*Original Research Article*

# ESTIMATION OF GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE AMONG THE CHARACTERS OF GLADIOLUS (*Gladiolus grandiflorus* L.)

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## Abstract

The present investigationwas carried out at the Horticultural Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh during *Rabi* season 2020-21 to determine the extent of genetic variability, heritability and genetic advance for twenty-five genotypes of Gladiolus. The present experiment was laid out in Randomized Block design (RBD) with three replications.Analysis of variancerevealed highly significant differences among the genotypes for all the characters. Highest PCV and GCV were recorded for number of spike per plant (35.81 and 23.41, respectively). The phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the characters studied indicating that the apparent variation is not only due to genotype, but also due to the influence of environment.The estimated heritability ranged between42.75 (number of spike per plant) to 99.01(spike weight).This suggested that these traits were least influenced by environmental factors.The estimated Genetic advance as percent of mean ranged between plant height at 90 days (9.81) to number of spike per plant (31.53).Results obtain from the study revealed that high heritability coupled with high genetic advance for width of longest leaf, stem girth, flowering duration, spike weight, number of floret per spike, floret diameter and fresh weight of corm indicating that the heritability is due to additive gene action and simple selection for such traits could be practiced for improving them.



**Keywords:** Gladiolus, Genetic variability, Heritability and Genetic advance


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## Introduction

Gladiolus (*Gladiolus grandiflorus* L.) is popularly known as “Queen of bulbous flower” is the member of family Iridaceae and native of South Africa with somatic chromosome number

2n = 2x = 30. Gladiolus is an aesthetic cut flower with fascinating spikes, possessing florets of brilliant color, attractive shapes and various sizes, which open gradually from base to the top.Gladiolus flowers have been associated with mankind since the dawn of civilization. They are symbols of love, beauty and tranquility. Due to its sword-shape foliage it is commonly called as "Sword lily".The stem of gladiolus is herbaceous and the leaves are narrowly linear, flattened at the sides and sheathing at the base. The flowers are bisexual, actinomorphic, perianth petaloid has three stamens and the ovary is completely inferior **(Hutchinson *et al.* 1959).** The propagating material of gladiolus is called "corm" which is a food - storing underground stem. While the new daughter corm is forming on the top of the old one, small new corms and cormels or cormlets are produced from the base. These corms and cormels are the chief means of gladiolus propagation.It is extensively grown in hills and plains almost all over the world.Total area under floriculture in India is second largest in the world and only next to China. Gladiolus is grown in an area of 9.37 thousand hectare with production of 707 million spikes in India. India has suitable agro-climatic conditions for gladiolus cultivation. Cut flowers being grown over an area of 1,460,000 ha, production of66,671,000 spikes with productivity of 45665.07 spikes in India **(Anonymous, 2018)**.In India, it is commercially cultivated in West Bengal, Himachal Pradesh, Sikkim, Karnataka, Uttar Pradesh, Tamil Nadu, Punjab and Delhi. The existence of genetic variability is the prerequisite for crop improvement programme. Yield is a complex quantitative trait which cannot be improved by selecting individuals on a per se performance basis. Thus, it can be improved by practicing selection for other traits which are highly heritable and are interrelated with the yield as well Progresses in any breeding program depend upon the extent and mature of variability existing in the base population.Thus, the success of any plant breeding program depends on selection of elite genotypes which ultimately depends on knowledge of variability and genetic diversity of the germplasms. Genotypic and phenotypic coefficient of variation measures the extent of variability (genotypic and phenotypic) present in a population for a particular character. Heritability is an index of transmissibility of a character from parents to their offspring. The concept of heritability is important in determining whether the phenotypic differences among the individuals are genetically or the result of environment factors. Genetic advance on the other hand measures the expected genetic gain from the selection applied in a population. Heritability along with genetic advance gives the best picture of the efficiency of selection. In order to incorporate desirable characters to maximize economic yields, the

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information on the nature and extent of genetic variability present in a population for desirable characters their association and relative contribution to yield constitutes the basic requirement. Considering these point, the present investigation was designed to find out the extentof genetic variability in Gladioluscultivars bydetermining the coefficient of variations, heritability and geneticadvance.

