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Study on Genetic Variability of Gladiolus (*Gladiolus grandiflorus* L.) Cultivars under Prayagraj Agro-climatic Conditions

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ABSTRACT: The present experiment was carried out from November 2020 to April 2021 in the experimental block of the department of horticulture, Naini Agricultural Institute, SHUATS, Prayagraj. The field experiment was carried out in randomised block design (RBD) with eight genotypes of Gladiolus. The data was observed from five randomly selected competitive plants from each replication for 25 quantitative characters. The genotypes are White prosperity (V1), Advanced red (V2), Strong gold (V3), Jessica (V4), Nightmare (V5), Purple flora (V6), Trade horn (V7), Priscilla (V8). The phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all characters indicating the influence of environment on these characters. High phenotypic and genotypic coefficients of variation was observed for Weight of daughter corm, Number of cormels per hectare, Number of corm per hectare, Number of days taken to first floret open, corm yield/plant, Weight of mother corm, Corm weight. The estimates of heritability varied from high (>60%), moderate (30% - 60%), low (<30%) for different characters under study. It was found high for all the traits except number of florets per spike. The genotypes Jessica followed by White prosperity were identified as high corm yielding and number of corm per hectare and produced higher spikes yield per plot which indicated that these genotypes may be sown 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 the improvement of yield and component traits by selection.

Keywords: GCV, PCV, Heritability, Genetic Advance, and Gladiolus.

INTRODUCTION

Gladiolus (*Gladiolus grandiflorus* L.) is an essential bulbous cut flower prized for its beauty of spikes along with longer vase-life and said to be "Queen of bulbous flower crops". It is native to South Africa belongs to the family Iridaceae. The Latin word 'Gladius' means sword, and hence, it is often called 'sword lily' because of the shape of its leaves. Most of this genus are primarily heteroploid with tiny chromosomes (n=15), contrasting with polyploids (diploid, triploid, tetraploid, pentaploid, hexaploid, and octoploid). It occupies fifth place in the international floriculture trade and fourth position in the bulbous flower trade (Kumar *et al.*, 2018).

The spikes are used in vase arrangements, in bouquets and for indoor decorations. The popularity of this crop as a cut spike is increasing day by day because of its long keeping quality and exhaustive range of colours of the spikes. Gladiolus, the queen of the bulbous ornamentals, is the leading geophytes grown worldwide garden displays. It occupies a pristine place in the garden for its magnificent inflorescence, wide array of colours, and fascinating varieties of different shapes and sizes (Pragya *et al.*, 2010). For modern and industrialised floriculture, there is a dire need to introduce new varieties that efficiently cope with our environment. Genetic variability is an essential factor for heritable improvement in any crop. The variability for various characters is a prerequisite for a plant breeder to develop a tremendous yielding variety. It is vital to study genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2) and genetic advance over a mean (GAM) which would help to encourage the efficiency of selection (Patra *et al.*, 2019; Mishra *et al.*, 2014; Verty *et al.*, 2017).

MATERIAL AND METHOD

Experimental Site. The experiment was conducted at the Departmental research field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, located between 25.87° North latitude 81.15° East altitude. The altitude is 78 meters above the mean sea level and performed in the year 2020-2021.

Genotypes observed. Eight genotypes such as White prosperity, Advanced red, Strong gold, Jessica, Nightmare, Purple flora, Trade horn, Priscilla were used

for the study. The experimental block design is depicted in Fig. 1.

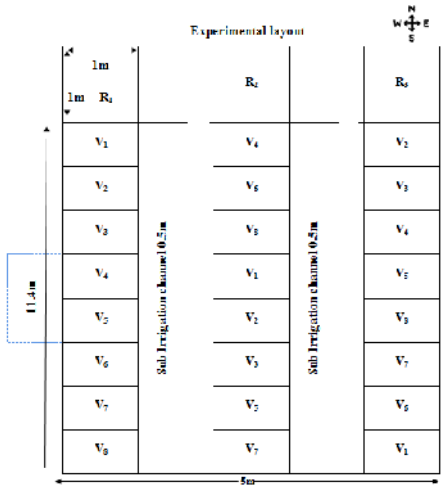

Fig. 1. Layout of experimental field.

Experimental setup. The entire experimental land was divided into subplots measuring 1.0 m × 1.0 m, and there were 24 plots. Bavistin (3g/litre) treated corms were planted on the ridges to a 6-7 cm depth by adopting a 30 × 20 cm spacing. Five randomly selected competitive plants from each replication were used for recording twenty-five quantitative characters.

