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EVALUATION OF GENETIC VARIABILITY HERITABILITY AND GENETIC ADVANCES IN GLADIOLUS (*GLADIOLUS GRANDIFLORUS* L.) GENOTYPES

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ABSTRACT

Assessment of variability, heritability and genetic advances of 31 gladiolus genotypes were evaluated. The presence of high amount of variability for all characters except sprout per corm and number of side spikes in the 31 gladiolus genotypes was recorded. The heritability of different field characters was categorized as very high which ranged between 23.40% (sprouts per corm) to 96.10% (florets per spike). Very high heritability coupled with high genetic advance for spike length, days to 50 per cent flowering, plant height advocated high genetic progress for them. It was concluded that highly significant varietal differences indicated the presence of high amount of variability.

INTRODUCTION

Gladiolus (*Gladiolus grandiflorus*L.), a member of family Iridaceae. It is one of the important bulbous ornamental for cut flower. It occupies 4th place in international cut flower trade after Rose, Carnation and Chrysanthemum (Farhat, 2004). The gladiolus belongs to kingdom- Plantae, Division- Magnoliophyta, Class- Liliopsida, Order- Asparagales, Family- Iridaceae, Genus- Gladiolus. Though, many cultivars of Gladiolus can be grown in a particular agro-climatic region all are not suited for cut flower purpose are for garden display or for exhibition purpose. Also new cultivars are being developed in different parts of the world, which need to be tested under different set of agro-climatic conditions. Because, the cultivars vary in their size of the plant, color, range, flower size, growing period etc. Therefore, there is a need for evaluation of varieties and new hybrids before they are recommended for the particular agro-climatic region. For this reason, many workers have done the work of evaluating different cultivars and new hybrids for studying their performance under different regions.

Environmental factor in combination with genetic and physiological factors play an important role in determination of plant potential for propagating material. These characters appear to be under strong genetic control (Sukarin *et al.*, 1987; Roy *et al.*, 2004). The key for any success of any genetic breeding program lies in the availability genetic variability for desired traits (Heller, 1996). The presence and magnitude of genetic variability in a gene pool is the pre-requisite of a breeding programme. The objective of the present investigation was to quantify the magnitude of genetic variability heritability & genetic advances in the present genotypes and to identify important yield-attributing characters to provide useful information for developing high yielding Gladiolus genotypes.

MATERIALS AND METHODS

The present investigation was carried out at AICRP (Floriculture), Ganeshkhind, Pune-7, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (M.S.) during 2011 to 2013. 31 Gladiolus genotypes were evaluated in a Randomized Block Design with two replications.

Genetic parameters

The genetic parameters such as genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability in broad sense and genetic advance for different characters were worked out for all the genotypes under study following the standard procedures.

Genotypic and phenotypic coefficient of variation

Genotypic and phenotypic coefficients of variation were estimated by the formulae as suggested by Burton (1952).

$$GCV = \frac{\sqrt{\text{Genotype variance}}}{\bar{X}} \times 100$$

Where,

$\bar{x}$ = The mean of character

$$PCV = \frac{\sqrt{\text{Genotype variance}}}{\bar{X}} \times 100$$

Where,

$\bar{x}$ = The mean of character

Heritability estimates

Heritability of a character on the other hand is an index of its transmissibility. In broad sense, it may be defined as the proportion of genotypic variance to phenotypic variance and heritability percentage in broad sense is calculated by the formulae as suggested by Johnson *et al*. (1995a, b).

$$h^2 = \frac{VG}{VP}$$

Where,

h^2 = Heritability estimates in broad sense

VG = Genotypic variance

VP = Phenotypic variance

Partitioning of variance

Variance is partitioned into genotypic, phenotypic and in environmental components. In order to form a reliable basis for selection, it is necessary to break up the observed variance and covariance into its heritable (genetic) and non-heritable (non-genetic) components. This was done as per the method suggested by Fisher (1954).

$$\text{Genotypic variance} = \frac{\text{Treatment - Error variance}}{\text{No. of replications}}$$

