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Varietal evaluation and genetic variability studies on gladiolus

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ABSTRACT

An experiment was conducted with 26 gladiolus cultivars at Research Farm of Directorate of Floricultural Research, New Delhi. The minimum days required for sprouting was recorded in cultivar Peter Pears (3.40 days), whereas earliest spike initiation (86.33 days) and first floret opening (100.33 days) were observed in cultivar Hunting Song. Maximum plant height (115.87 cm) and spike length (101.20 cm) were found in cultivar Amsterdam, whereas maximum rachis length (73.39 cm) was recorded in Snow Princess. Maximum number of florets per spike (18.60) and bigger florets size (97.72 mm) were recorded in Snow Princess and Priscilla, respectively. The cultivar Yellow Stone was found with maximum number of corms per plant (2.68), whereas highest average corm weight (71.60 g) and corm size (64.87 mm) were recorded in Forta Rosa, and highest cormels weight (17.50 g) in Argentina. Higher values of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were recorded for cormel weight, *i.e.* 104.36 and 67.26 and number of cormels per plant, *i.e.* 99.82 and 71.58, respectively. Maximum heritability was recorded for days to first floret opening (87.23%) followed by rachis length (82.07%) and days to spike initiation (78.26%). Highest values for genetic advance were recorded for plant height (26.35) and spike length (23.36). However, low genetic advance was observed for days to sprouting (0.04) followed by number of corms (0.32) and number of leaves per plant (0.59).

Key words: Evaluation, gladiolus, PCV, GCV, heritability, genetic advance.

INTRODUCTION

Gladiolus (Tourn) L. popularly known as "sword lily" is an important cut flower in domestic as well as export market. It belongs to Iridaceae family and originated from South Africa. Its fascinating spikes exhibiting varying size and form of florets with smooth, ruffled, deeply crinkled or laciniated tepals which are blotched or possess distinct patches or markings of various colours and colour combinations. 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.*, 9).

On account of availability of huge market for cut flowers due to rise in socio-economic status, change in life style of people and want for novelty, every year a large number of varieties are being added to the public domain. Therefore, it is necessary to study the performance of existing cultivars for their desirable characters. Moreover, exotic varieties are known for their better quality spike and multiplication rate, however, their suitability under local conditions needs to be tested before their recommendation. Hence, present investigation was aimed to assess the performance of gladiolus varieties suitable for cut flower and corms production under Delhi conditions *per se* or for identification of suitable parents for further crop improvement.

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MATERIALS AND METHODS

The experiment was carried out during 2012-13 at research farm of Directorate of Floricultural Research, New Delhi. The beds of 1 m × 1 m size were prepared. Healthy and uniform sized corms (4.5-5.0 cm) were planted at 5-7 cm depth at a spacing of 30 cm × 20 cm in a randomized block design with three replications in Oct., 2012. The 26 gladiolus varieties included in experiment were, *viz*., Amsterdam, Argentina, Eurovision, Fidelio, Flavo Laguna, Forta Rosa, Hunting Song, Jester Gold, Jackson Villa Gold, Lemon Drop, Limoncello, Mascagni, Novalux, Ocilla, Peter Pears, Prince Margaret Rose, Priscilla, Purple Flora, Rose Supreme, Rosiebee Red, Snow Princess, Solist, Verona, White Prosperity, Wig's Sensation, and Yellow Stone. Standard cultural practices were followed during the cropping season. The data were recorded on five randomly selected plants from each genotype in each replication on 17 characters. The data were subjected to statistical analysis as suggested by Cochran and Cox (4). Phenotypic and genotypic coefficients of variation were calculated as per formula described by Burton (2) and Burton and deVane (3). Heritability, in broad sense, was calculated as suggested by Allard (1) and genetic advance as per cent of mean was calculated following the method suggested by Johnson *et al*. (5).

RESULTS AND DISCUSSION

Data presented in Table 1 revealed that cultivars

Table 1. Performance of gladiolus varieties for morphological characters under Delhi conditions.

