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Genetic studies in relation to improvement of gladiolus grown in partially reclaimed sodic soil

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ABSTRACT

Gladiolus (*Gladiolus grandiflorus* L.) is one of the economically important and common flowering plants largely cultivated worldwide. It is very popular cut flower, because of its many forms and colours. The aim of this study was to evaluate the performance of 25 gladiolus varieties in partially reclaimed sodic soils of Uttar Pradesh to find out the most suitable variety to utilize the degraded waste land. The extent of variability, heritability and correlation coefficients for its floral characters were determined. High heritability coupled with high genetic advance and coefficient of variability were observed for different growth and floral attributes like plant height, plant diameter, tillers per clump, spike length, florets per spike, corm weight and corms per clump. Spike length was positively correlated with all the characters like plant height, leaf length, leaf width and average corm weight except tillers per clump at genotypic level. Number of florets per spike was significantly and positively correlated with plant diameter, leaf width, tillers per clump and corms per clump. The maximum leaf length and width were noticed in White Goddess and Green Woodpecker, respectively. However, maximum average number of cormels per clump was obtained from J V Gold and maximum average weight of cormels was obtained from Friendship. Spike length was positively and significantly associated with the plant height, leaf length & width and average corm weight.

Key words: Correlation, genotypic variation, gladiolus, phenotypic variation, sodic soil.

INTRODUCTION

Gladiolus (*Gladiolus grandiflorus* L.), is an important cut flower. It has gained the popularity in many parts of the world owing to its beauty and commercial value. It ranks next to tulip and has become one of the most important commercial flower crops of India due to very congenial growing conditions in various parts of the country. Availability of genetic variability is prerequisite for its genetic improvement. Similarly, genetic association provides reliable information on the nature, extent and direction of selection for desirable types. Studies made earlier (Mishra and Saini, 6; Anuradha and Gowda, 1; Sandhu *et al*., 8; Deshraj *et al*., 3) emphasized the role of different direct and indirect selection parameters in gladiolus improvement, but such studies are limited on sodic soil. Here our main focus is to produce gladiolus on degraded lands of Uttar Pradesh and without disturbing the agricultural priorities. Therefore, in the present study, an experiment was conducted to evaluate the genetic variability and characters association in gladiolus varieties grown on partially reclaimed sodic soil.

MATERIALS AND METHODS

The material of present study consisted of 25 exotic and indigenous gladiolus varieties, chosen on the basis of morphological characters. The experiment was laid out in Randomized Block Design with three replications at Banthra Research Station of CSIR-NBRI, Lucknow, Uttar Pradesh. The soil was partially reclaimed by biological methods and characterized as silty clay loam, non-saline sodic soil having pH 8.5, electrical conductivity (0.6 dSm^{-1}), 0.4% organic carbon with low availability of nitrogen (190 $kgha^{-1}$) and phosphorus (38 $kgha^{-1}$). Row to row and plant to plant spacings were maintained at 45 and 25 cm, respectively. Normal cultural practices were followed throughout the cropping season. Observations were recorded on 10 plants of each treatment from every replication for growth and floral characters, such as plant height (cm), tillers per plant, plant diameter (cm), leaf length (cm), leaf width (cm), leaves per plant, spike length (cm), florets per spike, spikes per clump, corms per clump and average corm weight (g). Mean data were subjected to statistical analysis by following the method suggested by Panse and Sukhatme (7). Coefficient of variability, heritability and correlation coefficient were computed according to Johanson *et al*. (4 & 5).

RESULTS AND DISCUSSION

The analysis of variance (Table 1) revealed significant differences among different varieties of

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gladiolus for all the characters indicating the presence of much variability for further genetic studies. The spike length was variable between 45.83 to 70.63 cm with arithmetic mean (X) of 55.46 ± 2.56 cm while florets per spike ranged from 12.07 to 18.77 (X = 14.46 ± 1.29). Tillers per clump and spikes per clump were variable between 1.40 to 2.93 and 1.0 to 2.63 with arithmetic mean of 2.08 ± 0.13 and 1.75 ± 0.18, respectively. Leaves per plant had low variation ranging from 6.10 to 7.43 with arithmetic mean of 6.98 ± 0.15. Leaf length and leaf width were variable from 30.17 to 40.00 cm and 2.83 to 4.07 cm with their arithmetic means of 35.87 ± 1.55 cm and 3.34 ± 0.29 cm, respectively. The maximum leaf length was noticed in 'White Goddess' and leaf width in 'Green Woodpecker'. Corms per clump ranged from 1.43 to 2.50 (X = 1.95 ± 0.17), the maximum being in 'J.V. Gold' and lowest in 'Video'. Average corm weight (g) was variable between 37.67 to 55.90 g with arithmetic mean of 44.66 ± 1.77, the maximum being in 'Friendship'. The range of plant height was between 37.37 to 70.07 cm with arithmetic mean of 54.30 ± 2.30 cm.