Parameters observed. The observations were recorded on quantitative characters selected for genetic variability studies such as Plant height at 30, 60, 90 days (cm), Number of leaves at 30, 60, 90 days (cm), number of shoot per plant, Days taken for corm sprouting, Rachis length (cm), Days taken to spike emergence, Days taken colour break stage, Number of floret per spike, Number of spike per plant, Number of days taken for first floret open, Number of days taken for last floret open, Spike length (cm), Floret diameter (cm), Vase life (days), Weight of daughter corm (g), Weight of mother corm (g), Corm diameter (cm), Corm weight (g), number of corm per hectare, number of cormels per hectare and Corm yield/plant (Mishra *et al.*, 2014 ; Balaram and Janakiram 2009 ; Naresh *et al.*, 2015).

Statistical analysis. Data were recorded and averaged were subjected to following statistical analysis, (a) Analysis of variance, (b) Standard error of mean (SEM) (c) Critical difference (C.D.) (d) Test of significance, (e) Mean performance, (f) Range, (g) Estimate of component of variance, Genotypic and Phenotypic variance, (h) Co-efficient of variation, (i) Heritability broad sense, (j) Genetic advance, (k) Correlation coefficient analysis of genotypic and phenotypic.

RESULTS AND DISCUSSION

Analysis of variance showed a significant difference among the different genotypes at 0.1% and 5% significance. The mean sum of squares due to genotype for different characters are presented in Table 1. The performance of the genotypes concerning these characters was statistically different, suggesting scope for growth, flowering and physiological characters improvement in Gladiolus (Patra *et al.*, 2019; Naresh *et al.*, 2015; Mishra *et al.*, 2014; Rahul *et al.*, 2012; (Singh, *et al.*, 2018).

Table 1: Analysis of variance for 25 different growth, flowering and corm yield of Gladiolus.

Sr. No.	Characters	Analysis of Variance		
		Replication df= 2	Genotypes df= 10	Error df= 20
1.	Plant height (cm) 30 DAS	41.765	43.412	8.358
2.	Plant height (cm) 60 DAS	22.753	85.562	14.207
3.	Plant height (cm) 90 DAS	53.400	470.446	48.628
4.	Number of leaves per plant at 30 DAS	0.125	0.613	0.077
5.	Number of leaves per plant at 60 DAS	0.500	0.738	0.167
6.	Number of leaves per plant at 90 DAS	0.125	1.024	0.077
7.	Number of shoot per plant	0.003	0.089	0.015
8.	Number of days for corm sprouting	0.042	3.881	0.042
9.	Rachis length (cm)	48.692	86.725	13.914
10.	Days taken for spike emergence	2.042	228.381	2.042
11.	Days taken for colour break stage	0.167	242.042	0.167
12.	Number of florets per spike	0.001	0.329	0.045
13.	Number of spikes per plant	0.001	0.039	0.007
14.	Number of days taken for first floret open	2.042	1242.095	0.756
15.	Number of days taken to last floret open	0.167	2.185	0.167
16.	Floret diameter (cm)	0.507	3.551	0.637
17.	Spike length (cm)	72.966	418.690	49.117
18.	Vase life (days)	0.042	1.375	0.232
19.	Weight of daughter corm (g)	4654.167	4270.833	1063.690
20.	Weight of mother corm (g)	1404.167	56966.071	3708.929
21.	Cormel diameter (cm)	0.172	0.697	0.049
22.	Corm weight (g)	1379.167	60226.190	6660.119
23.	Number of corm per hectare	717253798.625	5593840827.310**	1018457657.006
24.	Number of cormels per hectare	115475987812.500	9072974610000.000**	31302632812.500
25.	Corm yield/plant	326.186	791.411**	226.067

* & ** Significant at 5% & 1% level of significance

Table 2: Mean performance of 11 genotypes for growth, flowering and corms yield characters of Gladiolus (*Gladiolus grandiflorus* L.).