Variety	Days to sprouting	Days to spike initiation	Days to 1st floret opening	Plant height (cm)	Spike length (cm)	Rachis length (cm)	No. of florets/ spike	Floret dia. (mm)
Amsterdam	3.73	95.93	113.40	115.87	101.20	62.67	17.80	89.54
Argentina	4.13	87.20	107.40	103.26	89.22	56.37	14.93	96.42
Eurovision	4.33	102.07	119.33	99.10	84.62	59.98	16.60	82.88
Fidelio	4.20	101.00	118.89	93.38	80.48	55.64	14.75	89.00
Flavo Laguna	3.83	108.87	122.60	67.97	56.81	37.50	12.53	58.67
Forta Rosa	4.47	93.47	110.20	96.67	83.31	60.47	16.93	88.77
Hunting Song	3.93	86.33	100.33	67.26	55.55	31.34	9.27	89.01
Jester Gold	4.33	93.80	113.33	90.45	77.25	49.18	12.80	89.71
Jacksonville Gold	4.13	102.21	119.73	97.69	84.84	54.69	13.22	91.99
Lemon Drop	4.00	102.27	121.07	87.99	73.47	47.78	14.87	90.99
Limoncello	3.67	92.67	110.93	85.17	69.43	46.87	11.47	97.70
Mascagni	4.18	96.87	115.06	93.01	80.29	51.58	16.87	76.05
Novalux	4.80	100.47	115.73	105.61	90.25	52.82	15.06	86.89
Ocilla	4.13	95.67	114.73	109.59	92.92	66.73	17.40	79.95
Peter Pears	3.40	100.70	120.43	63.97	55.40	21.81	5.33	87.77
Prince Margaret Rose	3.87	88.60	103.20	69.32	57.42	32.84	9.59	71.45
Priscilla	3.66	89.47	109.20	97.74	83.04	55.64	14.13	97.72
Purple Flora	3.73	87.60	102.53	86.34	72.27	44.02	15.33	77.74
Rose Supreme	4.20	99.13	116.30	100.93	86.63	48.66	14.87	85.31
Rosiebee Red	4.07	109.73	127.13	95.09	80.93	45.30	12.86	78.76
Snow Princess	3.78	95.60	109.60	109.52	95.16	73.39	18.60	74.81
Solist	3.57	111.50	128.63	81.61	70.12	44.10	14.47	91.79
Verona	3.60	102.06	122.40	99.21	84.24	56.39	15.67	83.45
White Prosperity	3.95	96.53	114.93	114.03	98.27	59.66	14.80	96.14
Wig's Sensation	3.80	113.10	130.83	94.29	80.18	58.62	16.83	88.97
Yellow Stone	3.73	101.40	117.53	113.79	99.04	56.32	16.00	91.09
CD at 5%	0.82	4.48	4.47	12.96	13.09	8.89	2.89	10.02

differed significantly for growth and flowering characters, indicating potential for improvement through selection. The wide variation was observed for days required to spike initiation and first floret opening. Hunting Song had early spike initiation (86.33 days) and took minimum days to first floret opening (100.33 days), whereas, variety Wig's Sensation had late spike initiation (113.10 days) and took more days for first floret opening (130.83 days). Planting of early and late blooming varieties in judicious manner will prolong flowering duration. Variation in days to spike initiation and 1st floret opening seem to be genetically controlled as reported by Pragya *et al*. (13) in gladiolus. Plant height is an important character as it contributes towards better spike length with more number of florets and thereby enhances spike quality. Plant height varied significantly and ranged from 63.97 cm in variety Peter Pears to 115.87 cm in Amsterdam. The varieties, namely, Amsterdam, White Prosperity, Yellow Stone, Ocilla, Snow Princess, Novalux and Argentina were found significantly taller than other varieties. Number of leaves per plant varied from 6.73 (Argentina and Flavo Laguna) to 8.87 (Rosiebee Red). Variety Amsterdam had maximum stem diameter (17.84 mm) followed by Yellow Stone (17.82 mm) and minimum was found in Flavo Laguna (9.08 mm). Maximum number of shoots per plant was recorded in Novalux (2.73) followed by Yellow Stone (2.47) and Snow Princess (2.40).