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## Materials and Methods

The present investigation entitled "$D^2$ Analysis and Direct & Indirect Selection Parameter for Yield and Its Component in Gladiolus (*Gladiolus grandiflorus* L.)" was carried out at the Horticultural Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh during *Rabi* season 2020-21. Geographically, Meerut is situated at 29°01′ latitudes in the North and 77°45′ longitudes and at altitude of 277 m above Mean Sea Level(MSL) representing the North Western plain zone. The experimental materials comprised of 25 genotypes ofGladiolus*viz.*,Pusa Bindiya, White Prosperity,Pusa Jyotsana,Hunting Song,Eurovision,Pusa Kiran,Pusa Shanti,Mayur,PusaManmohak,Pusa Red Ralentine,Berlew,Oscar,Surya Kiran,Suchitra,Berlew-II,Local Orange,Rose Suprime,Traderhorn,Novalux,Red Beauty,Pink Friendship,Shobha,Pusa Vidushi,Anjali andLegend collected from different parts of India.Considering each genotype to represent one treatment the experiment was laid out in Randomized Block Design(RBD) with three (3) replications.The observation was recorded on five randomly selected plants per treatment from each replication for 16 characters *viz.*,Days to 50% corm sprouting, days to completely corm sprouting,plant height (cm), number of leaves per plant , length of longest leaf, width of longest leaves,stem girth (cm), days to spike emergence, flowering duration, number of spike per plant , spike length (cm), spike weight (g) number of florets per plant, flower diameter (cm) fresh weight of corm (gm) and yield of corm(q/ha).The genotypic and phenotypic coefficients of variation were calculated using the formulae of Burton (1952) and Johnson *et al.* (1955).The heritability and genetic advance were calculated according to Allard (1960) and genetic advance as per cent of mean was estimated using the method of Johnson *et al.* (1955).

## Results and Discussion

**Analysis of variance**

Analysis of variance (ANOVA)presented in Table-1 revealed highly significant differences among the genotypes for all the traits *viz.*, days to 50% corm sprouting, days to completely corm sprouting, plant height at 30, 60 and 90 days, number of leaves per plant at 30, 60 and 90 days, length of longest leaf, width of longest leaf, stem girth, days to spike emergence, flowering duration, number of spike per plant, spike length, spike weight, number of floret per spike, floret diameter, fresh weight and yield of corm indicates the presence of considerable genetic variability in the experimental material. These results were in agreement with the findings ofKumar and Kulkarni 2009; Bhujbali*et al*., 2013; Patra and Mohanty 2014; Emna and Faouzi 2015; Kumar *et al*., 2015; Rashmi *et al*.,2016; Ramzan *et al*.,2016; Singh *et al*., 2017; Momin *et al*., 2017; Ishwarraddy*et al*., 2018 and Kumar *et al*., 2019.

**Variance and Coefficients of Variation**

The Phenotypic coefficient of variation (PCV) andgenotypic coefficient of variation (GCV)were worked out for all the sixteen characters under study and the results were furnished inTable-2.The phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the characters studied indicating that the apparent variation is not only due to genotype, but also due to the influence of environment.The highest GCV was recorded for number of spike per plant (23.41). Moderate GCV obtained from flowering duration (15.59), days to 50% corm sprouting (14.96), days to complete corm sprouting (13.91), number of leaves per plant at 30 days (13.41),width of longest leaf (13.03), floret diameter (11.45), fresh weight of corm (11.43), number of floret per spike (11.33), stem girth (10.92) and spike weight (10.86). while lowest GCV was observed for number of leaves per plant at 60 days (9.36),length of longest leaf (9.04), yield of corm (8.75), plant height at 30 days (8.87), number of leaves per plant at 90 days (8.24), plant height at 60 days (6.82), spike length (5.81), days to spike emergence (5.32) and plant height at 90 days (4.88).The highest phenotypic coefficient of variation was found for number of spike per plant (35.81). Moderate PCV obtained for days to 50% corm sprouting (17.08), flowering duration (16.33), number of leaves per plant at 30 days (16.02), days to completely corm sprouting (14.79), weight of longest leaf (14.54), floret diameter (12.63), number of floret per spike (12.53), number of leaves per plant 60 days (12.16),

**Table-1: Analysis of variances (ANOVA) for sixteen characters of twenty-five genotypes in Gladiolus (*Gladiolus grandiflorus*L.)**

| Source of variation | D.F. | Days to 50%corm sprouting | Days to completely corm sprouting | Plant height | | | Number of leaves per plant | | | Length of longest leaf | Width of longest leaf |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | At 30 days | At 60 days | At 90 days | At 30 days | At60 days | At 90 days | | |
| **Replication** | 2 | 0.67 | 0.62 | 1.98 | 1.97 | 1.67 | 0.60 | 1.50 | 1.15 | 10.07 | 0.14 |
| **Treatment** | 24 | 2.04** | 6.27** | 36.04** | 51.69** | 59.50** | 1.53** | 1.46** | 1.81** | 82.72** | 1.71** |
| **Error** | 48 | 0.19 | 0.26 | 0.84 | 0.84 | 0.92 | 0.19 | 0.27 | 0.33 | 0.54 | 0.13 |

| Source of variation | D.F. | Stem girth (mm) | Days to spike emergence | Flowering duration | Number of spike per plant | Spike length (cm) | Spike weight (g) | Number of florets per spike | Floret diameter (cm) | Fresh weight of corm (g) | Yield of corm (q / ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Replication** | 2 | 8.48 | 13.91 | 1.51 | 0.05 | 7.61 | 6.26 | 0.60 | 0.37 | 8.35 | 0.86 |
| **Treatment** | 24 | 43.58** | 46.07** | 31.38** | 0.40** | 69.31** | 187.31** | 10.36** | 5.19** | 79.56** | 66.89** |
| **Error** | 48 | 0.91 | 1.39 | 0.98 | 0.12 | 0.73 | 0.62 | 0.72 | 0.35 | 0.68 | 3.99 |

