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Assessment of Genotypic and Phenotypic Correlation Coefficient in Twenty Genotypes of Gladiolus (*Gladiolus grandiflorus* L.) for Gwalior Region

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted to study the "Genotypic and Phenotypic correlation coefficient in twenty genotypes of Gladiolus for Gwalior region" during 2021-2022 at Department of Genetics and Plant Breeding, School of Agriculture, ITM University, Gwalior, Madhya Pradesh. In this experiment twenty genotypes of Gladiolus were planted for the evaluation and the results of investigation

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revealed that for yield improvement through selection emphasis should be given on the characters like Plant height, Spike length, Rachis length, No. of shoots per plant, No. of corms per plant. Especially the emphasis may be laid down upon the Plant height, Number of florets or Diameter of the floret, since these characters had highly significant and positive correlations with Spike length so a direct selection from genotypes will be more effective for improvement of this crop.

Keywords: Correlation coefficient; genotypic; gladiolus; phenotypic; yield.

1. INTRODUCTION

"Gladiolus is a bulbous ornamental flower having beautiful spikes as well as larger vase life, it belongs to family Iridaceae and sub- family Ixodidae" [1]. "It is called as the queen of bulbous flowers [2] and popularly known as sword lily because of its sword shaped leaf". "The centre of origin of Gladiolus is South Africa and widely spread in central Europe, Mediterranean region, western Asia and Asia Minor" [3]. "This genus is mostly heteroploidy, Ploidy in the genus ranges from diploid (2n= 30) to decaploid (2n = 12X = 180). It has first among bulbous flowers and eighth among cut flowers in world trade" [4]. According to Misra and Singh [5], "more than 30,000 varieties of gladiolus are cultivated and new cultivars are added annually". "Worldwide it is being grown in an area of 11,660 ha in the country with an estimated production of 106 crore cut flowers" [6]. "In India, major gladiolus producing states in country are Uttar Pradesh, West Bengal, Odisha, Chattisgarh, Haryana and Maharashtra, as it is mainly a winter season flower crop, in areas having moderate climate conditions, gladiolus can be grown throughout the year. It is cultivated for its magnificent spikes, which contain lovely, graceful, and delicate florets that open sequentially over a longer period and have good spike holding qualities. There are many varieties of gladiolus having beautiful inflorescence in large range of colours, different shades, size and wide range of No. of florets per spike. Genetic variation and Genetic relationship among genotypes are an important consideration for classification and utilization of germplasm resources in breeding programmes" [7]. "The magnitude of genetic variability in gene pool is the pre-requisite of the breeding programme" [8]. "Correlation measures the degree and direction of association between two or more variables and mutual relationship between various plant characters and determines the component character on which selection is based for genetic improvement for a particular character. Thus, association of yield with yield attributing characters is of great importance for planning and executing breeding programme. As correlation provides information about yield contributing characters. This information is useful to plant breeders in selection of elite genotypes from diverse genetic populations" [9]; (Johnson et al*.,* 1955). "Mass selection has been used to improve grain yield in several crops through indirect selection for highly traits which are associated with yield (Simmonds, 1979) and hence, the present experiment was conducted to study the genotypic and phenotypic correlation coefficient of 20 genotypes of gladiolus for their different flowering traits (24 traits)".

2. MATERIALS AND METHODS

The experimental materials for the present investigation consisting of 20 genotypes of gladiolus were sown at Crop Research centre (CRC), School of Agriculture, Department of Genetics and Plant Breeding, ITM university, Gwalior, Madhya Pradesh. Positioned 26.22 N 78.18 E geographically. The location falls under grid Agroclimatic zone of Madhya Pradesh with an average rainfall of 700 mm per year. The average elevation of the land of Gwalior is about 197 m above the mean sea level. The temperature during the summer months goes on ascending and reaches up to a high of 47°C. The winter months on the other hand are chilling and the temperature varies from 1℃ to 3°C. The experimental material consisted of twenty genotypes of gladiolus obtained from SHUATS, Prayagraj, Uttar Pradesh. The experiment was conducted during 2021-2022 in Randomized block design (RBD) with three replications. The experimental 15 corms of each genotype were planted with the spacing of 30 ×15 cm. All the recommended agronomic practices and management were followed to grow a successful crop. Data were recorded for growth, flowering and yield traits *viz.,* Days to 50% Sprouting, Days to Spike Initiation, Plant height at anthesis, Leaves per corm, Leaf area, 50% heading, Days to 1st floret initiation, Spike length, Rachis length, Number of floret per spike, Senescence of last floret, Plant height at spike fully opened, Number of partially opened flower, Days to senescence of