Different genotypes exhibited significant variation for flowering characters (Tables 1 & 2). Maximum spike length was recorded in Amsterdam (101.20 cm), followed by Yellow Stone (99.04 cm) and White Prosperity (98.27 cm), whereas shortest spikes were produced in varieties Peter Pears (55.40 cm) and Hunting Song (55.55 cm). Rachis length varied from 21.81 (Peter Pears) to 73.39 cm (Snow Princess). The variation in different characters among varieties may be due to genetic traits and the effect of prevailing environmental conditions. The present findings are in conformity with the findings of Swaroop (15) and Pandey *et al*. (12) in gladiolus.

Number of florets per spike was recorded maximum in Snow Princess (18.60) followed by Amsterdam (17.80), Ocilla (17.40), Forta Rosa (16.93), Mascagni (16.87) and Wig's Sensation (16.83). Floret diameter also varied significantly among different varieties with minimum diameter being in Flavo Laguna (58.67 mm) and maximum in Priscilla (97.72 mm). Maximum number of florets open at a time was recorded in Amsterdam (8.26) followed by Yellow Stone (7.13) and Novalux (7.00) and minimum were found in Peter Pears (4.30) followed by Hunting Song (4.67). The varieties with more number of florets, bigger floret size and more number of florets open at a time are well suited for exhibition

Table 2. Performance of gladiolus varieties for morphological and corm and cormel characters under Delhi conditions.

Variety	No. of floret open at a time	No. of leaves / plant	Stem dia. (mm)	No. of shoots / plant	No. of corms / plant	No. of cormels /plant	Av. corm wt. (g)	Cormel wt. (g)	Corm size (mm)
Amsterdam	8.26	8.13	17.84	1.40	1.20	8.93	60.13	2.40	61.92
Argentina	5.33	6.73	14.09	1.60	1.60	40.80	47.00	17.50	51.89
Eurovision	5.67	7.27	15.60	1.60	1.27	8.0	33.60	8.73	47.99
Fidelio	5.13	8.00	19.25	1.33	1.00	6.18	44.18	1.93	52.94
Flavo Laguna	5.58	6.73	9.08	1.33	1.58	1.96	15.41	1.20	36.87
Forta Rosa	6.33	7.73	14.94	1.00	1.13	15.20	71.60	3.93	64.87
Hunting Song	4.67	7.53	12.59	1.00	1.00	2.33	41.73	1.47	52.13
Jester Gold	5.93	7.80	14.03	1.13	1.06	11.06	50.33	4.73	55.96
Jacksonville Gold	5.93	7.67	14.42	1.84	1.43	10.33	43.50	4.10	58.14
Lemon Drop	6.00	7.33	16.47	1.33	1.20	7.40	35.53	2.67	51.15
Limoncello	6.40	7.73	14.86	1.00	1.00	10.00	41.67	3.00	50.87
Mascagni	5.13	7.67	13.26	1.33	1.00	4.17	34.85	1.58	49.35
Novalux	7.00	7.60	16.94	2.73	1.80	4.53	57.03	1.75	60.09
Ocilla	6.07	8.67	16.74	1.67	1.93	38.68	31.21	6.35	50.14
Peter pears	4.30	7.30	14.34	1.23	1.00	1.87	28.36	1.47	45.01
Prince Margaret Rose	4.80	7.93	12.11	1.00	1.63	20.95	31.95	2.35	50.28
Priscilla	6.00	7.60	15.09	1.67	1.87	18.73	47.93	8.60	59.62
Purple Flora	6.19	7.00	14.53	1.80	1.73	9.93	33.67	3.80	49.70
Rose Supreme	5.13	8.06	15.31	1.27	1.06	3.53	44.60	1.87	53.39
Rosiebee Red	6.20	8.87	15.16	1.06	1.00	16.06	49.60	4.40	52.96
Snow Princess	5.60	8.00	16.63	2.40	1.33	33.80	45.73	10.73	58.50
Solist	4.73	7.83	16.60	1.00	1.00	6.33	35.55	3.70	47.83
Verona	6.33	8.00	16.01	1.13	1.00	16.73	31.80	8.47	44.90
White Prosperity	5.27	7.60	14.32	1.26	1.16	22.80	36.63	10.91	51.09
Wig's Sensation	5.97	7.77	16.57	1.33	1.42	18.00	38.63	1.25	52.16
Yellow Stone	7.13	7.60	17.82	2.47	2.68	21.88	45.10	7.68	50.83
CD at 5%	1.09	0.70	2.20	0.49	0.61	13.94	13.78	6.05	5.92

