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GENETIC VARIABILITY AND HERITABILITY IN *Gladiolus hybridus*

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Abstract: An experiment was carried out with ten gladiolus varieties in randomizes block design, with three replications at the Dept. of Hort, B.A.U. Ranchi during the period Dec 2009-May 2014, to estimate genetic variability, heritability, genetic advance and genetic advance as % of mean for 11 contributing characters. Phenotypic and genotypic coefficients of variation were highest for the spike length (34.16 and 34.18 respectively) followed by number of floret per spike (33.02 and 33.25 respectively) indicated the presence of sufficient genetic variability for selection in these traits. Days taken for the spike emergence was positively and highly significant with the days taken for bud initiation, days taken for 1st floret to show colour, days taken for 1st floret to open, no. of floret open at a time, diameter of the floret and spike length. Days taken for spike emergence was however, negatively and significantly correlated with no. of floret per spike, no. of shoot per plant and vase life.
High heritability and high genetic advance in spike length (1.00 and 70.33), spike length indicated the presence of additive gene effects in these traits and their amicability for direct selection. The non additive gene effects were evident in very few characters. The selection on the basis of spike length, number of floret per spike and vase life will be more effective for further breeding programme.
Keywords: Gladiolus, Variability, Heterosis.

INTRODUCTION

Gladiolus, a majestic bulbous ornamental crop grown through out the world, belongs to family 'Iridaceae 'and its origin is South Africa. It is a popular decorative plant for use in herbaceous borders, bedding and for growing in pots and bowls. It comprises of about 300 species in which 250 are wild and 50 of garden origin. The genus *Gladiolus* includes about 180 species and more than 10,000 named cultivars. The wild species of gladioli are native to the Mediterranean region, the Middle East, western Asia, Madagascar and (especially) South Africa. Most of the more than 10,000 named cultivars probably were derived from just seven species native to South Africa. The modern garden gladioli have developed through natural and manmade crosses. Gladiolus is very rich in its varietal wealth and every year there is an addition of new varieties, hence varietal evaluation and creation of new varieties offers scope to improve the existing cultivars or genotypes in gladiolus. Commercial success of any crop depends upon the availability of suitable cultivars to suit the particular environment and

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needs of the consumer. In order to sustain the availability of cultivars, crop improvement is the need of the time. Hence, variability information about the different characters present among the individual cultivars belonging to single species or different species is important for the future breeding programme. It also helps to access the extent of combining ability between two different contributing characteristics. However, the heritability estimate helps in determining the relative amount of heritable portion of variation. Exploitation of variability is of great importance and is prerequisite for the effective screening of superior genotype.

The economic importance of ornamental flowers is increasing worldwide, which indicates a bright future for ornamental plant breeding. Breeders in response to consumer demand for novel products are continuously creating new and attractive varieties. Altered flower color and shape, improved fragrance, longer vase life in cut-flower species, as well as new plant morphology are some of the desirable traits. Growers are also looking for plants with improved agronomic traits such as increased production and resistance to pathogens. Florists and flower lovers look for newer cultivars with different colour, good spike yield and vase life in gladiolus. Keeping this in view an experiment was planned in the Department of Horticulture, BAU, Ranchi.

MATERIAL AND METHODS

The genetic material comprised of seven lines and three testers of Gladiolus (*Gladiolus hybridus*). The seven diverse germplasm complex lines as females were crossed with three testers as males to constitute twenty one varietal complexes. These crosses along with the ten parents constituted the total experimental material for this present investigation.

Hybridization work with seven lines and three testers was done during rabi season 2009. Seeds of twenty one crosses were obtained from the parents in the month of April- May 2010. During rabi session 2010 in the month of October seeds were sown for getting the cormels. These cormels were replanted further two seasons to attain standard size of corms. Thus the twenty one crosses along with ten parents were grown in the rabi season 2013 in a Randomised block design with three replications and the observations were recorded to study the variability, heterosis, combining ability and correlation.

Table 1: Estimate of genotypic, phenotypic, and environmental co-efficient of variance, heritability and genetic advance among the various characters