Phenotypic variance = Genotypic variance + Error variance

Environmental variance = Error variance

RESULTS AND DISCUSSION

Genetic parameters like genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance are useful biometrical tools for determination of genetic variability (Aditya *et al*., 2011). Significant treatment differences indicated appreciable amount of variability for all the characters studied (Table 2). The magnitudes of phenotypic and genotypic coefficient of variation were more or less same indicating little role of environment confirming the finding of Mahanta and Paswan (1995). The difference between G.C.V. and P.C.V. gives us an idea about the role off genotypic and environment on the character expression. In present investigation the magnitudinal difference between G.C.V. and P.C.V. were minimum indicating the little role of environment on the expression of various characters. The G.C.V. and P.C.V. magnitudes were highest for number of side spikes followed by number of florets per spike, inter-nodal length of first flower, first leaf length indicating the presence of good amount of variability for their characters. The variance (G.C.V/ P.C.V.) was of medium range for plant height, spike length, rachis length, second leaf length, flowering stem diameter, diameter of second florets, days to 50 per cent sprouting whereas it was minimum for days to harvest, sprout per corm, number of leaves, sprouted corm per cent, days to 50% flowering. The present investigation confirms the earlier findings of Balaram *et al*. (2000). Anuradha and Gowda (1990) who studied the genetical variability in 25 genotypes of gladiolus for 24 characters and recorded high degree of variability for all the characters except number of side shots and number of side spikes. And high phenotypic and genotypic coefficients of variation were observed for leaf area, rachis length, number of capsules and number of seeds per capsule, while these were low for number of side spike, floret diameter, floret length and number of leaves. Balamurugan *et al*. (2002) noticed high GCV in gladiolus for

Table 1: Analysis of variance for mean performance in Gladiolus genotypes

Source of variance	Replication	Treatment	Error
df	1	30	30
Days to 50 % sprouting	12.65	118.86	5.05
Dormancy period (days)	12.65	118.86	5.05
Sprouted corm per cent	37.16	215.14	30.49
Sprouts per corm	0.01	0.02	0.02
Days to 50% flowering	30.28	97.96	2.02
Plant height (cm)	73.10	259.21	27.37
Spike length (cm)	66.70	267.01	11.98
Rachis length (cm)	1.21	56.53	4.78
Florets per spike	0.01	11.42	0.23
Dia. of second floret (cm)	0.02	2.64	0.06
Inter-nodal length of first floret (cm)	0.49	1.36	0.19
No. of side spike	0.14	0.13	0.03
Flowering stem diameter (cm)	0.01	0.03	0.01
No. of leaves per plant	0.04	1.05	0.15
First leaf length (cm)	2.07	54.9	2.22
Second leaf length (cm)	1.21	53.79	3.41
Days to harvest	5.82	31.2	3.72
Yield (spikes per ha)	563895500	19187659404	31755103
Number of corm per plant	0.01	0.21	0.02
Number of cormels per plant	203.19	375.2	6.23
Diameter of corm (cm)	0.01	0.78	0.01
Diameter of cormels (cm)	0.01	0.01	0.001

