

Original Research Article

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Genetic Variability and Heritability Studies in Gladiolus (*Gladiolus grandiflorus* L.)

Suvigya Gautam*, Anita Kerketta and S. S. Sarvanan

Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj, U. P, India

*Corresponding author

ABSTRACT

The genetic materials was consisted of eleven gladiolus varieties in randomized block design (RBD) with three replications was used. Experiment was conducted at Farm of Department of Horticulture at Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences Naini, Prayagraj Uttar Pradesh in *Rabi* season 2019. Mean square due to treatments revealed that significant differences among the genotypes for all the traits except days taken for emergence of flower spike and days taken to show colour of basal floret. The maximum corms yield per plant obtained was American beauty, White prosparity, her majesty and White friendship. High GCV and PCV were exhibited for number of leaves per plant 30 DAS, number of shoot per plant, number of corm produced per mother corm, corms yield per plant, number of cormels per plant, number of cormels per hectare and number of corms per hectare. Therefore, it is concluded that the characters which showed high GCV, PCV and heritability coupled with genetic advance should be considered for direct selection. Here the number of cormels per plant, number of cormels per hectare, number of shoot per plant, vase life, plant height (cm) 90 DAS and plant height (cm) 60 DAS character under study showed high heritability and genetic advance. Thus one should select these characters for direct selection.

Keywords

Gladiolus, Mean performance, Genetic variability and heritability

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Introduction

Gladiolus (*Gladiolus grandiflorus* L.) is an important cut flower in domestic as well as export market (Ganesh *et al.*, 2014). *Gladiolus* is native to South Africa. *Gladiolus* has the basic chromosome number $n=15$. Most member of genus are heteroploids having the very small chromosomes ranging from $2n=30$ to 120 (Singh *et al.*, 2017). It is one of the most important bulbous crops grown commercially for cut flower, bouquets,

floral arrangements, interior decoration and garden display purposes (Lepcha *et al.*, 2007). In this regard gladiolus has gained much importance as it is the 'Queen of bulbous flowers'. The latin word 'Gladius' means sword and hence, it is often called as 'sword lily' because of the shape of its leaves (Mishra *et al.*, 2014). The wild species of gladioli are native to the Mediterranean region, the Middle East, western Asia, Madagascar and (especially) South Africa (Kispotta *et al.*, 2017). *Gladiolus* can be

grown in a particular agro-climatic region all are not suited for cut flower purposes are for garden display or for exhibition purpose (Bhujbal *et al.*, 2013).

Improvement through selection depends upon the variability existing in the available genotypes, which may be either due to different genetic constitution of cultivars or variations in the growing environments (Amrutha *et al.*, 2014). The spikes are used in vase arrangements, in bouquets and for indoor decorations (Swetha *et al.*, 2020). For a modern and industrialized floriculture, there is always demand and necessity of new varieties. So, there is a great challenge for the scientists to get a new dimension for gladiolus cultivation (Sharma *et al.*, 2018).

Materials and Methods

Location and source of experiment

The present investigation was carried out during Rabi season 2019 at Farm of Department of Horticulture at Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences Naini, Prayagraj Uttar Pradesh. The genetic materials were consisted of eleven varieties (Table-1). The experiment was laid out in Randomized Complete Block design (RCBD) with three replications. Uniform sized corms of each variety were planted at spacing 30cm × 20cm on plot size of 1m × 1m. All the recommended package of practices was followed to get a healthy crop.

Results and Discussion

Analysis of variance revealed that significant differences among the genotypes for all the traits except days taken for emergence of flower spike and days taken to show colour of basal floret under study indicating the presence of substantial genetic variability in

Gladiolus (Table-1). Similar results proposed Bhujbal, *et al.*, (2013) Amrutha, *et al.*, (2014), Ganesh *et al.*, (2014) and Kispotta *et al.*, (2020).