Characters	**Var. Environment**	**ECV**	**Var. Genotypical**	**GCV**	**Var Phenotypical**	**PCV**	**h^2 (Broad Sense)**	**Genetic Advancement5%**	**Gen Adv.as% Of Mean5%**
Seed Setting / Capsule	6.91	9.24	2.14	5.14	9.05	10.57	0.24	1.47	5.16
Germination % of Seeds	27.75	8.37	12.60	5.64	40.35	10.10	0.31	4.09	6.50
Survival% of Seeds	5.83	11.39	7.08	12.56	12.96	16.96	0.55	4.06	19.16
No. of Seeds to Attain Std. SizeCorm	3.04	14.47	20.70	37.79	23.74	40.47	0.87	8.75	72.69
Wt. of Corm (g)	2.22	8.04	19.05	23.56	21.27	24.90	0.90	8.51	45.94
Size of Corm (cm)	0.08	7.89	0.25	14.11	0.33	16.16	0.76	0.91	25.31
Sprouting % of Corm	2.55	2.08	534.34	30.04	536.89	30.11	1.00	47.51	61.74
Days taken for Spike Initiation	1.49	1.79	358.09	27.75	359.59	27.80	1.00	38.90	57.04
Days taken for Bud Initiation	1.47	1.66	402.59	27.40	404.07	27.45	1.00	41.26	56.34
Days taken for1st Floret to Show Colour	1.54	1.53	497.96	27.42	499.50	27.47	1.00	45.90	56.40
Days taken for1st Floret to Open	1.96	1.66	533.64	27.36	535.60	27.41	1.00	47.50	56.25
No. of Floret/Spike	0.18	3.89	13.10	33.02	13.28	33.25	0.99	7.40	67.56
No. of Floret open at aTime	0.08	6.82	1.61	30.92	1.69	31.67	0.95	2.55	62.20
Diameter of	0.09	3.21	9.69	32.46	9.78	32.62	0.99	6.38	66.54

Floret(cm)									
Spike Length(cm)	0.72	1.18	607.78	34.16	608.50	34.18	1.00	50.76	70.33
No of Shoots / Plant	0.03	17.41	0.01	9.26	0.04	19.72	0.22	0.09	8.95
Vase Life	0.12	4.19	7.26	32.09	7.38	32.37	0.98	5.50	65.55

Results and Discussion

The estimates of heritability in broad sense specifying the heritable portion of total variation, helps in identifying the appropriate characters for selection. Even though the heritability values indicate of effictiveness of selection based on the phenotypic performance, it does not necessarily mean a high genetic advance for a particular character. Heritability along with estimates of expected genetic advance should be considered while making selection. In crop improvement only the genetic component of variation is important, since only this can guide the breeder.

If the hb^2 of a character is high (0.8 or more), selection for this is very effective. This is because there would be close correspondence between genotype and phenotypic variances due to relatively smaller contribution of environment to the phenotype. However, for character with low hb^2 (less than 0.4), selection may be ineffective or virtually impractical due to masking effect of environment on the genotypic effects. The characters exhibited high hb^2 with high genetic advance in this study were in almost all the flowering characteristics but the highest values were in spike length (1.00 and 70.33), No. of Floret per Spike (0.99 and 67.56) and diameter of floret (0.99 and 56.54). This indicates the possibility of transformance of characters to the offspring from the parents which can increase the possibility of improvement of

these traits through selections. Similar observations exhibited high hb2 along with low genetic advance in gladiolus were Days taken for Spike Initiation (1.00 and 57.04), Days taken for Bud Initiation (1.00 and 56.34) and Days taken for1st Floret to Show Colour (1.00 and 56.40). The high hb2 coupled with low genetic advance indicates non additive gene action. Similar results were reported by Negi et al. (1985) in gladiolus. Other remaining characters exhibited moderate heritability with low genetic advance.

There is a good genetic variability in Gladiolus which can be utilized for varietal improvements. Its variability is helpful to the breeders in the evaluation of new geneotypes for selection. The estimates of genetic variability, heritability and genetic gain decide the breeding progamme for improvement in Gladiolus.

The mean performance of five characters was found more in the crosses than the parents giving an indication of improvement of heterozygous complex hybrids over the parents (table no.7).

The days taken for spike emergence, days taken for bud initiation, days taken for 1st floret to show color, days taken for 1st floret to open exhibited a wide phenotypic and genotypic variation among the parents as well as among the crosses (Table No.7).

The phenotypic and genotypic variability was found more in parents than in crosses in five characters whereas reverse trends were observed in moist of the characters except for No. of shoots per plant.

The phenotypic coefficient of variations which measures the total relative variations were high for ten characters. In all the characters studied the highest GCV & PCV were recorded for spike length followed by no of floret /spike, diameter of the floret and vase life.

The phenotypic variance was high in parents than crosses which might be due to genetic capability of parental contribution characters.

Table 2: Genotypic and Phenotypic correlations among the different characters in gladiolus

characters		Wt. of corm(gm)	Size of corm(cm)	Sprouting % of corm	Days taken for spike emergence	Days taken for bud initiation	Days taken for 1st floret to show color	Days taken for 1st floret to open	No of floret per spike	No. of floret open at a time	Diameter of the floret (cm)	Spike length (cm)	No. of shoots per plant	Vase life
Wt. of corm (gm)	G		0.758	0.820	0.5978	0.6206	0.6201	0.6314	0.8727	0.8876	0.8338	0.8448	-0.0871	0.7913
	P		0.631***	0.7726***	0.5637***	0.5845***	0.5841***	0.5951***	0.8183***	0.8151***	0.7830***	0.7996***	-0.0620	0.7378***
Size of corm(cm)	G			0.5517	0.4399	0.4367	0.4408	0.4542	0.6693	0.6479	0.7351	0.7655	-0.3646	0.7310
	P			0.4768***	0.3771***	0.3777***	0.3859***	0.3992***	0.5782***	0.5536***	0.6451***	0.6667***	-0.1911	0.6270***
Sprouting % of corm	G				0.7975	0.8274	0.8243	0.8254	0.8738	0.8319	0.7801	0.7943	-0.1422	0.8188
	P				0.7941***	0.8249***	0.8210***	0.8216***	0.8675***	-0.8094***	-0.7757***	0.7925***	-0.0600	-0.8110***
Days taken for spike emergence	G					0.9967	0.9908	0.9885	0.7461	0.7654	0.7730	0.7358	-0.1142	0.7886
	P					0.9954***	0.9890***	0.9859***	-0.7391***	0.7477***	0.7688***	0.7337***	-0.0565	-0.7808***
Days	G						0.992	0.990	0.762	0.7771	0.769	0.7389	-0.1300	0.7843