1st floret, Diameter of 1st flower, Diameter of 3rd floret, Durability of spike, Days to last floret opening, Number of corms per plant, Weight of daughter corms, Diameter of daughter corms, Number of cormels per plant, Number of daughter corms, Shoots per corm. Ten randomly selected plants from each plot were selected for the purpose of recording data. The data collected during the trail for these traits are subjected to analysis for genotypic and phenotypic correlation coefficients was estimated as per the procedure suggested by Johnson et al. (1955) and Al. Jabouri et al. [10] to study how these component characters under study influence spike yield and corm yield. The software used for the statistical analysis was R-Studio application and OP Stat.

3. RESULTS AND DISCUSSION

Shoots per corm, No. of florets per spike, Spike length, No. of spike per plant, No. of corms produced per mother corm are important economic character in gladiolus. Estimates of correlation coefficient among yield contributing character in a population of 20 genotypes of Gladiolus at genotypic and phenotypic levels are presented in (Tables 1 and 2). Present investigation revealed that in general phenotypic coefficient of correlation were having higher values for most of the characters than that of genotypic correlation coefficient. Similar observations were reported by various workers including Verty et al. [6], Lal et al. [11], Gowda [12] and Misra and Saini [13].

3.1 50% Sprouting

The character Days to 50% sprouting displayed positive significant correlation at both phenotypic and genotypic levels with traits Plant height at flowering stage (r_g 0.32; r_p 0.31), Diameter of first floret (r_g 0.56; r_p 0.32) and Diameter of 3rd floret (r_g 0.39; r_p 0.26) and significant negative correlation at phenotypic level with traits No. of shoots per plant (r_p -0.33), No. of corms per plant (r_p -0.27). similar results were also drawn by verty et al. [6], Choudhary et al. [14] and Ahmed et al. [15].

3.2 Spike Initiation

The character Days to spike initiation displayed a positive correlation at both genotypic and phenotypic level for the characters 50% heading (r_g 0.58; r_p 0.44), Days to 1st floret initiation (r_g 0.54; r_p 0.43), Spike length (r_g 0.43; r_p 0.26), Rachis length (r_g 0.54; r_p 0.28), Senescence of last floret (r_g 0.50; r_p 0.40), Plant height at fully spike opened (r_g 0.56; r_p 0.34), Diameter of 1st flower (r_g 0.47; r_p 0.28), Days to last floret opening (r_g 0.56; r_p 0.45). Only one character has been recorded to have negative correlation that is Durability of spike (r_g - 0.45; r_p - 0.31). Anuradha et al. [16], Archana et al. [17] and Bhujbal et al. [18] had also reported coinciding trends for days to spike initiation.

3.3 Plant Height at Flowering Stage

The character Plant height at flowering stage displayed a positive significant correlation at both genotypic and phenotypic level for the characters 50% heading (r_g 0.61 ; r_p 0.54), days to 1st floret initiation (r_g 0.67 ; r_p 0.59), spike length (r_g 0.68 ; r_p 0.49), rachis length (r_g 0.68 ; r_p 0.44), no. of floret spike (r_g 0.44 ; r_p 0.32), senescence of last floret (r_g 0.71 ; r_p 0.59), plant height at spike fully opened (r_g 0.57 ; r_p 0.38), days to senescence of 1st flower (r_g 0.65 ; r_p 0.57), diameter of 1st flower (r_g 0.87 ; r_p 0.52), diameter of 3rd floret (r_g 0.93 ; r_p 0.47), days to last floret opening (r_g 0.67 ; r_p 0.57) and significant negative correlation had been recorded in weight of daughter corms (r_g - 0.40 ; r_p - 0.29) in association with character plant height. In contrast to this trait *viz.,* diameter of daughter corms displayed significantly negative genotypic correlation. These results are in agreement with earlier reports of Neeraj et al. [19], Jhon et al. [20], Misra and Saini [5], Gowda [12], Lal et al. [11] in gladiolus and Kavitha and Anburani (2010) in African marigold and Rakesh Kumar and Santosh kumar [21] in snap dragon.