Mean Performance of Different varieties

For each of the traits evaluated, the descriptive statistics including the extreme genotype mean values and the means together with their standard errors obtained on the basis of average data are summarized in Table 2. In general, Gladiolus genotypes showed wide range of variability for most of the characters and all the traits exhibited broad spectrum of ranges between the maximum and minimum genotype mean values. For instance, plant height (cm) 30 DAS ranged from 32.90 to 52.56 with mean of 42.72, plant height (cm) 60 DAS ranged from 61.76 to 83.60 with a mean of 72.19, plant height (cm) 90 das ranged varied from 96.76 to 118.46 with mean of 106.83.

Similarly, Number of leaves/plant 30 DAS ranged from 2.05 to 4.86 and number of leaves/plant 90 DAS ranged varied from 9.54 to 13.18 respectively while, number of shoot per plant ranged varied from 1.22 to 2.25 with mean of 1.62. Days for 50% flowering varied from 95.68 to 84.84 with mean of 91.08.

Days taken for emergence of flower spike ranged from 74.08 to 83.22 with mean of 79.28, for days taken to show colour of basal floret ranged varied from 80.83 to 92.64 with mean value of 87.29 and number of florets per spike ranged varied from 9.45 to 14.81 with average value 12.22. Similarly number of spikes per plant ranged varied from 1.23 to 1.88 with mean of 1.48, floret length (cm) from 9.64 to 12.33 with average value of 10.91 and floret diameter (cm) ranged varied from 8.44 to 11.46 with mean of 9.99. Duration of flowering ranged varied from 8.31 to 11.63 with mean of 9.65 and

number of spikes per meter square also ranged varied from 13.44 to 20.60 with mean value of 16.18.

Number of spikes per ha ranged from 1411200.00 to 2163000.00 with mean of 1699218.00, for corm diameter (cm) ranged varied from 4.29 to 7.26 with mean value of 5.30 and vase life (days) ranged varied from 5.33 to 10.25 with average value of 8.01. The maximum Corms yield per plant (g) obtained was American beauty(103.37g) followed by White prosperity (101.44), Her majesty (97.11) and White friendship (92.22) and it ranged varied from 47.41 to 103.37 with mean of 78.64. Thus, it is possible to succeed in improving Corms yield per by direct selection. Similar results reported by Sharma *et al.*, (2018), Singh and Singh (2018), Kumar *et al.*, (2019) and Swetha *et al.*, (2020).

Genetic parameters for different characters in different gladiolus varieties

High GCV and PCV were exhibited for Number of leaves/plant 30 DAS (31.86 and 34.08), number of shoot per plant (24.90 and 25.19), number of corm produced per mother corm (27.96 and 32.13), corms yield per plant (23.67 and 29.34), number of cormels per plant, number of cormels per hectare (37.74

and 37.973) and Number of corms per hectare (27.96 and 32.13).

The moderate genotypic and phenotypic coefficient of variation was recorded for the characters Cormel diameter (18.07 and 19.78) followed by number of leaves per plant 60 DAS (17.45 and 18.57), vase life (17.27 and 17.52), weight of single corm (14.99 and 15.95), Corm diameter (14.91 and 15.87), plant Height (cm) 30 DAS (13.45 and 14.569) and rachis length (11.58 and 13.14). However, lowest GCV and PCV were recorded for days taken for emergence of flower spike (3.52 and 3.89), Days for 50% flowering (3.74 and 4.02), days taken to show colour of basal floret (3.91 and 4.15) and plant height (cm) 90 DAS (5.93 and 6.05).

High estimate of heritability were exhibited for number of cormels per plant (98.80) followed by number of cormels per hectare (98.80), number of shoot per plant (97.70), vase life (97.20), plant height (cm) 90 DAS (96.20) and plant height (cm) 60 DAS (89.90) the character under study. Moderate heritability was expressed in number of spikes per meter square (57.60) followed number of spikes per ha (57.60) and number of spikes per plant (57.50), while none of traits had exhibited lowest heritability.