Table 2: Mean performance in Gladiolus genotypes

Sr. No.	Genotypes	Days to 80% sprouting	Dormancy period (days)	Sprouted corm percent	Sprout per corm	Days to 50% flowering	Plant height (cm)	Spike length (cm)	Rachis length (cm)	Florets per spike	Dia. of second floret (cm)	Inter-nodal length of first floret (cm)
1	IARI Sel-3	34.00	59.00	100 (90.00)	1.00	70.34	103.83	82.84	40.17	14.00	8.33	3.50
2	Chaubattia	37.50	62.50	100 (90.00)	1.00	77.33	102.33	94.67	39.50	12.00	8.59	5.33
3	Kalyani 88/50	33.00	58.00	75 (60.11)	1.00	79.50	113.33	84.34	45.50	15.33	9.34	5.67
4	Suryakiran	37.00	62.00	90 (76.71)	1.00	75.50	109.16	88.67	40.84	14.67	6.42	4.42
5	IIHR-G-11	32.50	57.50	100 (90.00)	1.00	72.50	98.50	80.67	39.50	17.34	7.58	4.25
6	Sapana	35.50	60.50	75 (60.11)	1.00	72.67	93.00	73.67	41.17	14.33	5.34	3.33
7	Snow Prince	35.50	60.50	75 (60.11)	1.00	81.00	126.34	105.34	48.84	13.67	6.67	5.50
8	Rose Supreme	40.50	65.50	95 (80.78)	1.00	70.34	97.67	74.84	40.50	14.67	9.84	5.84
9	Subhangini	33.00	58.00	95 (80.78)	1.00	70.84	121.33	102.50	46.34	14.17	7.67	5.59
10	PhuleNeelrekha	49.00	74.00	85 (67.50)	1.34	78.50	117.66	97.50	52.50	18.50	7.17	5.83
11	PusaSuhagan	46.50	71.50	100 (90.00)	1.00	71.00	120.00	99.16	49.84	15.34	10.00	5.17
12	Summer Sunshine	46.00	71.00	95 (80.783)	1.00	72.17	104.67	85.50	45.17	14.17	9.00	6.17
13	Mayur	47.00	72.00	100 (90.00)	1.00	72.00	81.17	66.00	35.67	10.84	8.33	3.75
14	IIHR 77-59-32	33.00	58.00	85 (67.50)	1.17	69.17	87.00	64.67	37.67	14.67	8.00	4.58
15	IARIR 77-86-26	36.00	61.00	95 (80.78)	1.33	75.34	103.16	87.17	42.34	13.17	7.67	4.17
16	Pricilla	48.50	73.50	95 (80.78)	1.00	73.17	100.34	87.67	36.83	10.33	9.33	5.00
17	Yellow Stone	43.50	68.50	100 (90.00)	1.00	84.67	118.34	102.50	49.17	14.17	7.33	4.58
18	PS Hybrid	56.00	81.00	100 (90.00)	1.00	75.34	122.33	103.34	49.84	15.00	9.00	6.00
19	PhulePrerna	53.50	78.50	100 (90.00)	1.33	92.33	106.17	86.84	37.67	11.33	8.33	5.50
20	Tejas	54.50	79.50	95 (80.78)	1.00	91.34	112.50	93.67	38.00	14.00	8.34	5.59
21	IIHR-87-22-1	56.50	81.50	100 (90.00)	1.00	84.84	115.67	89.83	39.50	14.50	9.17	4.58
22	Low Land Queen	35.50	60.50	85 (67.50)	1.17	84.83	103.33	90.83	39.67	13.67	8.33	4.67
23	ArkaKesar	47.50	72.50	100 (90.00)	1.00	70.17	107.00	87.00	39.84	15.84	5.75	4.42
24	Friendship	47.00	72.00	95 (80.78)	1.00	68.67	86.83	72.00	30.50	10.00	7.67	3.17
25	Sel from Sel-1	45.50	70.50	80 (90.00)	1.00	81.17	109.34	92.17	39.17	12.83	8.17	4.17
26	Tambri	47.00	72.00	95 (80.78)	1.00	86.00	98.84	87.34	40.17	8.83	8.17	4.67
27	IIHR G-12	49.50	74.50	100 (90.00)	1.00	80.50	111.67	93.34	47.00	16.50	8.50	4.50
28	Darshan	38.50	63.50	95 (80.78)	1.17	86.67	115.17	102.17	49.67	18.00	9.50	3.83
29	Suncerre	41.00	66.00	100 (90.00)	1.17	80.33	121.50	106.17	51.34	15.67	9.67	4.67
30	Jagjee 7	52.00	77.00	100 (90.00)	1.00	87.33	93.17	72.33	39.34	10.34	7.67	4.34
31	White prosperity	33.00	58.00	100 (90.00)	1.00	86.50	110.34	101.50	44.17	17.50	9.50	3.67
	Mean	**42.74**	**67.74**	**93.71 (80.96)**	**1.05**	**78.13**	**106.83**	**88.91**	**42.50**	**14.04**	**8.20**	**4.72**
	S.E.(±)	1.59	1.58	5.81	8.51	1.00	3.70	2.44	1.54	0.34	0.17	0.31
	C.D. at 5%	4.59	4.58	16.78	NS	2.90	10.68	7.07	4.46	0.98	0.49	0.89

Table 2: cont....

