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To study Induction of Flowering in Gladiolus cormels by Chemicals

Manoj Nazir, Barkha singh, Kesar Durani

Director Research , Shobhit University Meerut (U.P)

Pt. Jawala Prasad Upadhyay Govt college Patana, Chhattisgarh

Directorate of Agriculture, Jammu

Abstract

An experiment was conducted at Shobhit university using the cormels of gladiolus cvs. Shobhit Snow White and Shobhit Red in an attempt to induce flowering in the plants raised from cormels during 2021 and 2022**. Two foliar sprays of chemicals viz, gibberellic acid (25 ppm), benzyl adenine (50 ppm), salicylic acid (100 ppm), potassium dihydrogen phosphate (1%), potassium nitrate (1%) and calcium nitrate (1%) were given twice at monthly interval. Salicylic acid and calcium nitrate recorded less number of days for flowering and highest flowering percentage. Spike length, number of florets per spike, size of second floret, number of corms and cormels per plot were maximum with salicylic acid. Gibberellic acid treatment significantly delayed flowering and also resulted in minimum flowering percentage. Flowering percentage was significantly high in cv. Phule Ganesh over cv. Phule Prerna. Cultivar Phule Ganesh was also found superior in respect of number of corms produced per plot but cv. Phule Prerna recorded maximum number of big and small cormels per plot.**

Key words: Corm, Cormel, Benzyl adenine, , gibberellic acid, gladiolus, potassium dihydrogen, salicylic acid, potassium dihydrogen ortho phosphate

Gladiolus is one of the commercially important flower crops belonging to the family Iridaceae. Based on the size, gladiolus corms can be grouped into two categories: flowering stock (2.5 to 5.0 cm or more) and planting stock (1.0 to 2.5 cm). Flowering stock (large and medium sized corms) is used for production of cut spikes, whereas planting stock (small sized corms) production of flower grade corms for the subsequent planting season. Cormels are incapable of producing spikes and are used for the production of flower grade corms only. Thus, it will be most economical to the flower growers, if cormels can be induced to produce spikes along with flower grade corms. But there is no documented information available on flower induction, hence attempts were made to induce flowering in the plants raised from cormels.

MATERIALS AND METHODS

The present investigation was carried out at the College Farm, College of Agriculture, Shobhit University Meerut during 2020 and 2021. The cormels (16 each) of two cultivars namely, Shobhit Snow white and Shobhit Red procured from Research Station floriculture unit Jammu weighting 1.10 g and 1.00 g and measuring 1.1+ 0.2 cm and 1.0+ 0.2 cm, respectively, were planted at a spacing of 30 x 20 cm and depth of 2 cm, during October 2021 Seven treatments viz., gibberellic acid (GA_3) at 25 ppm; benzyl adenine (BA) at 50 ppm; salicylic acid (SA) at 100 ppm; calcium nitrate (Ca $(NO_3)^2$) at 15%; potassium nitrate. (KNO_3) at 1%; potassium dihydrogen ortho. Phosphate (KH_2PO_4) at 1% and control (water spray) were imposed as foliar spray twice at monthly interval, the first being given one month after planting. Corms and cormels were lifted in the month of April 2005. The data recorded on various observations were subjected to analysis of variance as applicable to split plot design.

RESULTS AND DISCUSSION

The plant height measured up to the tip of the flower spike was significantly high in the cv. Shobhit snow white (87.43) (Table 1) than in the cv. Shobhit Red (82.19). It was lowest in GA_3 treatment as it could not produce significant flowering. All the treatments viz., SA, KNO_3, $Ca(NO_3)^2$, BA and KH_2PO_4 significantly increased the plant height and this may be correlated with flower inducing ability of respective chemicals due to which the final plant height after spike emergence increased significantly. Cultivar shobhit snow white, however, was found to be significantly early in flowering (77.81 day) than cv. Shobhit Red (85.91 day). Salicylic acid, $Ca(NO_3)^2$ and KH_2PO_4, significantly reduced the number of days for flowering over GA_3, Flowering percentage was significantly high in the cv. Shobhit Red (57.69) than in cv. Shobhit snow white (35.27). All the treatments except GA_3, and KH_2PO_4significantly increased flowering percentage over control. Salicylic acid recorded highest flowering percentage (83.12) and minimum flowering percentage was recorded in GA, (13.86).