purpose. The variation in these parameters might be attributed to differences in genetic constitution of genotypes. The present findings are in conformity with the earlier findings of Pandey *et al*. (12) in gladiolus, Wankhede and Gajbhiye (16) in gerbera and Kumar *et al.* (8) in snapdragon.

The data presented in Table 2 exhibits significant variation for corm and cormel characters among the varieties evaluated. Maximum number of corms per plant was recorded in Yellow Stone (2.68), Ocilla (1.90) and Priscilla (1.87), whereas, single corm per mother corm was found in Verona, Hunting Song, Fidelio and Peter Pears. Varieties producing more than one corm per plant can be considered as good multipliers and may be used as parents in further breeding programmes. Number of cormels per plant varied significantly and ranged from 1.87 to 40.80. Average corm weight varied among genotypes and was found maximum in cultivar Forta Rosa (71.60 g) followed by Amsterdam (60.13 g) and minimum in Flavo Laguna (15.41 g), whereas, maximum cormels weight was recorded in Argentina (17.50 g) followed by Snow Princess (10.73 g). The large sized corm was found in variety Forta Rosa (64.87 mm) followed by Novalux (60.09 mm), while variety Flavo Laguna produced the smallest corm (36.87 mm). Variation in number of corms and cormels per plant may be due to the differential genetic make-up of the varieties. The present findings are in conformity to the work of Pandey *et al*. (12) in gladiolus.

A wide range of variation was observed for growth and flowering characters in genotypes. Phenotypic coefficient of variation (PCV) was found to be higher than genotypic coefficient of variation (GCV) for all the characters studied, indicating the influence of the environment (Table 3). Higher PCV and GCV were observed for cormel weight (104.36 and 67.26) and number of cormels per plant (99.82 and 71.58, respectively) indicating high genetic variability for these traits. It offers greater scope for selection of potential parent in breeding programme with higher multiplication rate. The similar results were also reported by Nazir and Dwivedi (11) in gladiolus. However, days taken to first floret opening (7.17), days to spike initiation (7.92), number of leaves per plant (5.64) and days taken to first floret opening (6.70) recorded low PCV and GCV values suggesting low variability among the genotypes studied. These results are in conformity with that of Namita *et al*. (10). Estimation of GCV helps in the measurement of the range of heritable portion of genetic diversity in a character and provide means

Table 3. Estimation of genetic parameters for different traits in gladiolus germplasm.