Table.1 Details of different varieties of Gladiolus

S. No.	Variety symbol	Genotypes	Source
1	V ₁	White Prosperity	Sheel biotech, New Delhi
2	V ₂	Candyman	Sheel biotech, New Delhi
3	V ₃	Friendship pink	Sheel biotech, New Delhi
4	V ₄	American Beauty	Sheel biotech, New Delhi
5	V ₅	True yellow	Sheel biotech, New Delhi
6	V ₆	Her Majesty	Sheel biotech, New Delhi
7	V ₇	Red majesty	Sheel biotech, New Delhi
8	V ₈	Novulax	Sheel biotech, New Delhi
9	V ₉	Advantage	Sheel biotech, New Delhi
10	V ₁₀	Sovenior saffron	Sheel biotech, New Delhi
11	V ₁₁	White friendship	Sheel biotech, New Delhi

Table.2 Mean performance of 11 different varieties for various traits in gladiolus

Varieties	Plant Height (cm) 30 DAS	Plant Height (cm) 60 DAS	Plant Height (cm) 90 DAS	Number of leaves/plant 30 DAS	Number of leaves/plant 60 DAS	Number of leaves/plant 90 DAS	Number of shoot/plant	Days for 50% flowering	Rachis length (cm)	Days taken for emergence of flower spike	Days taken to show colour of basal floret	Number of florets per spike	Number of spikes per plant
White prosparity	52.56	83.60	118.46	2.93	6.81	10.99	1.22	84.84	55.50	74.08	80.83	14.81	1.88
Candy man	45.03	75.35	110.17	4.87	8.86	13.04	1.35	88.15	51.10	76.41	84.74	12.96	1.71
Friendship pink	44.37	73.67	108.57	2.45	6.27	10.50	2.19	92.35	43.50	80.54	88.68	12.18	1.46
American beauty	36.16	65.38	101.17	2.05	5.34	9.54	2.20	89.28	44.70	77.04	85.32	9.45	1.31
True yellow	40.18	69.09	103.42	3.47	7.37	11.56	1.38	93.79	41.19	79.69	88.27	11.75	1.38
Her majesty	46.72	75.83	110.30	4.83	8.94	13.18	2.25	91.86	52.12	80.24	87.92	12.80	1.54
Red majesty	50.47	81.13	114.93	2.20	5.74	9.96	1.52	93.56	46.99	81.25	89.79	11.45	1.40
Novalux	41.58	70.38	105.26	2.27	6.12	10.34	1.71	95.68	42.35	83.22	92.64	12.59	1.55
Advantage	32.90	61.76	96.76	4.62	8.57	12.79	1.35	94.77	40.30	82.71	91.28	11.20	1.46
Sovenior saffron	38.20	67.15	101.65	4.41	8.30	12.57	1.30	91.08	38.64	80.48	87.29	12.58	1.33
White friendship	41.78	70.73	104.47	3.42	7.25	11.52	1.33	86.55	41.36	76.46	83.42	12.64	1.23
Mean	42.72	72.19	106.83	3.41	7.23	11.45	1.62	91.08	45.25	79.28	87.29	12.22	1.48
C.V.	5.60	2.99	1.18	12.10	6.36	4.08	3.81	1.49	6.21	1.67	1.40	3.99	9.80
S.E.	1.38	1.25	0.73	0.24	0.27	0.27	0.04	0.78	1.62	0.77	0.71	0.28	0.08
C.D. 5%	4.07	3.68	2.16	0.70	0.78	0.80	0.11	2.30	4.79	2.26	2.09	0.83	0.25
C.D. 1%	5.56	5.02	2.94	0.96	1.07	1.08	0.14	3.14	6.53	3.09	2.84	1.13	0.34
Range Lowest	32.90	61.76	96.76	2.05	5.34	9.54	1.22	84.84	38.64	74.08	80.83	9.45	1.23
Range Highest	52.56	83.60	118.46	4.87	8.94	13.18	2.25	95.68	55.50	83.22	92.64	14.81	1.88