Genotypes	Plant height (30 das)	Plant height (60 das)	Plant height (90 das)	No. of leaves per plant (30 das)	No. of leaves per plant (60 das)	No. of leaves per plant (90 das)	No. of shoot per plant	Days taken for corm sprouting	Rachis length	Days For Spike emergence	Days for colour break stage	No. of floret per Spike	No. Of spike per plant	No. of days taken for first floret open	No. of days taken for last floret open	Floret diameter	Spike length	Vase life	Corm weight	Weight of mother corm	Weight of daughter corm	Corm diameter	No. Of corm per hectare	No. Of cormels per hectare	Corm yield/plant
White prosperity	37.86	67.69	108.57	4	6.66	8	1.16	4	58.02	82	87	11	1	90	12	11.3	106.78	9	484.33	357	125	3.85	283500.00	7147000.00	101.440
Advanced red	31.81	65.38	102.37	4	6.66	8	1.05	6	46.85	87	94	11.77	1	94.67	13	14.3	113.28	9	350	280	200	3.59	153300.00	2695350.00	53.657
Strong gold	31.81	54.04	98.49	3.66	7.66	8	1.1	6	42.72	79.67	87	11.5	1.11	90.33	13	11.3	91.05	8	710	594	170	4.57	259942.00	4472650.00	89.023
Jessica	43.18	64.72	116.57	3	8	8.33	1.16	3.33	53.27	72	77.33	11.11	1.05	53.33	13	11.57	100.94	8.33	680	607	55	4.78	297500.00	3512250.00	103.370
Nightmare	34.63	61.39	89.26	3	7.33	9.66	1.38	5	44.77	82	87	11.16	1.33	61.67	10.67	11.27	109.29	7.67	813.33	704	105	4.85	25650.00	4472300.00	92.213
Purple flora	37.05	57.04	93.24	4	7.66	8	1.1	3	53.39	71	76	10.89	1.1	52.67	12	11.37	100.78	8.67	626.66	544	70	4.71	251300.00	2074100.00	82.510
Trade horn	36.45	64.91	105.13	4	7	8	1.55	4	54.99	68	76	10.77	1	52.33	13	10.8	84.65	9.67	630	560	75	4.85	263750.00	6146350.00	97.273
Priscilla	39.14	54.47	76.18	3.33	7	8	1.1	4	48.71	61	66	11	1	46.33	13	12	80.76	9.33	620	520	85	4.32	246785.00	3036200.00	76.930
Mean	**36.49125**	**61.205**	**98.72625**	**3.62375**	**7.24625**	**8.24875**	**1.2**	**4.41625**	**50.34**	**75.33375**	**81.29125**	**11.15**	**1.07375**	**67.66625**	**12.45875**	**11.73875**	**98.44125**	**8.70875**	**614.29**	**520.75**	**110.625**	**4.44**	**251578.375**	**4194525**	**87.052**
S.Ed	**1.669**	**2.176**	**4.026**	**0.161**	**0.236**	**0.161**	**0.007**	**0.118**	**2.154**	**0.825**	**0**	**0.085**	**0.125**	**0.25**	**0**	**0.025**	**1.7825**	**0.25**	**47.117**	**48.77819697**	**18.13731109**	**0.170430128**	**18425.14**	**26000.27**	**8.681**
C.D. 5%	**5.063**	**6.601**	**12.213**	**0.487**	**0.373**	**0.487**	**0.215**	**0.358**	**6.533**	**2.502**	**0.71**	**0.37**	**0.15**	**1.52**	**0.71**	**1.39**	**12.27**	**0.84**	**142.930**	**101.234**	**57.12**	**0.38**	**55892.451**	**309864.698**	**26.33**
C.D. 1%	**7.027**	**9.162**	**16.95**	**0.676**	**0.518**	**0.676**	**0.299**	**0.496**	**9.067**	**3.473**	**0.99**	**0.51**	**0.21**	**2.11**	**0.99**	**1.93**	**17.03**	**1.17**	**198.369**	**140.5**	**0**	**0.53**	**77571.947**	**430054.641**	**-**
C.V	**7.922**	**6.158**	**7.0639**	**7.674**	**1.911**	**3.372**	**10.221**	**4.622**	**7.41**	**1.897**	**0.5**	**1.91**	**8.03**	**1.28**	**3.27**	**6.79**	**7.11**	**5.53**	**13.288**	**11.063**	**33.594**	**4.991**	**5.492**	**4.215**	**17.272**

Table 3: Estimating component of variance and genetic parameters for 25 character growth, flowering and corm yield of 8 genotypes in Gladiolus.