3.4 Leaves per Corm

The character leaves per corm displayed a significant and positive correlation at both genotypic and phenotypic level for the characters Diameter of 1st flower (r_g 1.01; r_p 0.33) and Diameter of 3rd floret (r_g 0.84; r_p 0.26) which indicates the importance photosynthetic area for these characters. whereas, negative correlation at genotypic and phenotypic levels for the characters recorded in no. of cormels per plant (r_g - 0.68; r_p - 0.28) and shoot per corm (r_g - 0.77; r_p - 0.47) indicates that increase in leaf number results in length of shoot. The results are in accordance with Zorana et al. (2011), Bazzaz et al. [22], Jhon et al. [20], Neeraj et al. [19] in gladiolus, Gangadhara et al. (2008) in tuberose.

3.5 Leaf Area

The character leaf area estimated a significant and positive correlation at both genotypic and phenotypic level for the characters, Number of partially opened flower (r_g 0.46; r_p 0.30) and Weight of daughter corms (r_g 0.56; r_p 0.27) whereas significant and negative correlation of character leaf area at both genotypic and phenotypic level was recorded for character durability of spikes (r_g - 0.28; r_p - 0.29). Similar work was carried out by Zorana et al. (2011).

3.6 50% Heading

The character 50% heading displayed a significant and positive correlation at both genotypic and phenotypic level for the characters, Days to 1st floret initiation (r_g 0.96; r_p 0.94), Spike length (r_g 0.46; r_p 0.33), Number of florets per spike (r_g 0.38; r_p 0.29), Plant height at spike fully opened (r_g 0.47; r_p 0.39), Days to senescence of 1st flower (r_g 0.90; r_p 0.88) and Days to last flower opening (r_g 0.88; r_p 0.82). indicating that earlier flowering results in earlier opening of floret. Whereas, significant and negative correlation was recorded by this parameter with one character that is durability of spikes (r_g -0.69; r_p -0.57). The results are in consonance with Sakkeer Hussain et al. [23], Manjunath et al. (1997) and Anuradha et al. [24].

3.7 Days to 1st Floret Initiation

Days to 1st floret initiation has shown significant and positive correlation at both genotypic and phenotypic level with Spike length (r_g 0.48; r_p 0.35), Rachis length (r_g 0.50; r_p 0.36), No. of floret per spike (r_g 0.42; r_p 0.32), Plant height at spike fully opened (r_g 0.48; r_p 0.38), Days to senescence of 1st floret (r_g 0.97; r_p 0.97), Diameter of 1st flower (r_g 0.48; r_p 0.30), Days to last floret opening (r_g 0.95; r_p 0.90). Whereas, significant and negative correlation was recorded by this parameter with only one character that is durability of spikes (r_g - 0.64; r_p - 0.53). The result is in conformity with Balarama and Janakiram (2009), Verma [25] Jhon et al. [20] and Neeraj et al. [19].

3.8 Spike Length

Character spike length had recorded significant and positive correlation at both genotypic and phenotypic level with characters Rachis length (r_g 0.98 ; r_p 0.98), No. of floret per spikes (r_g 0.89 ; r_p 0.78), Senescence of last floret (r_g 0.55 ; r_p 0.37), Plant height at spike fully opened (r_g 0.87 ; r_p 0.80), Days to senescence of 1st floret (r_g 0.54 ; r_p 0.42), Diameter of 1st flower(r_g 0.75 ; r_p 0.27), Diameter of 3rd floret (r_g 0.55 ; r_p 0.31) and Days to last floret opening (r_g 0.57 ; r_p 0.40), whereas for this parameter no negative significant correlation was recorded. These findings are in agreement with Jhon et al., [20]. Similar results were reported by Sisodia et al. [26], Verty et al. [6], Aasia et al. (2016), Balaram and janakiram [27], Verma [25], Jhon et al. [20], Neeraj et al. [19], Singh et al. [28] and Hegde (1994) in gladiolus, Gangadharappa et al. (2008) in Tuberose and Rakesh Kumar and Santosh Kumar [21] in Snap dragon. Especially the emphasis may be laid down upon the plant height, number of florets or diameter of the floret. Since these characters had highly significant positive correlations with spike length so a direct selection from genotypes will be more effective for improvement of this crop.