Varieties	Floret length (cm)	Floret diameter (cm)	Duration of flowering (days)	Number of spikes per meter square	Number of spikes/ha	Number of corm produced per mother corm	Corm diameter (cm)	Weight of single corm (gm)	Corms yield/plant (g)	Number of Cormels /plant	Cormel diameter (cm)	Number of corms per hectare	Number of cormels/ Hectare	Vase life (days)
White propparity	10.46	10.11	9.54	20.60	2163000	2.49	5.31	40.68	101.44	42.60	1.21	261100	4472650	9.57
Candy man	12.33	11.46	10.48	18.72	1965250	1.53	7.26	54.25	82.51	25.67	1.09	161000	2695350	10.25
Friendship pink	11.57	10.49	8.88	15.93	1673000	1.46	5.49	37.91	55.40	19.75	1.20	153300	2074100	8.22
American beauty	10.83	9.84	10.34	14.28	1499750	2.83	4.29	36.62	103.37	33.45	1.23	297500	3512250	7.83
True yellow	10.56	9.79	11.63	15.13	1589000	1.47	4.59	45.25	65.96	44.43	0.74	154350	4665500	8.12
Her majesty	11.56	10.52	9.22	16.88	1772750	2.70	5.35	35.97	97.11	42.59	1.24	283500	4472300	7.43
Red majesty	11.29	10.21	9.25	15.38	1615250	2.39	5.90	37.13	89.02	58.54	0.93	251300	6146350	8.18
Novalux	10.44	9.75	9.62	17.04	1789200	2.11	4.59	36.46	76.93	68.07	0.68	221550	7147000	9.34
Advantage	9.64	8.44	8.52	15.98	1678250	1.47	5.32	32.17	47.41	29.17	1.11	154000	3063200	5.33
Sovenior saffron	10.43	9.58	8.31	14.62	1534750	1.20	5.44	44.90	53.65	24.59	1.23	126350	2581600	6.62
White friendship	10.91	9.81	10.35	13.44	1411200	2.44	4.80	37.75	92.21	49.94	1.13	256550	5243350	7.25
Mean	10.91	10.00	9.65	16.18	1699218	2.01	5.30	39.92	78.64	39.89	1.07	210954	4188514	8.01
C.V.	2.51	3.33	3.59	9.80	9.80	15.84	5.44	5.45	17.33	4.18	8.03	15.84	4.18	2.95
S.E.	0.16	0.19	0.20	0.92	96144	0.18	0.17	1.26	7.87	0.96	0.05	19288	101005	0.14
C.D. 5%	0.47	0.57	0.59	2.70	283625	0.54	0.49	3.70	23.21	2.84	0.15	56900	297963	0.40
C.D. 1%	0.64	0.77	0.80	3.68	386881	0.74	0.67	5.05	31.67	3.87	0.20	77615	406439.	0.55
Range Lowest	9.64	8.44	8.31	13.44	1411200	1.20	4.29	32.17	47.41	19.75	0.68	126350	2074100	5.33
Range Highest	12.33	11.46	11.63	20.60	2163000	2.83	7.26	54.25	103.37	68.07	1.24	297500	71470	10.25

Table.3 Estimates of variability, heritability and genetic advance as percentage of mean for different varieties of *Gladiolus*