Sr. No.	Characters	Mean	Range		Vg	Vp	GCV	PCV	H^2 (%)	GA	GA as (% Mean)
			Max	Min							
1.	Plant height (cm) 30 DAS	36.49	43.18	31.81	11.68	2.04	9.37	12.27	58.30	5.38	14.80
2.	Plant height (cm) 60 DAS	61.205	67.69	54.04	23.78	37.99	7.96	10.07	62.60	7.94	12.98
3.	Plant height (cm) 90 DAS	98.72	116.57	76.18	140.60	189.234	2.01	13.93	74.30	21.05	21.32
4.	Number of leaves per plant at 30 DAS	3.62	4	3	0.17	0.25	11.65	13.95	69.76	0.72	20.05
5.	Number of leaves per plant at 60 DAS	7.24	8	6.66	0.19	0.35	6.01	8.24	53.33	0.65	9.05
6.	Number of leaves per plant at 90 DAS	8.25	10	8	0.31	0.39	6.80	7.59	80.30	1.03	12.56
7.	Number of shoot per plant	1.2	1.55	1.05	0.02	0.03	13.05	16.57	61.98	0.25	21.16
8.	Days taken for corm sprouting	4.41	6	3	1.27	1.32	23.75	23.75	100	2.20	48.93
9.	Rachis length	50.34	63.01	39.95	24.27	38.18	9.78	12.27	63.56	8.09	16.07
10.	Days for spike emergence	75.33	87	61	75.44	77.48	11.53	11.68	97.36	17.65	23.43
11.	Days for colour break stage	81.29	94	66	80.62	80.79	11.04	11.05	99.79	18.47	22.73
12.	Number of floret per spike	11.15	12	10.66	0.09	0.13	2.75	3.35	67.57	0.52	4.66
13.	Number of spike per plant	1.07	1.33	1	0.01	0.01	7.62	14.25	28.59	0.092	8.39
14.	Number of days taken for first floret open	67.66	97	45	413.77	414.53	30.06	30.08	99.81	41.86	61.87
15.	Number of days taken for last floret open	12.45	13	10	0.67	0.83	6.58	7.35	80.14	1.51	12.14
16.	Floret diameter	11.73	14.5	10.2	0.97	1.60	8.74	10.84	65.0009	1.69	14.51
17.	Spike length	98.44	117.76	71.73	123.16	172.27	11.27	13.33	71.49	19.33	19.63
18.	Vase life	8.70	10	7	0.38	0.61	7.08	8.99	62.13	1.002	11.50
19.	Corm weight	614.29	813.33	350	19855.35	20515.47	21.75	25.49	72.83	234.91	38.24
20.	Weight of mother corm	520.75	704	280	17752.38	2140.309	25.60	28.14	82.71	249.62	47.96
21.	Weight of daughter corm	97.08	66	53.33	1069.04	2132.73	33.67	47.56	50.12	47.68	49.11
22.	Corm diameter	4.44	4.85	3.59	0.21	0.26	10.46	11.59	81.48	0.86	19.46
23.	Number of corm per hectare	251578.375	153300	153300	3479139000	4585267000	27.961	32.13	75.70	98.2	50.11
24.	Number of cormel per hectare	4188514.00	714700	2074100	499133000	52973900	37.743	37.97	98.20	97.50	77.27
25.	Corm yield/ plant	78.64	1033.37	47.41	346.38	532.13	23.667	29.334	65.10	30.93	39.33

Genetic parameters like the genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability, genetic advance are useful biometrical tools for the determination of genetic variability (Rahul *et al.,* 2012; Rashmi *et al.,* 2014; Pal *et al.,* 2017; Verty *et al.,* 2017; Choudhary *et al.*, 2011; Kispotta *et al.,* 2017) described in Table 3. The phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the traits studied, indicating that the apparent variation is due to genotype and the influence of the environment. Similar results were reported by Choudhary *et al.,* (2011); Kumar *et al.,* (2019); Mishra *et al.,* (2014); Naresh *et al*., (2015) in Gladiolus. The difference between GCV and PCV gives us an idea about the role of genotypic and environment on the character (Singh *et al*., 2017; Kumar *et al.,* 2018).

Genotypic coefficient of variation (GCV). Genotypic coefficient of variation (GCV) was observed for the characters ranging weight of daughter corm (33.6786) to number of floret per spike (2.7578). High magnitude of GCV was recorded for the weight of daughter corm (33.6786), number of days taken for first floret open (30.0614), the weight of mother corm (25.6022), Days taken for corm sprouting (23.7566), Corm weight (21.757), number of corms per hectare (27.96), number of corms produced per mother corm (27.96), number of shoot/plant (24.904), corms yield/plant (g) (23.66) our findings were supported by Naresh *et al.,* (2015); Swetha *et al.,* (2019); Rahul *et al.,* (2012); Rashmi and Kumar (2014); Verty *et al*.,(2017); Mishra *et al.,* (2014).