A wide range of variability was noticed for most of the characters (Table 1). Genetic variability would help a great deal in detecting the range of genetic diversity for various traits in the population. The high genotypic (GCV) and phenotypic (PCV) variability was noticed for tillers per clump (21.50, 23.06%) followed by corms per clump (19.93, 22.59%), spikes per clump (15.93, 20.59%) and plant height (16.77, 17.57%). The low coefficient of variability for leaves per plant was in agreement of low variation among population. Phenotypic and genotypic variability was quite comparable for all the traits, though PCV was higher partly due to genotypic interaction with environment. However, narrow disparity between two components in present study indicated that they are comparatively stable to environmental variation under genotypic control. Variability alone is not much helpful in determining the heritable portion of variation. Amount of advance to be expected from a selection can be obtained by studying coefficient of variability along with heritability (Burton, 2). Heritability estimates in broad sense ranged from 59.92 to 91.17 percent. Maximum was noticed for plant height (91.17%) followed by spike length (87.99%), tillers per clump (86.96%), average corm weight (80.32%), corms per clump (77.84%) and plant diameter (76.88%). The heritability for leaf width, leaf length, leaves per plant and florets per plant was also high and more or less of similar magnitude. The high heritability indicates that the genotypes are under genotypic control and also confirms the conclusion drawn from genotypic coefficient of variation. The heritability is property not only of these three characters but also of the population and environmental circumstances to which the individuals are exposed. Hence, its value depends upon the magnitude of all the components of variances (Singh and Singh, 10).

The information about heritability can be used to calculate the expected genetic advance which is product of heritability and selection differential expressed in the unit of standard deviation. Thus

Table 1. F value, mean, range, genetic variability and heritability in gladiolus.

Trait	F value	Mean ± SE	Range	Components of variance			Coefficient of variability (%)		Heritability (%)	Genetic advance (%)
				σ^2p	σ^2g	σ^2e	GCV	PCV		
Plant height (cm)	31.93**	54.30 ± 2.30	37.37-70.07	91.010	82.970	8.040	16.77	17.57	91.17	32.99
Tillers per clump	22.13**	2.08 ± 0.13	1.40-2.93	0.230	0.200	0.030	21.50	23.06	86.96	41.25
Plant diameter (cm)	4.14**	1.19 ± 0.09	0.97-1.43	0.017	0.013	0.004	9.69	11.05	76.88	17.50
Leaf length (cm)	6.19**	35.87 ± 1.55	30.17-40.00	8.860	6.250	2.610	6.97	8.33	70.54	12.50
Leaf width (cm)	1.97*	3.34 ± 0.29	2.83-4.07	0.103	0.075	0.028	8.20	9.62	72.89	14.45
Leaves per plant	7.61**	6.98 ± 0.15	6.10-7.43	0.113	0.078	0.035	3.98	4.82	69.11	6.86
Spike length (cm)	22.95**	55.46 ± 2.56	45.83-70.63	82.830	72.430	9.890	15.34	16.36	87.99	29.65
Florets per spike	3.24**	14.46 ± 1.29	12.07-18.77	3.480	2.350	1.130	10.60	12.90	67.53	17.94
Spikes per clump	5.47**	1.75 ± 0.18	1.0- 2.63	0.129	0.078	0.052	15.93	20.59	59.92	25.41
Corms per clump	11.38**	1.95 ± 0.17	1.43-2.50	0.194	0.151	0.043	19.93	22.59	77.84	36.22
Average corm wt (g)	13.24**	44.66 ± 1.77	37.67-55.90	24.040	19.310	4.730	9.84	10.98	80.32	18.16

*,**Significant at 5 and 1% probability levels; σ^2p, σ^2g and σ^2edenote phenotypic, genotypic and error variances, respectively; GCV and PCV denote genotypic and phenotypic coefficients of variability

the genetic gain has an added edge over heritability as a guiding factor in selection programmes where characters are to be improved in desired direction. The direct genetic gain was maximum for tillers per plant (41.25%), followed by corms per clump (36.22%), plant height (32.99%), spike length (29.65%) and spikes per clump (25.41%). The high heritability coupled with high genetic advance and coefficient of variability noticed for plant height, tillers per clump, spike length, average corm weight, corms per clump and plant diameter indicated that most likely the heritability is due to additive gene effect and simple selection model will be good enough to do the needful. Some kind of simultaneous scheme such as selection index based on multiple characters might be of appreciable use in this material (Singh and Singh, 10).