*, ** significant at 5% and 1% level, respectively

fresh weight of corm (11.58), stem girth (11.27), spike weight (10.91) and number of leaves per plant at 90 days (10.61). While, lowest PCV was observed for yield of corm (9.54), length of longest leaf (9.12), plant height at 30 days (8.77), plant height at 60 days (6.99), stem girth (5.91), days to spike emergence (5.56) andplant height at 90 days (4.99).Further the present findings exhibited that the estimate of Phenotypic coefficient of variation(PCV) were magnitudinally higher than their correspondingGenotypic coefficient of variation(GCV) for all the traits studied. This suggests that phenotypic expression of the genotypes was least influenced by factors and desirable improvement can be achieved through simple selection procedures. These results were in consonance with the findings of Patra and Mohanty 2014; Kumar *et al*., 2015; Kumar *et al*., 2015; Rashmi *et al*., 2016; Ramzan *et al*., 2016; Nainwal*et al*., 2016; Verty*et al*., 2017; Kaushik *et al*., 2018; Swetha *et al*., 2020; Balaram and Jankram 2009 andKispota*et al*., 2017.

A perusal of the genetic parameters revealed that, number of spike per plant exhibited high phenotypic and genotypic coefficient of variation suggesting that the existence of sufficient genetic variability for this trait in the population. Thus, it provides the basis for selection of desirable genotypes from the diverse population for enhancement of gladiolus production.

**Heritability**

All the characters under study showed high heritability (>80%). The results obtained on heritability in broad sense for yield and attributing characters has been presented in Table-2**.** The estimated heritability ranged between42.75 (number of spike per plant) to 99.01(spike weight).Highest heritability was observed for spike weight (99.01) followed by length of longest leaf (98.05), fresh weight of corm (97.47), spike length (96.91), plant height at 90 days (95.48), plant height at 60 days (95.27), stem girth (94.00), plant height at 30 days (93.35), days to spike emergence (91.44), flowering duration (91.14), days to completely corm sprouting (88.39), yield of corm (84.02), floret diameter (82.16), number of floret per spike (81.74) andlength of longest leaf (80.35) respectively. Moderateheritability wasobserved for days to 50% corm sprouting (76.73), number of leaves per plant at 30 days(70.03) and number of leaves per plant at 90 days (60.31).While lowest heritability was observed for number of leaves per plant at 60 days (59.18) and number of spike per plant (42.75).This suggested that these traits were least influenced by environmental factors. In other words it could be concluded that the phenotypic expression for these traits were true representative of its genotype. Such high heritability estimates have been

**Table-2: Estimates of range, GCV (%), PCV (%), Heritability $h^2$ % (BS), Genetic advance and Genetic advance as percentage of mean for sixteen characters in Gladiolus (*Gladiolus grandiflorus*L.).**