3.9 Rachis Length

Character Rachis length had recorded significant and positive correlation at both genotypic and phenotypic level for the characters, No. of florets per spike (r_g 0.89; r_p 0.76), Senescence of last floret (r_g 0.53; r_p 0.35), Plant height at spike fully opened (r_g 0.86; r_p 0.79), Days to senescence of 1st flower (r_g 0.55; r_p 0.43), Diameter of 3rd floret (r_g 0.50; r_p 0.30) and Days to last floret opening (r_g 0.56; r_p 0.39) indicates that more length of rachis will lead to more No. of florets, Plant height, more Days to senescence of florets. Whereas, significant and negative correlation was recorded for this parameter for only one character that is Durability of spikes (r_g - 0.64; r_p - 0.28) indicating that small rachis length directly affects the durability of spikes. Hussain et al. [23], Anuradha et al. [16], Lepcha et al. [29], Kumar et al. [7] and Thakur et al. [30] reported similar observation in gladiolus.

3.10 No. of Florets per Spike

Character No. of florets per spike had recorded significant and positive correlation at both genotypic and phenotypic level for the characters Senescence of last floret (r_g 0.45 ; r_p 0.33), Plant height at spike fully opened (r_g 0.81 ; r_p 0.68), Number of partially opened flower (r_g 0.31 ; r_p 0.28), Days to senescence of 1st flower (r_g 0.45 ; r_p 0.36) and Days to last floret opening (r_g 0.48 ; r_p 0.37), whereas at genotypic level correlation had been recorded negative with parameter *viz.,* No. of corms per plant, Diameter of daughter corms, Number of cormels per plant. The results are similar with Neeraj et al. [19], Bichoo et al. [31], Nimbalkar et al. [32], Ahmad et al. [15] and Verty et al. [6]. The above character which showed positive significant correlation with number of florets per spike should be taken into consideration for selection point of view.

3.11 Senescence of Last Floret

Senescence of last floret had displayed significant and positive correlation at both genotypic and phenotypic level for the characters, Plant height at spike fully opened (r_g 0.52; r_p 0.39), Days to senescence of 1st flower (r_g 0.93; r_p 0.89), Diameter of 1st flower (r_g 0.79; r_p 0.40), Diameter of 3rd floret (r_g 0.78; r_p 0.45) and Days to last floret opening (r_g 0.95; r_p 0.95). Whereas, at genotypic level, few characters displayed negative correlation with this parameter *viz.,* Durability of spikes and No. of daughter corms. Similar results were also reported by Jhon et al. [20], Balaram and Janakiram [27] and Verty et al. [6].

3.12 Plant Height at Spike Fully Opened

The character Plant height at spike fully opened displayed a positive correlation at both genotypic and phenotypic level for the characters Days to senescence of 1st flower (r_g 0.58; r_p 0.48), Diameter of 1st flower (r_g 0.55; r_p 0.28), Diameter of 3rd floret (r_g 0.44; r_p 0.33) and Days to last floret opening (r_g 0.58; r_p 0.44).Whereas, significant and negative correlation was recorded with only one character that is Durability of spike (r_g - 0.40; r_p - 0.31) and at genotypic level trait Diameter of daughter corms had also shown a negative and significant correlation with this parameter. This result is supported by the findings of Lal et al. [11], Gowda [12], Misra and Saini [5], Jhon et al. [20], Choudhary et al. [14], Balaram and Janakiram [27], Kumar et al. [7] and Sisodia et al. [26].

3.13 No. of Partially Opened Flower

For No. of partially opened flower traits like Days to senescence of 1st flower, Diameter of 1st flower, Diameter of 3rd floret, Days to last floret opening and Diameter of daughter corms have shown positive and significant correlation at genotypic level.