Traits	Var Genotypical	Var Phenotypical	GCV	PCV	h ² (Broad Sense)	Genetic Advancement	Gen. Adv as % of Mean 5%
Plant Height (cm) 30 DAS	33.02	38.74	13.45	14.56	85.2	10.92	25.58
Plant Height (cm) 60 DAS	41.56	46.23	8.93	9.41	89.9	12.59	17.44
Plant Height (cm) 90 DAS	40.15	41.75	5.93	6.04	96.2	12.80	11.98
Number of leaves/plant 30 DAS	1.18	1.35	31.86	34.08	87.4	2.09	61.36
Number of leaves/plant 60 DAS	1.59	1.80	17.45	18.57	88.3	2.44	33.77
Number of leaves/plant 90 DAS	1.60	1.82	11.07	11.80	88.1	2.45	21.41
Number of shoot/plant	0.16	0.16	24.90	25.19	97.7	0.82	50.71
Days for 50% flowering	11.57	13.41	3.73	4.02	86.3	6.51	7.15
Rachis length (cm)	27.45	35.36	11.57	13.14	77.6	9.51	21.01
Days taken for emergence of flower spike	7.76	9.53	3.51	3.89	81.5	5.18	6.53
Days taken to show colour of basal floret	11.62	13.11	3.90	4.14	88.6	6.60	7.57
Number of florets per spike	1.67	1.91	10.59	11.32	87.6	2.49	20.43
Number of spikes per plant	0.02	0.04	11.39	15.02	57.5	0.26	17.79
Floret length (cm)	0.51	0.59	6.58	7.04	87.3	1.38	12.67
Floret diameter (cm)	0.51	0.62	7.15	7.88	82.2	1.33	13.36
Duration of flowering (days)	0.92	1.04	9.94	10.56	88.5	1.85	19.25
Number of spikes per meter square	3.42	5.93	11.42	15.05	57.6	2.89	17.86
Number of spikes/ha	37704970000	65436390000	11.42	15.05	57.6	303638	17.86
Number of corm produced per mother corm	0.31	0.41	27.96	32.13	75.7	1.007	50.11
Corm diameter (cm)	0.62	0.70	14.90	15.86	88.2	1.52	28.84
Weight of single corm (gm)	35.83	40.56	14.99	15.95	88.3	11.589	29.03
Corms yield/plant (g)	346.37	532.14	23.66	29.33	65.1	30.931	39.33
Number of Cormels/plant	226.67	229.45	37.74	37.97	98.8	30.827	77.279
Cormel diameter (cm)	0.03	0.045	18.07	19.77	83.5	0.365	34.01
Number of corms per hectare	3479139000	4595267000	27.96	32.13	75.7	105726.5	50.11
Number of cormels/hectare	2499133000000.00	2529739000000.00	37.74	37.97	98.8	3236821	77.27
Vase life (days)	1.91	1.97	17.26	17.51	97.2	2.809	35.06

High heritability values indicate that the characters under study are less influenced by environment in their expression. The plant breeder, therefore adopt simple selection method on the basis of the phenotype of the characters which ultimately improves the genetic background of these traits. Similar results were also quoted by Mishra *et al.*, (2014), Sharma *et al.*, (2018), Singh and Singh (2018), Swetha *et al.*, (2020).

Genetic advance is defined as the differences between the mean genotypic value of the selected lines and the mean genotypic value of the parental population (original population before selection). In other words genetic advance denotes the improvement in the genotypic value of the new population over the original population. Genetic advance is usually expressed as percent of mean. The range of genetic advance as percent of mean is classified as suggested by (Johnson *et al.*, 1955). Low less than 10%, moderate 10-20% and high more than 20%. Genetic advance estimates are presented in (Table 3). Among the studied characters the high, moderate and low estimates of genetic advance as percent of mean was recorded. The genetic advance as percentage of mean was highest for number of cormels per plant (77.27) followed by number of cormels per hectare (77.28), number of leaves per plant 30 DAS (61.36), number of shoot per plant (50.71), Number of corm produced per mother corm (50.11), number of corms per hectare (50.12), corms yield per plant (39.33) and vase life (35.06) recorded. However it was exhibited moderate for duration of flowering (19.26), followed number of spikes per meter square (17.87), number of spikes per ha (17.87), number of spikes per plant (17.79) and plant height (cm) 60 DAS (17.45). Lowest genetic advance as percent of mean recorded for days taken for emergence of flower spike (6.54), days for 50% flowering (7.15) and days taken to show colour of basal floret (7.57). Similar results

were also reported by Mishra *et al.*, (2014), Singh *et al.*, (2017), Sharma *et al.*, (2018), Singh and Singh (2018), Kumar *et al.*, (2019), Swetha *et al.*, (2020) and Kispotta *et al.*, (2020).

In conclusion the highly significant varietal differences revealed the presence of high amount of variability for all characters except days taken for emergence of flower spike, days taken to show colour of basal floret. Highly Therefore, it is concluded that the characters which showed high GCV, PCV and heritability coupled with genetic advance should be considered for direct selection. Here the number of cormels per plant, number of cormels per hectare, number of shoot per plant, vase life, plant height (cm) 90 DAS and plant height (cm) 60 DAS character under study showed high heritability and genetic advance. Thus one should select these characters for direct selection.

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