| Characters | | Range | | Heritability (%) | G.A. | G.A. % mean | GCV (%) | PCV (%) |
|---|---|---|---|---|---|---|---|---|
| | | Min. | Max. | | | | | |
| Days to 50% corm sprouting | | 3.65 | 7.01 | 76.73 | 1.42 | 27.00 | 14.96 | 17.08 |
| Days to completely corm sprouting | | 7.81 | 12.60 | 88.39 | 2.74 | 26.94 | 13.91 | 14.79 |
| Plant height | At 30 days | 34.42 | 48.21 | 93.35 | 6.82 | 16.86 | 8.47 | 8.77 |
| | At 60 days | 53.45 | 67.29 | 95.27 | 8.28 | 13.71 | 6.82 | 6.99 |
| | At 90 days | 84.27 | 98.45 | 95.48 | 8.89 | 9.81 | 4.88 | 4.99 |
| Number of leaves per plant | At 30 days | 3.81 | 6.96 | 70.03 | 1.15 | 23.11 | 13.41 | 16.02 |
| | At 60 days | 5.25 | 8.27 | 59.18 | 1.00 | 14.83 | 9.36 | 12.16 |
| | At 90 days | 6.98 | 10.15 | 60.31 | 1.13 | 13.19 | 8.24 | 10.61 |
| Length of longest leaf | | 48.33 | 68.47 | 98.05 | 10.68 | 18.43 | 9.04 | 9.12 |
| Width of longest leaf | | 3.95 | 7.79 | 80.35 | 1.34 | 24.06 | 13.03 | 14.54 |
| Stem girth (mm) | | 26.74 | 39.44 | 94.00 | 7.53 | 21.82 | 10.92 | 11.27 |
| Days to spike emergence | | 66.41 | 79.30 | 91.44 | 7.60 | 10.48 | 5.32 | 5.56 |
| Flowering duration | | 15.48 | 25.91 | 91.14 | 6.26 | 30.66 | 15.59 | 16.33 |
| Number to spike per plant | | 1.00 | 2.00 | 42.75 | 0.41 | 31.53 | 23.41 | 35.81 |
| Spike length (cm) | | 72.62 | 89.45 | 96.91 | 9.70 | 11.79 | 5.81 | 5.91 |
| Spike weight (g) | | 58.29 | 88.48 | 99.01 | 16.17 | 22.25 | 10.86 | 10.91 |
| Number of florets per spike | | 12.26 | 18.87 | 81.74 | 3.34 | 21.09 | 11.33 | 12.53 |
| Floret diameter (cm) | | 8.77 | 13.66 | 82.16 | 2.37 | 21.37 | 11.45 | 12.63 |
| Fresh weight of corm (g) | | 35.91 | 52.87 | 97.47 | 10.43 | 23.24 | 11.43 | 11.58 |
| Yield of corm (q / ha) | | 42.23 | 61.05 | 84.02 | 8.65 | 16.51 | 8.75 | 9.54 |

reported byBhujbali*et al*., 2013; Patra and Mohanty 2014; Mishra *et al*., 2014; Kumar *et al*., 2015; Nainwal*et al*., 2016; Singh *et al*., 2017; Verty*et al.*, 2017 and Kaushik *et al*., 2018.

**Genetic Advance as Percentage of Mean**

Genetic advance as percent of mean depicted in Table-2 was found high (>20%) for number of spike per plant (31.53) followed by flowering duration (30.66), days to 50% corm sprouting (27.00), days to completely corm sprouting (26.94), width of longest leaf (24.06), fresh weight of corm (23.24), number of leaves per plant at 30 at days (23.11), spike weight (22.25), stem girth (21.82), floret diameter (21.37) and number of floret per spike (21.09). while the moderate genetic advance (<20% to >10%) was observed for length of longest leaf (18.43), plant height at 30 days (16.86), yield of corm (16.51), number of leaves per plant at 60 days (14.83), plant height at 60 days (13.71), number of leaves per plant at 90 days (13.19), spike length (11.79) and days to spike emergence (10.48), respectively. while the lowest (<10%) was observed for plant height at 90 days (9.81).Results obtain from the study revealed that high heritability coupled with high genetic advance for width of longest leaf, stem girth, flowering duration, spike weight, number of floret per spike, floret diameter and fresh weight of corm indicating that the heritability is due to additive gene action and simple selection for such traits could be practiced for improving them. Similar results were obtained byBhujbali*et al*., 2013; Patra and Mohanty 2014; Mishra *et al*., 2014; Kumar *et al*., 2015; Nainwal*et al*., 2016; Singh *et al*., 2017; Verty*et al*., 2017; Kaushik *et al*., 2018. Ishwarraddy*et al*., 2018; Kumar *et al*., 2019 and Swetha *et al*., 2020.

## Conclusion

On the basis of results shown in the present investigation Variance analysis revealed that sufficient amount of genetic variability existed among the present set of breeding material and study for genetic parameters, with these genotypes, was worth for valuable findings. All the traits *viz.*, days to 50% corm sprouting, days to corm sprouting, plant height, number of leaves per plant, length of longest leaf, width of longest leaves, stem girth, days to spike emergence, flowering duration, number to spike per plant, spike length, spike weight, number of florets per plant, flower diameter, fresh weight of corm yield of corm, yield of corm to respond direct selection is effective. The estimates of heritability was high for all the traits under study *viz.*,spike weight, length of longest leaf, fresh weight of corm, spike length, plant height at 90 days plant height at 60 days, stem girth, plant height at 30 days, days to spike emergence,

flowering duration, days to completely corm sprouting, yield of corm, floret diameter, number of floret per spike, length of longest leaf, days to 50% corm sprouting, number of leaves per plant at 30 day, number of leaves per plant at 90 days, number of leaves per plant at 60 days and number of spike per plant. This indicated the influence of additive gene action for expression of these characters and hence selection based on these traits may be useful for effective improvement in gladiolus crop.Results obtain from the study revealed that high heritability coupled with high genetic advance for width of longest leaf, stem girth, flowering duration, spike weight, number of floret per spike, floret diameter and fresh weight of corm indicating that the heritability is due to additive gene action and simple selection for such traits could be practiced for improving them.

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