The interaction between the cultivars and treatments was found to be significant in respect of flowering percentage. Cultivar Shobhit Snow Red, BA, $Ca(NO_3)^2$, KNO_3, and control. In case of cv. Shobhit snow white, SA recorded maximum flowering percentage (75.00) which was significantly superior over other treatments. This was followed by Ca $(NO_3)^2$ (47.62) which was at par with KH_2PO_4 (39.52), and BA (36.80). In cv. Phule Ganesh also, SA recorded maximum flowering percentage (91.25) but was at par with Ca $(NO_3)^2$ (82.50) and KNO, (78.27).

Cultivars Shobhit Snow white and shobhit Red did not show significant difference in respect of spike length and number of florets per spike (Table 2). Among the treatments, SA increased the spike length (61.50) and number of florets per spike (12.17) significantly. The two cultivars, however, differed significantly in respect of size of second floret. Cultivar Shobhit Red produced significantly big florets (10.62) cm) than Cultivar Shobhit Red (8.12 cm). Among the treatments, SA (10.25 cm) and BA (10.08 cm) significantly increased the size of second floret and were at par.

In gladiolus, SA was found to be highly effective in promoting early flowering as well as in increasing the flowering percentage. The mechanism by which SA induces flowering in plants is not known. One hypothesis suggests that SA induces flowering by acting as chelating agent (Oota, 1975), because the free 0-hydroxyl group confers metal chelating activity on benzoic acids. This view is supported by the fact that chelating agents can induce flowering in Lemnaceae (Seth et al., 1978) and that this induction resembled the flower inducing effects of SA (Pieterse and Muller, 1977).

Salicylic acid induced improvement in flowering performance of the cultivars in respect of days to flowering, spike length, number of florets per spike and size of second floret, may possibly be due to stimulation of alternate respiration by salicylic acid as it stimulates alternate oxidase (AOX) and in turn promotes alternate respiration (Chen and Klersig, 1991).

The cultivars Shobhit snow white and Shobhit Red have potential to produce 16-18 and 14-16 florets per spike, respectively in the plants raised from corms. In this experiment, however, the maximum number of florets per spike does not exceed 13.33 in Cultivar Shobhit Snow white (SA treatment) and 11.33 in Cultivar Shobhit Red (BA treatment). KH_2PO_4, treatment was found to be the next best in respect of spike length, number of florets per spike and $Ca(NO_3)^2$, in respect of earliness.

From the results, it can be concluded that $Ca\ (NO_3)^2$ and KNO_3, are the next best treatments to salicylic acid for flower induction in the gladiolus plants raised from cormels. The nitrates either calcium or potassium were effective in induction of flowering in many plant species by sensitizing the buds to floral stimulus (Bueno and Valmayor, 1974). Further, calcium acts as secondary messenger in signaling of various physiological processes including flower induction. Calcium binds with calmodulin, activates it, such an activated calmodulin-Ca complex is held responsible for phytochrome mediated responses which includes flower induction (Krishnamoorthy, 1993).

Flower inducing ability of benzyl adenine was also reported by several workers under in vitro as well as in vivo conditions. Induction of flowering may be due to its ability to alter the assimilate distribution i.e. the theory of nutrient diversion (Sachs et al., 1979). In gladiolus also, Tawar et al. (2003) reported improvement in the flowering performance of different gladiolus cultivars when the corms are used as planting material.

Gibberellins strongly inhibited flowering in the plants raised from gladiolus cormels. Gibberellins, a component of the florigen as proposed by Chailakhyan (1936), however, promotes flowering in long day plants (Chen et al., 2003.

Table 1. Effect of foliar spray of different chemical solutions on plant height, days to flowering and percent flowering in gladiolus cvs. Shobhit Snow White and Shobhit Red raised from cormels.