3.14 Days to Senescence of 1st Flower

The character Days to senescence of 1st flower displayed a positive correlation at both genotypic and phenotypic level for the characters Diameter of 1st flower (r_g 0.56; r_p 0.33), Diameter of 3rd floret (r_g 0.51; r_p 0.31), Days to last floret opening (r_g 0.99; r_p 0.95), whereas, significant and positive correlation was recorded in character Durability of spikes (r_g - 0.60; r_p -0.50). Similar findings were reported by Singh et al. [33] and Anuradha et al. [16].

3.15 Diameter of 1st Flower

The character Diameter of 1st flower displayed a positive correlation at both genotypic and phenotypic level for the characters Diameter of 3rd floret (r_g 1.01; r_p 0.71), Days to last floret opening (r_g 0.57; r_p 0.28), and at genotypic level characters Durability of spike also recorded a positive correlation with this character. Hence, selection based on these characters is important for improving Diameter of 1st floret and results are in conformity with the findings of Misra and Saini [5], Singh et al. [34], Anuradha et al. [24], Sakkeer Hussain [23], Balaram and Janakiram [27], Thakur et al. [30] and Verty et al. [6] in gladiolus.

3.16 Diameter of 3rd Floret

The character Diameter of 3rd floret displayed a positive correlation at both genotypic and phenotypic level for the characters, Durability of spike (r_g 0.25; r_p 0.38) and Days to last floret opening (r_g 0.55; r_p 0.32) whereas as at genotypic level, trait Shoots per corm recorded significant negative correlation for this character. There exists a positive and significant relationship of diameter of 3rd floret with durability of spike and days to last floret opening.at both genotypic and phenotypic level. Similar results were reported by Anuradha et al. [24], Archana et al. [17], Balaram and Jankiram [27], Thakur et al. [30] and Verty et al. [6].

3.17 Durability of Spike

Character Durability of spikes exhibits significant negative correlation with characters Days to last floret opening (r_g - 0.54; $r_{p\,-}$ 0.27) and Number of cormels per plant (r_g - 0.53; $r_{p\,-}$ 0.32). There exists a negatively significant relationship of Durability of spike with character Days to last floret opening and Number of cormels per plant. This indicates that if the Durability of spike is low, less will be the Days to last floret opening and less No. of cormels per plant.

3.18 Days to Last Floret Opening

Character Days to last floret opening does not display any significant correlation with other characters.