Sr. No.	Genotypes	No. of side spikes	Flower Stem Diameter(cm)	No. of leaves per plant	First leaf length (cm)	Second leaf length (cm)	Days to harvest	Yield (spikes per ha)	No. of corm per plant	No. of cormels per plant	Dia. of corm (cm)	Dia. of cormels (cm)
1	IARI Sel-3	0.17	0.80	8.83	35.17	47.17	180.50	331000	1.90	28.00	3.94	0.35
2	Chaubattia	0.00	0.95	9.33	35.34	44.33	189.00	262800	1.52	29.50	3.63	0.48
3	Kalyani 88/50	0.50	1.04	9.67	35.67	45.17	188.00	132500	1.31	13.17	4.03	0.44
4	Suryakiran	0.00	1.07	9.17	30.67	38.67	185.00	144300	1.36	24.00	4.49	0.34
5	IIHR-G-11	1.34	0.80	9.84	29.67	39.84	182.50	167500	1.43	28.34	5.64	0.63
6	Sapana	0.00	1.03	7.67	33.50	46.00	182.50	331500	1.19	48.00	4.28	0.53
7	Snow Prince	0.33	0.77	9.84	40.00	54.00	194.00	280100	1.70	44.00	4.67	0.42
8	Rose Supreme	0.00	0.83	8.00	26.00	36.84	182.50	283100	1.68	49.00	4.53	0.34
9	Subhangini	0.17	0.97	9.33	42.00	49.84	185.50	142500	1.17	21.50	3.53	0.54
10	PhuleNeelrekha	0.00	1.09	11.17	27.34	42.17	190.50	188000	1.64	26.34	4.45	0.45
11	PusaSuhagan	0.00	0.75	9.33	36.17	48.34	181.00	147500	1.04	17.17	3.63	0.52
12	Summer Sunshine	0.00	1.12	9.17	25.34	37.00	183.50	311700	1.56	51.50	3.89	0.38
13	Mayur	0.00	1.10	8.67	35.67	49.17	184.50	230700	2.17	36.00	3.44	0.40
14	IIHR 77-59-32	0.00	0.80	8.84	37.50	49.34	181.00	235000	1.55	64.00	4.27	0.44
15	IARIR 77-86-26	0.00	0.83	8.33	36.34	50.00	186.00	368900	2.36	56.00	4.20	0.51
16	Pricilla	0.00	0.87	8.17	28.84	41.00	184.50	217400	1.34	39.00	4.71	0.39
17	Yellow Stone	0.00	1.02	8.34	38.67	49.34	186.50	167000	1.04	20.50	4.46	0.51
18	PS Hybrid	0.17	1.05	9.33	28.34	46.83	182.00	548890	2.02	26.00	4.15	0.39
19	PhulePrerna	0.17	0.88	8.84	23.00	36.17	196.00	141500	1.78	28.84	4.38	0.44
20	Tejas	0.34	1.02	8.33	33.00	47.50	191.00	179000	1.52	26.50	3.60	0.62
21	IIHR-87-22-1	0.00	1.04	8.17	34.34	48.00	186.50	289240	1.35	23.00	4.06	0.44
22	Low Land Queen	0.00	0.83	8.50	33.34	49.34	184.50	209900	1.05	27.50	3.46	0.37
23	ArkaKesar	0.17	0.82	8.67	22.17	36.34	181.00	239350	1.57	67.00	4.20	0.45
24	Friendship	0.17	0.75	8.34	23.17	35.34	181.50	274110	1.48	30.00	3.65	0.49
25	Sel from Sel-1	0.00	1.02	8.50	33.17	42.34	185.00	192600	1.26	19.00	3.88	0.40
26	Tambri	0.17	0.83	8.17	26.34	40.34	189.50	159000	1.29	27.00	4.21	0.39
27	IIHR G-12	0.17	1.03	8.50	34.33	45.17	183.00	157500	1.39	34.00	5.11	0.42
28	Darshan	0.00	1.05	8.17	28.34	39.17	189.00	167000	1.48	26.34	3.69	0.43
29	Suncerre	0.00	0.97	9.34	34.84	49.67	187.50	429800	1.31	25.00	4.27	0.43
30	Jagjee 7	0.00	0.75	8.17	28.33	38.84	190.00	212900	1.37	28.50	4.31	0.51
31	White Prosperity	0.00	0.90	8.17	26.50	45.17	188.00	388200	2.07	16.21	6.34	0.55
	Mean	0.12	0.93	8.80	31.71	44.14	185.85	242919	1.50	32.29	4.23	0.45
	S.E.	0.12	2.99	0.27	1.05	1.30	1.36	3984.67	0.09	1.76	0.08	0.02
	C.D. at 5%	0.33	8.63	0.79	3.04	3.77	3.94	11508.48	0.25	5.10	0.22	0.08