Treatment	Plant height (cm)			Days to flowering			Percent flowering		
	SSW (C_1)	SR (C_2)	Mean	SSW (C_1)	SR (C_2)	Mean	SSW (C_1)	SR (C_2)	Mean
GA_3 25ppm	71.56	77.78	74.62	82.47	90.47	86.47	10.95	15.78	12.47
BA 50 ppm	84.25	86.14	85.47	78.34	85.31	81.47	35.47	65.48	50.86
SA 100 ppm	00.65	88.21	94.32	69.42	81.95	75.39	74.35	90.47	82.47
$Ca(NO_3)_2$ 1%	96.47	78.34	87.34	76.14	81.35	78.42	46.78	81.35	64.95
KH_2PO_4 1%	91.56	72.49	82.95	73.49	85.47	79.43	38.42	20.36	29.48
KNO_3 1%	90.78	87.62	89.74	79.14	85.36	82.49	27.95	77.48	52.34
Control	71.53	78.41	74.32	78.98	85.47	81.63	7.96	46.85	26.47
Mean	86.43	81.96	-	76.89	84.75	-	34.95	56.76	-
			C.D. (P=0.05)			C.D. (P=0.05)			C.D. (P=0.05)
Cultivar (C)			3.44			0.58			17.48
Treatment (T)			5.04			6.06			18.56
Interaction (C x T)			N.S.			N.S.			18.42

S. S.W= Shobhit Snow White

S.R = Shobhit Red

Table 2. Effect of foliar spray of different chemical solutions on spike length, number of florets per spike and size of second floret in gladiolus Cultivars Shobhit Snow White, Shobhit Red raised from cormels.

Treatment	Spike length (cm)			Number of florets/spike			Diame of second floret		
	SSW (C_1)	SR(C_2)	Mean	SSW (C_1)	SR (C_2)	Mean	SSW (C_1)	SR (C_2)	Mean
GA_3 25ppm	71.56	77.78	74.62	82.47	90.47	86.47	10.95	15.78	12.47
BA 50 ppm	84.25	86.14	85.47	78.34	85.31	81.47	35.47	65.48	50.86
SA 100 ppm	00.65	88.21	94.32	69.42	81.95	75.39	74.35	90.47	82.47
$Ca(NO_3)_2$ 1%	96.47	78.34	87.34	76.14	81.35	78.42	46.78	81.35	64.95
KH_2PO_4 1%	91.56	72.49	82.95	73.49	85.47	79.43	38.42	20.36	29.48
KNO_3 1%	90.78	87.62	89.74	79.14	85.36	82.49	27.95	77.48	52.34
Control	71.53	78.41	74.32	78.98	85.47	81.63	7.96	46.85	26.47
Mean	86.43	81.96	-	76.89	84.75	-	34.95	56.76	-
			C.D. (P=0.05)			C.D. (P=0.05)			C.D. (P=0.05)
Cultivar (C)			3.44			0.58			17.48
Treatment (T)			5.04			6.06			18.56
Interaction (C x T)			N.S.			N.S.			18.42

Table 3. Effect of foliar spray of different chemical solutions on number of corms, cormels and weight of cormels per plot in gladiolus Cultivars Shobhit Snow White and Shobhit Red raised from cormels.

Treatment	Number of corms/plot			Number of big cormels (>1.0cm) /plot			Number of small cormels (<1.0)/plot			Weight of cormels / plot (g)		
	SSW (C_1)	SR (C_2)	Mean	SSW (C_1)	SR (C_2)	Mean	SSW (C_1)	SR (C_2)	Mean	SSW (C_1)	SR (C_2)	Mean
GA_3 25ppm	14.87	14.87	14.84	74.51	48.35	61.47	244.75	100.47	172.43	62.45	51.47	56.81
BA 50 ppm	12.47	14.95	13.94	73.95	45.97	59.86	289.47	95.14	192.85	76.35	56.43	66.21
SA 100 ppm	15.36	14.95	14.65	70.65	52.78	61.84	265.47	120.47	192.56	72.14	64.27	68.41
$Ca(NO_3)_2$ 1%	11.56	14.51	12.74	67.14	42.98	55.47	205.41	101.48	153.84	69.41	59.43	64.72
KH_2PO_4 1%	12.43	13.48	13.41	59.34	40.53	49.35	213.48	72.98	143.97	63.47	50.41	56.28
KNO_3 1%	12.86	15.47	13.94	64.81	42.75	53.74	143.95	135.71	139.42	72.16	52.35	63.19
Control	13.42	13.94	13.58	47.39	54.61	51.75	151.34	133.65	142.71	52.43	64.83	58.83
Mean	12.84	14.75	-	65.84	46.71	-	216.94	108.78	-	66.41	57.51	-
			C.D. (P=0.05)			C.D. (P=0.05)			C.D. (P=0.05)			C.D. (P=0.05)
Cultivar (C)			1.04			5.12			22.47			N.S.
Treatment (T)			1.47			6.48			54.98			N.S.
Interaction (C x T)			N.S.			6.48			54.98			N.S.