Table 1. Phenotypic coefficient correlations for 24 traits

Characters	D5S	DSI	PHFS	LPC	LA	5H	DFFI	SL	RL	NFPS	SLF	PHSFO	NPOF	DSFF	DFF	DTF	DS	DLFO	NCP	WDC	DDC	NCP	NDC	SC
D5S	**1****																							
DSI	0.190^{NS}	**1****																						
PHFS	0.316*	0.472**	**1****																					
LPC	0.086^{NS}	-0.133^{NS}	0.166^{NS}	**1****																				
LA	0.158^{NS}	0.180^{NS}	0.082^{NS}	0.053^{NS}	**1****																			
5H	0.246^{NS}	0.446**	0.543**	-0.050^{NS}	0.184^{NS}	**1****																		
DFFI	0.176^{NS}	0.436**	0.592**	0.064^{NS}	0.249^{NS}	0.949**	**1****																	
SL	0.106^{NS}	0.268*	0.491**	0.067^{NS}	0.066^{NS}	0.336**	0.352**	**1****																
RL	0.155^{NS}	0.280*	0.441**	0.053^{NS}	0.134^{NS}	0.356**	0.361**	0.985**	**1****															
NFPS	0.074^{NS}	0.067^{NS}	0.324*	-0.077^{NS}	0.190^{NS}	0.298*	0.321*	0.781**	0.768**	**1****														
SLF	0.182^{NS}	0.400**	0.593**	0.125^{NS}	0.120^{NS}	0.725**	0.830**	0.371**	0.351**	0.339**	**1****													
PHSFO	0.076^{NS}	0.344**	0.383**	-0.113^{NS}	0.059^{NS}	0.395**	0.388**	0.801**	0.793**	0.688**	0.390**	**1****												
NPOF	-0.074^{NS}	0.067^{NS}	0.059^{NS}	0.001^{NS}	0.307*	0.186^{NS}	0.220^{NS}	0.147^{NS}	0.146^{NS}	0.287*	0.206^{NS}	0.225^{NS}	**1****											
DSFF	0.127^{NS}	0.485**	0.578**	0.064^{NS}	0.237^{NS}	0.884**	0.957**	0.424**	0.431**	0.363**	0.896**	0.480**	0.236^{NS}	**1****										
DFF	0.324*	0.282*	0.523**	0.333**	0.226^{NS}	0.203^{NS}	0.303*	0.271*	0.275*	0.135^{NS}	0.400**	0.284*	0.076^{NS}	0.339**	**1****									
DTF	0.269*	0.230^{NS}	0.478**	0.260*	0.165^{NS}	0.158^{NS}	0.253^{NS}	0.314*	0.305*	0.200^{NS}	0.456**	0.339**	0.076^{NS}	0.316*	0.715**	**1****								
DS	0.068^{NS}	-0.311*	-0.144^{NS}	0.100^{NS}	-0.298*	-0.573**	-0.532**	-0.230^{NS}	-0.283*	-0.156^{NS}	-0.064^{NS}	-0.318*	-0.130^{NS}	-0.501**	0.018^{NS}	0.176^{NS}	**1****							
DLFO	0.138^{NS}	0.457**	0.571**	0.010^{NS}	0.145^{NS}	0.826**	0.901**	0.401**	0.391**	0.371**	0.957**	0.448**	0.244^{NS}	0.954**	0.285*	0.329*	-0.279*	**1****						
NCP	-0.193^{NS}	0.058^{NS}	-0.007^{NS}	0.019^{NS}	-0.242^{NS}	-0.072^{NS}	-0.019^{NS}	-0.082^{NS}	-0.134^{NS}	-0.235^{NS}	0.010^{NS}	0.070^{NS}	-0.104^{NS}	0.011^{NS}	0.125^{NS}	-0.024^{NS}	-0.005^{NS}	0.009^{NS}	**1****					
WDC	0.126^{NS}	-0.071^{NS}	-0.292*	-0.142^{NS}	0.279*	0.043^{NS}	0.020^{NS}	-0.154^{NS}	-0.075^{NS}	-0.011^{NS}	-0.007^{NS}	-0.112^{NS}	0.107^{NS}	-0.006^{NS}	-0.137^{NS}	-0.112^{NS}	0.000^{NS}	0.014^{NS}	-0.014^{NS}	**1****				
DDC	-0.064^{NS}	-0.163^{NS}	-0.213^{NS}	-0.102^{NS}	0.164^{NS}	0.064^{NS}	0.072^{NS}	-0.187^{NS}	-0.130^{NS}	-0.124^{NS}	0.024^{NS}	-0.156^{NS}	0.128^{NS}	0.055^{NS}	-0.202^{NS}	-0.192^{NS}	-0.075^{NS}	0.038^{NS}	0.161^{NS}	0.675**	**1****			
NCP	0.040^{NS}	0.239^{NS}	-0.044^{NS}	-0.287*	-0.037^{NS}	0.200^{NS}	0.109^{NS}	-0.119^{NS}	-0.075^{NS}	-0.230^{NS}	-0.072^{NS}	-0.035^{NS}	-0.144^{NS}	0.083^{NS}	-0.226^{NS}	-0.170^{NS}	-0.326*	0.045^{NS}	0.142^{NS}	0.232^{NS}	0.343**	**1****		
NDC	0.133^{NS}	0.090^{NS}	0.001^{NS}	-0.120^{NS}	-0.110^{NS}	-0.085^{NS}	-0.113^{NS}	0.133^{NS}	0.162^{NS}	0.050^{NS}	-0.230^{NS}	0.112^{NS}	0.073^{NS}	-0.112^{NS}	-0.123^{NS}	-0.063^{NS}	-0.197^{NS}	-0.153^{NS}	-0.037^{NS}	0.112^{NS}	0.154^{NS}	0.476**	**1****	
SC	-0.145^{NS}	0.059^{NS}	-0.140^{NS}	-0.477**	-0.420**	-0.103^{NS}	-0.156^{NS}	-0.150^{NS}	-0.189^{NS}	-0.044^{NS}	-0.106^{NS}	-0.025^{NS}	-0.045^{NS}	-0.174^{NS}	-0.194^{NS}	-0.166^{NS}	0.183^{NS}	-0.077^{NS}	0.284*	0.134^{NS}	0.191^{NS}	0.100^{NS}	0.016^{NS}	**1****

