot																			1.000

Conclusion

On the basis of results shown in the present investigation it was concluded that the high magnitude of heritability (in broad sense) coupled with high genetic gain was observed for most of traits exhibiting additive genetic effect. Highest GCV and PCV were recorded for spike yield per plot (86.73, 86.74 respectively), high GCV and PCV for days taken for sprouting of corms (15.57, 19.64 respectively). lowest GCV and PCV were recorded for days taken for spikes emergence (3.79, 4.90 respectively). The genotypes Little prince followed by Her Majesty, Orange, Ecohonder produced higher spikes yield per plot which indicated that these genotypes may be down for higher yield and indicated good response to selection owing to their high heritability, variability and genetic advance showing additive gene effect. These genotypes can be used for improvement of yield and component traits by selection.

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