Trait	Range		General mean ± SE	P.C.V.	G.C.V.	Heritability (h^2) %	Genetic advance	Genetic advance as per cent of mean
	Min.	Max.						
Days to sprouting	3.40	4.80	3.98 ± 0.29	13.12	2.57	3.85	0.04	10.14
Days to spike initiation	86.33	113.10	97.59 ± 2.08	7.92	7.01	78.26	12.47	1.87
Days to 1st floret opening	100.33	130.83	114.94 ± 1.70	7.17	6.70	87.23	14.82	1.67
No. of florets per spike	5.33	18.6	14.34 ± 1.06	21.55	17.28	64.27	4.09	11.52
Plant height (cm)	63.97	115.87	92.57 ± 4.46	17.75	15.66	77.82	26.35	1.96
Spike length (cm)	55.40	101.20	78.89 ± 4.53	19.46	16.72	73.85	23.36	2.24
Rachis length (cm)	21.81	73.39	50.17 ± 2.99	24.44	22.14	82.07	20.73	3.72
Floret diameter (mm)	58.67	97.72	84.56 ± 4.36	12.96	9.40	52.57	11.87	1.77
No. of florets open at a time	4.30	8.26	5.74 ± 0.37	18.17	14.14	60.56	1.30	27.93
No. of leaves per plant	6.73	8.87	7.66 ± 0.28	8.48	5.64	44.23	0.59	17.89
Stem diameter (mm)	9.08	19.25	15.16 ± 1.56	22.34	13.41	36.04	2.51	8.16
No. of shoots per plant	1.00	2.73	1.43 ± 0.17	36.25	29.78	67.51	0.72	118.34
No. of corm per plant	1.00	2.68	1.32 ± 0.24	37.91	21.11	31.00	0.32	86.90
No. of cormel per plant	1.87	40.80	13.04 ± 5.24	99.82	71.58	51.42	13.79	11.33
Av. corm wt. (g)	15.41	71.60	41.83 ± 4.85	31.49	24.24	59.26	16.02	3.79
Cormel wt. (g)	1.20	17.50	4.73 ± 2.18	104.36	67.26	41.54	4.22	28.07
Corm size (mm)	36.87	64.87	52.61 ± 2.04	12.38	10.38	70.35	9.44	3.28

P.C.V. = Phenotypic coefficient of variation, G.C.V. = Genotypic coefficient of variation, E.C.V. = Environmental coefficient of variation

to compare the genetic variability in the quantitative characters. The genotypic coefficient of variation along with heritability estimates provide reliable estimates of the amount of genetic advance to be expected through phenotypic selection (Burton, 2). Maximum heritability was recorded for days to first floret opening (87.23%) followed by rachis length (82.07%) and days to spike initiation (78.26%). High heritability estimates for these traits indicated less influence of environment in their expression and more scope for the improvement through direct selection. Minimum value for heritability was recorded for days to sprouting (3.85%) followed by number of corms per plant (31%) and stem diameter (36.04%). High heritability associated with high genetic advance proves more effective for improvement of a character through selection. In the present study, high heritability estimates with high genetic advance was observed for plant height, rachis length, spike length, days to first floret opening and days to spike initiation, indicating that these are simply inherited traits and the heritability is due to additive gene effects and selection may be effective in early generations for these traits. These results are in conformity with the earlier findings of Kumar *et al.* (7), Nazir and Dwivedi (11) and Pratap and Rao (14) in gladiolus. Highest values for genetic advance were recorded for plant height (26.35) and spike length (23.36). However, low heritability with low genetic advance was recorded for days to sprouting (3.85 and 0.04) followed by number of corms (31.00 and 0.32) and number of leaves per plant (44.23 and 0.59, respectively). The results are in line with the findings of Kumar *et al.* (6) and Kumar *et al*. (7) in gladiolus.

On the basis of above findings, it can be concluded that varieties Yellow Stone, Snow Princess, Amsterdam, Argentina, Ocilla, Novalux and White Prosperity performed better over others varieties under Delhi conditions for plant height, spike length, number of florets per spike and number of florets open at a time. Whereas, varieties Yellow Stone, Snow Princess, Prince Margaret Rose, Argentina, Ocilla, Novalux and Priscilla produced higher number of corms as well as cormels per plant and therefore these are considered to be good multiplier. Therefore, these varieties can be recommended *per se* for their cultivation for respective traits. The varieties Yellow Stone, Purple Flora, Chemistry, Snow Princess, Verona, Priscilla, Amsterdam, Argentina, Ocilla and Mascagni can be used in breeding for developing desirable hybrids with attractive colour, long spike and rachis length, long vase-life and better multiplication rate with better climatic and soil adaptability.

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