Modern cultivars of gladiolus do not show significant response to day length and are relatively photo-insensitive but prefers high light intensities. Gibberellins although used as a substitute for long day requirement of flower induction in many LDPs, could not induce flowering in plants raised from gladiolus cormels. This may be due to photo-insensitive nature of gladiolus or there might be requirement of some other factors, other than photoperiod, for the flowering of plants raised from cormels. Like in many fruit crops, gibberellins in gladiolus cormels could not induce flowering, instead promoted vegetative growth.

The two cultivars differed significantly in respect of number of corms and cormels produced per plot. Number of corms per plot was significantly high in cv. Phule Ganesh (15.48) (Table 3) than in Cultivar Shobhit Snow White (13.95). On the other hand, number of large and small sized cormels were significantly high in Cultivar Snow White (66.24 and 217.05) than in Cultivar Red Majesty (47.62 and 109.38).

Salicylic acid treatment recorded highest number of corms and cormels per plot but it did not differ significantly with GA_3, in respect of number of corms; with GA_3, BA or $Ca(NO_3)^2$ in respect of big cormels; and with BA, GA_3, $Ca(NO_3)^2$, or KH_2PO_4, in respect of small cormels. Different treatments including SA, however did not show significant difference in the weight of total cormels. Number of big cormels was significantly increased by SA (62.33) and GA_3, (62.17) over control (52.00). Number of small cormels was also highest in SA (193.8) but was at par with all remaining treatments including control.

The increase in corm and cormel production by SA treatment may be attributed to its ability to alter the hormonal balance in the corms and cormels resulting in increased ratio of promoters versus inhibitors. This alteration in hormonal balance maintains sink activity of corms and cormels. Alternatively it may have tuber/corm and cormel inducing activity as that of jasmonates and brassinosteroids, which is yet to be investigated.

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Assesment of Genetic diversity and population structure in Gladiolus (Gladiolus hybridus Hort.)

Manoj Nazir

Shobhit University, Meerut

Directorate of Agriculture, Jammu (J and K)

Abstract

Hundred and one genotypes of gladiolus were evaluated during *Winter (2021)* in a randomized block design with two replications to access the genetic diversity and variability. The mean sums of squares were highly significant for all the 13 characters studied, indicating the presence of variability. The genotypes studied were grouped into eighteen clusters. Among the eighteen clusters, Cluster-I was largest with 28 genotypes, followed by Cluster-II (16), Cluster-IV (12), Cluster-V1 (10), Cluster-V (8) and Cluster-III (6) The maximum intra-cluster distance was exhibited by genotypes of the Cluster-VI, while the lowest by the genotypes of the Cluster XI to XVIII. The inter-cluster distance was highest between the Cluster-IV and Cluster XL. The traits, number and weight of corms and cormels/plant, rachis length and interfloret length contributed considerably to divergence. In the divergence class analysis, all the clusters were grouped in DC, and DC, suggesting that interating between the high per se performance genotypes from each cluster will more heterotic as compared to others. On the basis of performance of different genotypes of eighteen clusters, twenty-eight genotypes were identified as potent parents for hybridization.
Key words: Clusters, divergence, gladiolus, variability

These days most of Gladiolus cultivars are developed from interspecific hybridization among several species. Hence wide variation is exhibited among the cultivars for their Growth, shape, spike length and floret colour. Gladiolus is a Genus of perennial herbaceous bulbous flowering plants of high economic importance. Several features like massive spikes with florets, brilliant colours, attractive shapes, make it a queen of bulbous flowers. They are ideal for display, floral arrangements, interior decoration and making high quality bouquet. in India , commercial value of Gladiolus has increased a lot because of its local and export market value.

Gladiolus is an important commercial crop cultivated for cut flowers. The area under this crop is increasing very fast in India due to high economic returns within a short period. The Mahalanobis D_2, statistic is the rational criterion to study the genetic variations in available genotypes (Mahalnobis, 1936). In the present investigation with D, statistic, an attempt was made to study the variability among the genotypes and also to identify the suitable genotypes of gladiolus for hybridization programme on the basis of their clustering pattern.