taken for bud initiation							9	5	2		5			
	P						0.9915***	0.9889***	0.7552***	0.7579***	0.7650***	0.7367***	-0.0556	0.7757***
Days taken for 1st floret to show color	G							0.9993	0.7713	0.7935	0.7880	0.7529	-0.1269	0.8064
	P							0.9988***	0.7635***	0.7733***	0.7823***	0.7314***	-0.0569	0.7984***
Days taken for 1st floret to open	G								0.7716	0.8050	0.7920	0.7535	-0.1105	0.8141
	P								0.7634***	0.7831***	0.7859***	0.7516***	-0.0530	0.8058
No. of floret per spike	G									0.8569	0.8358	0.8757	-0.1341	0.8260
	P									0.8324***	0.8264***	0.8693***	-0.0592	0.8118***
No. of floret open at a time	G										0.8848	0.8493	-0.0459	0.8760
	P										0.8589***	0.8289***	-0.0056	0.8462***
Diameter of floret (cm)	G											0.9231	-0.1611	0.8963

	P											0.9177***	-0.0711	0.8864***
spike length(cm)	G												-0.1049	0.9089
	P												-0.0501	0.9000***
No. of shoots per plant	G													-0.1238
	P													-0.0821
Vase life	G													
	P													

In the present investigation most of the characters exhibited an increase in the estimates of correlation coefficients from phenotypic to genotypic level, this indicates the suppressing effect of the environment, which modifies the phenotypic expression of these characters by reducing by reducing phenotypic coefficients. Spike lengths, no. of floret per spike, no. of floret open at a time and vase life are the desirable characteristics to determine the good commercial variety. The phenotypic and genotypic correlation studies indicated that all theses traits was strongly and positively correlated with weight of the corm, size of the corm, days taken for spike emergence, days taken for bud initiation, days taken for 1st floret to show colour, days taken for 1st floret to open and diameter of the floret while only the no. of shoots per plant observed negative correlation.

Balaram et. al. (2005), Kumar et.al. (2011), found the genotypic correlation coefficients were higher than the phenotypic correlation. Significant positive association of number of florets per spike was observed with spike length by Misra et. al.(1998), Monika et. al. (2008), Choudhary et. al. (2011), Lahijie (2012), Pal et.al. (2012) Bhatia et.al. (2009).

Table 3: Range and mean of heterosis of over mid parent (MP) and better parent (BP) for different characters

Characters	Range of heterosis percent over		Number of crosses showing significant positive	
	Mid	Better	Mid	Better
Wt. of Corm (g)	-72.37 - 1.81	-77.68 - 3.28	0	0
Size of Corm (cm)	-29.64 - 26.31	-40.94 - 14.17	2	1
Sprouting % of Corm	- - 7.37	- 13.07	0	0
Days taken for Spike emergence	- - 25.87	- - 23.93	2	4
Days taken for Bud Initiation	- - 13.62	- - 20.06	3	5
Days taken for1st Floret to Show Colour	- 65.90 - 23.58	-14.03 - 22.53	0	2
Days taken for1st Floret to Open	- 7.12 - 25.15	-10.01 - 23.50	1	1
No. of Floret/Spike	- 47.25 - 0.24	-39.11 - 3.07		1
No. of Floret open at aTime	- 24.50 – 15.56	- 37.35 - 11.43	1	2
Diameter of Floret(cm)	- 31.58 - 26.68	- 45.95 - 14.98	9	8
Spike Length(cm)	- 33.22 - 20.34	- 41.90 - 7.25	7	2
No of Shoots / Plant	-14.29 - 42.86	- 25.00 - 25.00	1	0

Conclusion

Genetic variability was analyzed to determine the more variable characters which might be used inbreeding programme. In the present study, high heritability accompanied with low genetic advance for the characters no. of shoots per plant, seed setting per capsule, germination % of seeds is indicative of non additive gene action. This study shows that genotypes should be selected on the basis of spike length, diameter of floret, no. of floret per spike and vase life, because these are the more variable characters among the genotypes. Correlation analysis revealed that had maximum direct effect on indicating the importance of these characters as selection for the development of gladiolus.

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