All the possible genotypic and phenotypic correlations among 11 characters are presented in Table 2. Corm weight was positively associated with all the characters at genotypic and phenotypic levels but was significant only with plant height (0.407**), plant diameter (0.459*), and spike length (0.402*). This indicates that all the component characters under study influenced the corm yield directly as well as indirectly to a great extent. Corms per clump had positive correlation with tillers per plant, plant diameter, and leaf width and spike length at both genotypic and phenotypic levels. However, significant positive association was noticed with tillers per clump (0.546**) and leaf width (0.589**) at genotypic level. This indicates that leaf size plays an important role in producing more corms due to high photosynthetic activity in plant. Spike length, the main focal point of gladiolus, was positively and significantly associated with plant height (0.439*), leaf length (0.392*), leaf with (0.835**) and average corm weight (0.402*) at genotypic level. The significant correlation of spike length with plant height, florets per spike and corm weight was also reported by Anuradha and Gowda (1). However, contrary to this negative correlation of spike length with florets per spike was noticed by Mishra and Saini (6). Significant correlation of spike length and corm weight suggests that planting of moderately bigger size corm may give better quality spike length.

Table 2. Correlation coefficients among various traits in gladiolus.

Traits		Tillers per plant	Plant diameter	Leaf length	Leaf width	Leaves per plant	Spike length	Florets per spike	Spikes per clump	Corms per clump	Av. corm wt.
Plant height	rg-	-0.298	-0.173	0.262	-0.115	0.278	0.439*	-0.075	0.259	-0.613	0.407**
	rp-	-0.272	-0.106	0.194	-0.055	0.224	0.427	-0.111	0.137	-0.504	0.334
Tillers per clump	rg-		-0.471*	-0.417*	- 0.049	-0.387	-0.018	-0.482*	0.270	0.546**	0.126
	rp-		-0.329	-0.310	0.019	-0.303	-0.012	-0.313	0.172	0.479	0.066
Plant diameter	rg-			0.141	0.474*	0.047	0.234	1.016**	-0.483*	0.232	0.459*
	rp-			0.040	0.305	0.048	0.214	0.437	-0.242	0.124	0.243
Leaf length	rg-				0.265	0.289	0.392*	0.149	0.092	-0.062	0.264
	rp-				0.292	0.263	0.293	0.162	-0.007	-0.001	0.199
Leaf width	rg-					-0.120	0.835**	0.425*	0.009	0.589**	0.290
	rp-					-0.014	0.466	0.201	0.010	0.288	0.179
Leaves per plant	rg-						0.076	-0.396	0.345	-0.207	0.235
	rp-						0.063	-0.315	0.209	-0.158	0.118
Spike length	rg-							0.373	0.080	0.021	0.402*
	rp-							0.167	0.018	0.001	0.329
Florets per spike	rg-								-0.806**	-0.005	0.383
	rp-								-0.364	-0.008	0.085
Spikes per clump	rg-									-0.159	0.268
	rp-									-0.075	0.167
Corms per clump	rg-										0.213
	rp-										0.156

*,** Significant at 5 and 1% levels

Similarly the significant positive correlation of leaf length and leaf width with spike length and leaf width with florets per spike emphasized that selection for optimum leaf size (length × width) in gladiolus will be more desirable to produce quality spikes with more florets by accumulating more food material through photosynthesis.

The negative correlation of tillers per clump with spike length (-0.018) is indicative that more tillers are undesirable to get long spikes. However, positive genotypic and phenotypic correlation of spike length with florets per spike suggests that long spike with more florets (compact spike length) may be possible and varieties with quality spikes with compact florets may be developed in gladiolus. Florets per spike was positively significant with plant diameter (1.016**) at genotypic level and magnitude was more than one. The correlation coefficient more than one may be raised due to low variances and high co-variances of two varieties involved in correlation. Such results may also arise due to sampling errors. Similar conclusion was also drawn by Singh and Khanna (9). Significant negative correlation (-0.482*) of florets per spike with tillers per clump suggests that more tillers per clump may reduce the florets per spike which is also in agreement of negative correlation of tillers per clump with spike length (-0.018) and spikes per clump with florets/ spike (-0.806**). The negative associations between above traits indicate that these characters inherited independently or were governed by different sets of genes. However, more tillers per clump in gladiolus may be helpful in producing more seed material, *i.e.* corms per clump but not the quality spike. Vanlalruati *et al*. (11) also studied the association of various morphological traits through correlations which showed that leaf area, number of florets per spike and spike length exhibited significant and positive correlation with that of spike per clump.

In present study, spike length, plant height, tillers per clump, corms per clump,average corm weight, leaf length, leaf width and florets per spike were less affected by environment and also had appreciable influence towards quality spike as well as corm production. Hence, to keep balance in production of quality spike and corms per clump due emphasis should be given on above characters in breeding and selecting promising gladiolus varieties.

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