Table 2. Genotypic coefficient correlations for 24 traits

Characters	5S	SI	HFS	PC	A	H	FFI	L	L	FPS	LF	HSFO	POF	SFF	FF	TF	S	LFO	CP	/DC	DC	CP	DC	C
5S	**																							
SI	.311*	**																						
HFS	.320*	.616**	**																					
PC	.380**	).304*	.543**	**																				
A	.213^{NS}	.237^{NS}	.078^{NS}	).016^{NS}	**																			
H	.307*	.585**	.616**	).027^{NS}	.203^{NS}	**																		
FFI	.241^{NS}	.541**	.679**	.121^{NS}	.284*	.966**	**																	
L	.132^{NS}	.430**	.684**	).109^{NS}	.042^{NS}	.460**	.489**	**																
L	.211^{NS}	.453**	.632**	).154^{NS}	.134^{NS}	.489**	.501**	.980**	**															
FPS	.112^{NS}	.108^{NS}	.446**	).201^{NS}	.185^{NS}	.380**	.421**	.898**	.897**	**														
LF	.250^{NS}	.501**	.713**	.447**	.192^{NS}	.776**	.883**	.553**	.538**	.456**	**													
HSFO	.053^{NS}	.564**	.575**	).230^{NS}	.060^{NS}	.471**	.488**	.871**	.862**	.813**	.522**	**												
POF	.015^{NS}	.253^{NS}	.334**	).170^{NS}	.466**	.273*	.370**	.314*	.332**	.316*	.356**	.303*	**											
SFF	.193^{NS}	.584**	.652**	.160^{NS}	.267*	.903**	.970**	.548**	.558**	.459**	.934**	.583**	.429**	**										
FF	.565**	.470**	.879**	.014**	.366**	.356**	.485**	.759**	.741**	.494**	.799**	.557**	.552**	.565**	**									
TF	.391**	.399**	.934**	.844**	.281*	.263*	.432**	.558**	.502**	.444**	.788**	.445**	.363**	.510**	.010**	**								
S	.035^{NS}	).455**	).167^{NS}	.560**	).289*	).698**	).640**	).242^{NS}	).304*	).219^{NS}	).285*	).406**	).361**	).609**	.256*	.381**	**							
LFO	.187^{NS}	.567**	.677**	.196^{NS}	.213^{NS}	.882**	.956**	.570**	.568**	.483**	.951**	.583**	.412**	.991**	.572**	.554**	).548**	**						
CP	).274*	.040^{NS}	.015^{NS}	.224^{NS}	).262*	).059^{NS}	.011^{NS}	).162^{NS}	).234^{NS}	).397**	.053^{NS}	.055^{NS}	).308*	.046^{NS}	).016^{NS}	).128^{NS}	).007^{NS}	.044^{NS}	**					
/DC	.157^{NS}	).197^{NS}	).400**	).422**	.563**	.051^{NS}	.017^{NS}	).195^{NS}	).032^{NS}	).150^{NS}	).108^{NS}	).056^{NS}	.204^{NS}	).037^{NS}	).162^{NS}	).166^{NS}	).141^{NS}	).060^{NS}	).092^{NS}	**				
DC	).130^{NS}	).283*	).507**	).032^{NS}	.346**	.052^{NS}	.071^{NS}	).673**	).543**	).621**	).047^{NS}	).392**	.534**	.007^{NS}	.087^{NS}	).163^{NS}	).123^{NS}	).013^{NS}	.312*	.945**	**			
CP	.032^{NS}	.256*	).054^{NS}	).685**	).073^{NS}	.318*	.168^{NS}	).109^{NS}	).042^{NS}	).277*	).106^{NS}	.051^{NS}	).167^{NS}	.113^{NS}	).281*	).223^{NS}	).537**	.058^{NS}	.343**	.307*	.353**	**		
DC	.262*	).011^{NS}	.055^{NS}	).826**	).340**	).071^{NS}	).223^{NS}	.127^{NS}	.190^{NS}	.028^{NS}	).393**	.305*	.153^{NS}	).239^{NS}	).260*	).019^{NS}	).230^{NS}	).227^{NS}	.021^{NS}	.302*	).084^{NS}	.752**	**	
C	).329*	.071^{NS}	).250^{NS}	).770**	).482**	).128^{NS}	).220^{NS}	).141^{NS}	).220^{NS}	).092^{NS}	).181^{NS}	.083^{NS}	.007^{NS}	).233^{NS}	).572**	).511**	.224^{NS}	).133^{NS}	.307*	).206^{NS}	.014^{NS}	.243^{NS}	.061^{NS}	**