Table 3: Assessment of genetic variability in Gladiolus genotypes

Sr. No.	Character	Range	Mean	Coefficient of variation			Heritability (Bs) (%)	Genetic Advancementat 5%	GA as a percent of mean
				GCV	PCV	ECV			
1	Days to 50% sprouting	32.50 - 56.50	42.74	17.65	18.42	5.25	91.90	14.89	34.85
2	Dormancy period (days)	57.50 - 81.50	67.74	11.14	11.61	3.32	91.90	14.89	21.99
3	Sprouted corm (%)	75-100	93.70	7.78	9.75	5.88	63.70	17.16	18.58
4	Sprouts per corm	1.00-1.33	1.05	6.31	13.07	11.44	23.40	0.07	6.29
5	Days to 50% flowering	68.67-92.33	78.13	8.87	9.05	1.82	96.00	13.98	17.89
6	Plant height (cm)	81.17-126.34	106.83	10.08	11.21	4.89	80.90	19.95	18.67
7	Spike length (cm)	64.67-106.17	88.91	12.70	13.28	3.89	91.40	22.24	25.02
8	Rachis length (cm)	30.50-52.50	42.49	11.97	13.02	5.14	84.40	9.63	22.66
9	Florets per spike	8.83-18.50	14.04	16.85	17.19	3.41	96.10	4.78	34.02
10	Diameter of second floret (cm)	5.34-10.00	8.20	13.86	14.17	2.91	95.80	2.29	27.95
11	Inter-nodal length of 1st floret	3.17-6.17	4.72	16.20	18.66	9.27	75.30	1.37	28.95
12	Number of side spike	0.00-1.34	0.12	187.46	229.53	132.44	66.70	0.39	315.40
13	Flowering stem diameter	0.75-1.12	0.93	12.62	13.42	4.55	88.50	0.23	24.46
14	Number of leaves per plant	7.67-11.17	8.80	7.61	8.78	4.39	75.10	1.20	13.59
15	1st leaf length (cm)	22.17-42.00	31.71	16.18	16.85	4.70	92.20	10.15	32.02
16	2nd leaf length (cm)	35.34-54.00	44.14	11.37	12.12	4.19	88.10	9.70	21.98
17	Days to harvest	180.50- 196.00	185.85	1.99	2.25	1.04	78.70	6.77	3.65
18	Yield (spikes per ha)	132500- 548890	242919.00	40.28	40.36	2.32	99.70	201272.70	82.86
19	No. of corm per plant	1.04- 2.17	1.51	20.95	22.48	8.14	87.00	0.61	40.23
20	No. of cormels per plant	13.17-67.00	32.29	42.07	42.77	7.73	96.70	27.52	85.24
21	Dia. Of corm (cm)	3.44 – 6.34	4.23	14.71	14.93	2.57	97.00	1.26	29.85
22	Dia. Of cormels (cm)	0.34 -0.63	0.45	15.56	17.62	8.26	78.00	0.13	28.32

GCV: Genotypic coefficient of variation; PCV: Phenotypic Coefficient of variation ECV: Environmental Coefficient of Variation; Bs: Broad sence GA: Genetic advance

number of side shoots. Whereas, low for longevity of individual florets and duration of first floret. Further, they reported that there was a considerable difference in GCV and PCV for number of side shoots per plant, duration of flowering and longevity of individual florets.

Florets per spike was the most heritable character (96.10%) followed by days to 50% flowering (96.00%), diameter of second florets. This showed that all the characters have high heritability. These results are in conformity with Soorianathasundaram and Nambisan (1991) who studied the gladiolus cultivars for genetic variability and observed highest heritability value for spike weight and length. Estimated genetic advance as percentage of mean was highest for spike length, followed by spike weight, number of florets and floret size. Appreciably high genetic advance was observed for the spike length and plant height, days to 50% flowering. Very high heritability and high genetic advance of these characters suggested involvement of additive genetic control indicating that Simple selection will serve the purpose of selecting better genotypes. Similar work was done by Deepti (2000) and reported that heritability varied for different characters viz., diameter of leaf, length of spike, plant height, and length of flower and maximum heritability was in length of spike. Further, she reported that expected genetic advance ranged from 0.3107 and 0.2769.

Heritability estimate involve the breeding value of the genotype and help to understand the repeatability of performance for character studied. It is being used in predicting the performance of genotypes in subsequent generations and to decide the appropriate weight age to be given for improving particular character and the breeding method to be followed for improvement of specific character. The estimates of heritability alone fail to indicate the response to selection (Shashikanth *et al*., 2010). Therefore heritability estimates appear to be more meaningful when accompanied by estimates of genetic advances.

CONCLUSION

Highly significant varietal differences revealed the presence of high amount of variability for all characters except sprouts per corm and number of side spikes in the 31 genotypes studied. The magnitudinal differences between GCV and PCV were minimum indicating the little role of environment on the expression of various characters. Very high heritability coupled with high genetic advance for spike length, days to 50% flowering, plant height advocated high genetic progress for them.

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