

Genetic variability, heritability and genetic advance of quantitative traits in gladiolus

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ABSTRACT

The present experiment was conducted in the farm area of the Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana during 2011-2012 to assess the variability, heritability and genetic advance of 12 gladiolus genotypes for fifteen characters planted at five different planting times from 10 October to 10 December at fortnightly interval. The coefficient of variation (%) for various traits ranged from 5.73 (florete size) to 60.21 (number of cormels). Phenotypic coefficients of variation (PCV) and genotypic coefficients of variation (GCV) for all the traits under study ranged from 7.72 to 81.61 per cent and 5.17 to 55.09 per cent respectively. PCV was higher than the respective GCV for all the traits under study indicating high degree of environmental influence. The heritability of different traits varied from 29.10 (duration of flowering) to 86.91 per cent (size of corms). The high heritability coupled with high genetic advance (percentage of mean) for corm weight (85.52 and 88.56 respectively) advocated high genetic progress for this character.

Keywords: Heritability; genetic advance; genotypic coefficient of variation; phenotypic coefficient of variation; gladiolus

INTRODUCTION

Gladiolus is an important bulbous crop which occupies important position among cut flowers in domestic as well as international market. The crop has wide range of varietal wealth which exhibits a huge range of variability. The key for any success of any genetic breeding programme for crop improvement lies in the availability of genetic variability for desired traits (Heller 1996). Generally the estimates of heritability of traits

are environment specific (Shimelis and Rhandzu 2010) and should be incorporated in and specifically applied only to the population and environment sampled. Thus selection of traits based on heritability and genetic advance as per cent of mean is of great importance to the breeder for making criteria for improvement in a complex character. The objective of the present study was to quantify the value of genetic variability, heritability and genetic advance for

different quantitative traits in the gladiolus genotypes and to identify important quantitative traits to provide information for developing high yielding gladiolus genotypes.

MATERIAL and METHODS

The present study was undertaken in the farm area of Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana during 2011-2012. The experimental material comprised of 12 gladiolus genotypes viz Punjab Flame, Punjab Pink Elegance, Punjab Glance, Punjab Lemon Delight, Sylvia, Suchitra, CPG, Jacksonville Gold, Red Advance, Red Beauty, Fidelio and Rose Supreme planted at five different planting times viz 10 October, 25 October, 10 November, 25 November and 10 December 2011. The genotypes were sown under randomized block design (RBD) with three replications. Corms were planted at a spacing of 30 x 20 cm with plot size of 2.4 m² and standard packaging techniques were followed to raise the crop. The data on fifteen traits viz days taken to sprouting of corms, days taken to bud initiation, days from bud initiation to flowering, floret size, number of florets per spike, plant height, spike length, weight of spike, number of florets open at one time, vase life, duration of flowering, number of corms per plant, number of cormels per plant, weight of corms per plant and size of corms under five different planting dates were recorded

and pooled. The standard statistical procedures were followed for calculating estimates of variability (Burton and De Vane 1953). Heritability and genetic advance as per cent of population mean were determined as per the formulae suggested by Burton and De Vane (1953) and Johnson et al (1955) respectively.

Coefficient of variability: Phenotypic and genotypic coefficient of variation was calculated as per the formula suggested by Burton and De Vane (1953).

$$PCV = \frac{\sqrt{\text{Phenotypic variance}}}{\text{General mean of population } (\bar{X})} \times 100$$

$$GCV = \frac{\sqrt{\text{Genotypic variance}}}{\text{General mean of population } (\bar{X})} \times 100$$

Heritability: Heritability (h^2) in broad sense (bs) was calculated as per formula given by Burton and De Vane (1953) and Johnson et al (1955).

$$h^2 \text{ (bs) \%} = \frac{V_g}{V_p} \times 100$$

Genetic advance: The expected genetic advance resulting from selection of five per cent superior individuals was calculated by the formula suggested by Burton and De Vane (1953) and Johnson et al (1955).

$$GA = K \cdot \sigma_p \cdot H$$

where GA is genetic advance, K is 2.06 (selection differential at 5% selection index), σ_p is phenotypic standard deviation and H is heritability (in broad sense).

Genetic advance expressed as per cent of population mean was calculated by the method by Johnson et al (1955) as follows:

$$\text{Genetic advance (\%)} = \frac{\text{Genetic advance (GA)}}{\text{Population mean } (\bar{X})}$$

RESULTS and DISCUSSION

Coefficient of variation: The results indicated that coefficient of variation (%) for various traits under study ranged from 5.73 to 60.21. The highest coefficient of variation (%) was observed in number of cormels per plant (60.21) suggesting high degree of variation in the genotypes under evaluation for this character while lowest coefficient of variation was recorded in floret size (5.73) and corm size (6.41). The estimates of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) for fifteen traits of gladiolus genotypes are presented in Table 1.

Phenotypic coefficients of variation (PCV) for various traits under study ranged from 7.72 to 81.61 per cent. The maximum expression of PCV (%) was for number of cormels per plant (81.61) followed by weight of corms per plant (50.27), weight

of spike (35.45), number of florets opened at a time (31.40), vase life (26.90), number of corms per plant (25.01) and days taken from bud initiation to flowering (21.89). PCV (%) was moderate for duration of flowering days (20.89) and days taken to corm sprouting (20.26) while minimum expressions of PCV (%) were observed for number of florets per spike (18.24), size of corms (17.72), days taken to bud initiation (17.69), spike length (14.87), plant height (13.61) and floret size (7.72). PCV was also observed highest for number of cormels per plant by Katwate et al (2002) and Nazir et al (2004).