D5S: days to 50% sprouting
DSI: days to spike initiation
PHFS: plant height at flowering stage
LPC: leaves per corm
LA: leaf area
5H: 50% heading
DFFI: days to first floret initiation
SL: spike length
RL: Rachis length
NFPS: no. of florets per spike
SLF: senescence of last floret
PHSFO: plant height at spike fully opened
NPOF: no. of partially opened flower
DSFF: days to senescence of first flower
DFF: diameter of first flower
DTF: diameter of third floret
DS: durability of spike
DLFO: days to last floret opening
NCP: number of corms per plant
WDC: weight of daughter corm
DDC: diameter od daughter corm
NCP: no. of cormels per plant
NDC: number of daughter corms
SC: shoots per corm

3.19 No. of Corms per Plant

The character No. of corms per plant exhibits a significant and positive correlation at both genotypic and phenotypic level for the character Shoots per corm (r_g 0.30; r_p 0.28), whereas this character recorded positive correlation with Diameter of daughter corms and Number of cormels per plant at genotypic level. Good multiplication ratio is very much essential for expansion of any crop. Number of corms per plant showed significantly positive correlation with Shoots per corm as in agreement with Neeraj et al*.* [19], Balaram and Jankiram [27], Aaditya et al*.* [35], Ahmad et al*.* [15], Thakur et al*.* [30] and Verty et al*.* [6] in gladiolus indicating that with increase in the No. of shoots and Spikes the total corm production increases.

3.20 Weight of Daughter Corms

The character Weight of daughter corms exhibits a significant and positive correlation at both genotypic and phenotypic level for the character Diameter of daughter corms (r_g 0.94; r_p 0.64) and at genotypic level this character recorded positive correlation with characters *viz.,* No. of cormels per plant and No. of daughter corms. Weight of daughter corms showed a positive correlation with Diameter of daughter corms at both genotypic and phenotypic level and similar trend was reported by Neeraj et al*.* [19], Nimbalkar et al*.* [32], Janakiram [36], Thakur et al*.* [30] and Verty et al*.* [6]. Pointing that increase in the diameter of daughter corm result in the increase in Weight of daughter corm.

3.21 Diameter of Daughter Corms

Diameter of daughter corm exhibits a significant and positive correlation with no. of cormels per plant (r_g 0.35; r_p 0.34). Corm diameter was recorded to be positively and significantly associated with No. of cormels per plant at both genotypic and phenotypic level indicated that with increase in size of daughter corm No. of cormels can also be increased. Similar findings were reported by Neeraj et al*.,* [19], Jhon et al*.* [20] Balaram and Janakiram [27].

3.22 No. of Cormels per Plant

Trait No. of cormels per plant exhibits a significant and positive correlation at both genotypic and phenotypic level for the character, no. of daughter corms (r_g 0.75; r_p 0.47) [37,38].

4. CONCLUSION

Based on the above investigation, it can be concluded that cultivars were having substantial variability for most of the characters. A promising gladiolus cultivar with number of florets per spike could be obtained by selection on the basis of plant height, weight of corm and size of corm. Therefore, selection should be based on spike length, number of florets per spike and floret size for better cultivars. Further studies on correlation among the characters and its relation with spike length, plant height, number of florets per spike and number of corms produced per mother corm are recommended for better information and understanding the improvement process [39,40].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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