Phenotypic coefficient of variation (PCV). A phenotypic coefficient of variation (PCV) was observed for the characters ranging from weight of daughter corm (47.569) to number of floret per spike (3.3549). High magnitude of GCV was recorded for the number of cormels/hectare (37.973), number of cormels/ plant (37.97), corms yield/plant (g) (29.33), the weight of daughter corm (47.569), number of days taken for first floret open (30.0889), the weight of mother corm (28.1499), Corm weight (25.4938), Days taken for corm sprouting (23.7566) similar findings were reported by Kumar *et al.,* (2019) Naresh *et al.,* (2015); Swetha *et al.* (2019); Rahul *et al.,* (2012); Rashmi and Kumar (2014); Verty *et al.,* (2017); Mishra *et al.,* (2014).

Heritability. In the present study, the heritability estimates in a broad sense were classified into three groups such as high (>75%), moderate (60% - 75%), low (<60%). The high heritability in the broad sense was observed for the characters *viz*. Days taken for corm sprouting (100), Number of days taken for first floret open (99.8176), Days taken for colour break stage (99.7937), number of cormels/hectare (98.80), Days taken for spike emergence (97.3652), the weight of mother corm (82.7181), Corm diameter (81.482), Number of leaves at 90 DAS (80.303), number of days taken for last floret open (80.1418), number of corms per hectare (75.70). The current observations support the previous findings observed by Kumar *et al.* (2018); Kispotta *et al.,* (2017); Verty *et al*., (2017); Naresh *et al.,* (2015); Swetha *et al.* (2019); Rahul *et al.,* (2012); Rashmi and Kumar (2014); Mishra *et al., (*2014).

Genetic Advances. The Genetic Advance estimates were found to be high for the weight of mother corm (249.6294), Corm weight (234.9176), number of corms per hectare (98.200), number of cormels/hectare (97.500), corms yield/plant (g) (30.93), the weight of daughter corm (47.6865), Number of days taken for first floret open (41.8654) similar observations were reported by Singh *et al.,* (2017); Verty *et al.,* (2017); Archana *et al.,* (2008); Naresh *et al.,* (2015); Swetha *et al.* (2019); Rahul *et al.,* (2012); Rashmi and Kumar (2014); Verty *et al.,* (2017); Mishra *et al., (*2014); Singh *et al.,* 2017.

Genotypic correlation coefficient. Genotypic correlation coefficient analysis revealed that Corms weight/plant (g) showed a significant positive association with Number of spike per plant (cm) (1.17**), the weight of mother corm (g) (0.99**), Corm diameter (cm) (0.93**), Number of leaves per plant at 60 DAS (0.82*), number of corms per hectare (0.90**) and number of cormels/hectare (0.46**) similar findings were earlier reported by Patra *et al*., (2019); Verty *et al.,* (2017); Rashmi *et al.,* (2016); Mishra *et al.,* 2014; Rahul *et al.,* (2012).

Phenotypic correlation coefficient. Phenotypic correlation coefficient analysis revealed that Corms yield/plant (g) showed a significant positive association with Number of leaves per plant at 60 DAS (0.51*), number of leaves per plant at 90DAS (0.57**), the weight of mother corm (g) (0.97**), Corm diameter (cm) (0.23**). Similar findings were reported by Verty *et al.,* (2017); Rahul *et al.,* (2012); Rashmi *et al.,* (2014); Mishra *et al.,* (2014); Balram and Janakiram, (2009); Singh and Sen (2000); Rahul *et al.,* (2012); Pal *et al.,* (2017).

CONCLUSION

Based on the present investigation, the high magnitude of heritability (in broad sense) coupled with high genetic gain was observed for most traits exhibiting additive genetic effect. It was observed that PCV was higher than GCV for all the traits studied highest GCV and PCV is recorded as the weight of daughter corm (g) (33.6786 and 47.569), number of days taken for first floret open (30.0614 and 30.0889), Weight of mother corm (25.6022 and 28.1499), Days taken for corm sprouting (23.7566 and 23.7566) respectively.

Genotypic and phenotypic correlation coefficient analysis revealed that Corm weight/plant (g) showed a significant positive association with number of leaves per plant at 60 DAS, Weight of mother corm (g), Corm diameter (cm) while the negative association with Number of leaves per plant at 30 DAS and Floret diameter.

The genotypes Jessica followed by White prosperity, Trade horn, Nightmare and strong gold produced higher spike yield per plot, indicating that these genotypes may be shown for higher yield. They indicated an excellent response to selection owing to their high heritability, variability and genetic advance showing additive gene effect.

These genotypes can be used for the improvement of yield and components traits by selection.

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Conflict of Interest. None.

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