The genotypic coefficients of variation (GCV) for all the traits under study ranged from 5.17 to 55.09 per cent. Maximum expressions of GCV (%) were observed in number of cormels per plant (55.09), weight of corm per plant (46.49), weight of spike (30.94) and number of florets opened at one time (22.02). Moderate expression of GCV (%) was observed for days from bud initiation to flowering (19.54), number of corms (19.03) and days to sprouting of corms (18.49). Minimum expressions of GCV (%) were observed for floret size (5.17). These results also corroborate the findings of Mahanta and Paswan (1993) who reported maximum GCV for number of daughter corms. Genotypic coefficient of variation (GCV) has also been observed higher for number of cormels per plant by Sheikh et al (1995), Raj and Mishra (1996) and

Table 1. Coefficient of variation, phenotypic coefficient and genotypic coefficient of variation, heritability and genetic advance of fifteen traits of gladiolus genotypes

Character	Coefficient of variation (%)	PCV (%)	GCV (%)	Heritability (h_b %)	Genetic advance	Genetic advance as % of mean
Days taken to sprouting of corms	8.29	20.26	18.49	83.26	4.46	34.75
Days taken to bud initiation	8.39	17.69	15.57	77.52	24.27	28.24
Days taken from bud initiation to flowering	9.87	21.89	19.54	79.68	6.29	35.94
Floret size (cm)	5.73	7.72	5.17	44.80	0.60	7.12
# florets/spike	13.08	18.24	12.71	48.56	2.17	18.24
Plant height (cm)	9.65	13.61	9.60	49.72	11.14	13.94
Spike length (cm)	10.32	14.87	10.70	51.82	9.80	15.87
Duration of flowering (days)	17.59	20.89	11.27	29.10	1.30	12.52
Weight of spike (g)	17.30	35.45	30.94	76.19	18.96	55.64
# florets open at one time	22.38	31.40	22.02	49.20	1.39	31.82
# corms/plant	16.23	25.01	19.03	57.92	0.47	29.84
# cormels/plant	60.21	81.61	55.09	45.57	11.43	76.60
Weight of corms/plant (g)	19.13	50.27	46.49	85.52	42.26	88.56
Size of corms (cm)	6.41	17.72	16.52	86.91	1.27	31.73
Vase life (days)	22.15	26.90	15.26	32.18	1.76	17.83

PCV = Phenotypic coefficient of variation, GCV = Genotypic coefficient of variation

Sidhu (1989). Raj and Mishra (1996) obtained the highest PCV and GCV for number of cormels/plant and average weight of cormels/plant. Both the genotypic and phenotypic variance were highest for characters like number of cormels per plant, weight per corm, plant height and spike length.

Heritability: Data pertaining to heritability (in broad sense) and genetic advance are presented in Table 1.

In the present study heritability estimates in broad sense were classified into 3 groups such as high (>80%), moderate (50-80%) and low (<50%). High heritability was recorded for size of corms (86.91), weight of corms per plant (85.52) and days taken to sprouting of corms (83.26). The spike length (51.82), number of corms per plant (57.92), weight of spike (76.19) and days taken to bud initiation (77.52) showed moderate heritability (50-80%) while the other traits showed low heritability (<50%) ie duration of flowering (29.10). Mishra and Saini (1988), Negi et al (1982) and Neeraj et al (2005) also reported high heritability for weight of corms. The present results on the high heritability for weight of daughter corms support the earlier findings of Mahanta and Paswan (1993).

Genetic advance: The highest genetic advance as percentage of mean was recorded for weight of corms per plant

(88.56) followed by number of cormels (76.60) and weight of spike (55.64). Moderate genetic advance (%) estimates were obtained for days taken from bud initiation to flowering (35.94), number of florets opened at one time (31.82) and size of corm (31.73). Low genetic advance (%) was observed for number of corms per plant (29.84), days taken to bud initiation (28.24), number of florets (18.24), vase life (17.83), spike length (15.87), plant height (13.94), duration of flowering (12.52) and floret size (7.12). Archana et al (2008) also reported maximum genetic advance as percentage of mean for corm weight while high value of genetic advance was observed for number of cormels per plant by Katwate et al (2002).

The high heritability coupled with high genetic advance as percentage of mean was observed for corm weight (85.52 and 88.56% respectively) indicating that selection for this character is governed by additive gene action and can be improved easily by selection method. The high heritability coupled with high genetic advance for corm weight was also reported by Mishra et al (2014). These results are also in conformity with the findings of Archana et al (2008).

PCV was higher than GCV for all the characters under study indicating high degree of environmental influence on these traits. Likewise Katwate et al (2002) and Patil et al (2002) also reported higher PCV

than GCV for all characters. The greater differences between GCV and PCV were observed for the traits like number of florets per spike, plant height, spike length, duration of flowering, weight of spike, number of florets opened at one time, number of corms per plant, number of cormels per plant, weight of corms per plant and vase life indicating that these traits were influenced by environmental factors to greater extent while all others traits showed very little difference between GCV and PCV indicating that there was very little environmental influence on them and these traits cannot be improved by providing favorable environment. Mishra et al (2014) also reported greater difference between GCV and PCV for the plant height at 30 days after planting and number of corms per plant. The above findings are broadly in agreement with the earlier findings of Burton (1952).

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