MATERIALS AND METHODS:

One hundred one diverse gladiolus genotypes collected from different research stations in India (50 Genotypes from Jammu and rest from P.A.U Ludhiana, I.A.R.I , New Delhi) and were assessed to study the variation through diversity analysis. The experiment was conducted in a randomised block design with two replications, during *Rabi* 2021. Observations were recorded on three randomly selected plants on number of florets/spike and the contributing characters viz, days to sprouting and Bowering, plant height, length of spike, interfloret length, size of floret, number of leaves/plant, number and weight of corms and cormels/plant and rachis length. The D_2, statistic was used to find out generalized distance between the genotypes as per Rao (1952). The clustering was done by following Tochers method (Singh and Chaudhary, 1997). The clusters were grouped into four divergence classes (DC) on the basis of mean (M) and standard deviation (S) of D values by following Arunachalam and Bandopadhyay (1984).

RESULTS AND DISCUSSION

The treatment differences were significant for various morphological characters. All the genotypes were grouped into 18 clusters, indicating the presence of diversity for different traits among the various genotypes studied. The Cluster-I (28) had highest number of genotypes, followed by Cluster-II (16), Cluster-IV (12), Cluster-VI (10), Cluster-V (8), Cluster-III (6), Cluster-VII and VIII (4), Cluster-IX (3) and Cluster X (2) The Cluster XI to XVIII, were mono- genotypic (Table 1). Grouping of genotypes into 18 clusters suggested presence of considerable diversity in the material under investigation. Patil (1998) formed 18 clusters in 40 genotypes of gladiolus on the basis of 11 characters.

Looking to the data on cluster means (Table 2). It was observed that the Cluster-I included the genotypes with earliness with less number and weight of cormels/plant. However, in Cluster-Il the genotypes possessed earliness with low yield. The genotypes included in Closter-III were taller and had long spike length. Genotypes included in Cluster-IV were high yielder and in Cluster-V the genotypes were dwarf with short spike length. less number of leaves and low yielder. Likewise, Cluster-VI was marked with low yielding genotypes; Cluster-VII with tall, more number and weight of corms and high yielding: Cluster. VIII with late, tall, light weight corms and cormels, longer spike and rachis length and high yielding; Cluster-IX with late, tall, high yielder with more number and weight of cormels; cluster X with more number and weight of cormels Cluster-XI with tallest, longer spike and rachis length less numbered and light weighted corms; Cluster-XII with earliness, short inter floret, spike and rachis length and highest number of corms; Cluster-XIII with short inter floret, rachis length, small sized of second floret, less number and weight of corms and cormels, low yielder; Cluster-XIV with late, tall, bigger sized second florets, longer inter floret, spike and rachis length, maximum number of leaves, heavy weighted corms, high yielding; Cluster-XV with late; Cluster-XVI with earliness, tall, longer spike and, rachis length, small sized second florets, maximum number of corms and cormels/plant Cluster-XVII with very late, short spike and rachis length, high yielding; and Cluster-XVIII with early but low yielding.

The maximum intra-cluster distance (Table 3) was recorded within Cluster-VI while it was lowest for the genotypes of clusters-III, indicating that genotypes of Cluster-VI varied in genetic architecture and might have originated from different genetic pool. In Cluster-III, the trend was exactly reverse of the Cluster-IV. The inter- cluster distance between the genotypes of Cluster- V and Cluster-XI was maximum suggesting about possibility of genetic make-up of these genotypes. The genotypes of Cluster-IV and Cluster-XV exhibited lowest inter cluster distance, indicating the resemblance among the genotypes of this group for all characters studied. Low magnitude of inter-cluster distance values suggested that very little domestication had occurred.

Table 1.Distribution of 101 genotype of gladiolus in 18 clusters.

Cluster	Genotype	No. of genotype
1	94-1,2,3,6,7,8,20,21,22,24,35,43,44,6,49,59, 60,62,67,70,71,80,83,85,86,94,95	28
2	94-7,18,19,25,26,27,33,37,38,48,50,57,75,89,98,99	16
3	94-10,13,14,51,78,100	6
4	94-9,12,29,30,31,32,34,45,64,68,93,97,	12
5	94-16,23,56,73,74,76,87,88	8
6	94-5,11,15,40,53,79,82,90,91,92	10
7	94-28,65,81,84	4
8	94-36,39,55,69	4
9	94-4,58,61	3
10	94-41,52	2
11	94-42	1
12	94-47	1
13	94-54	1
14	94-66	1
15	94-72	1
16	94-77	1
17	94-96	1
18	94-101	1

_" underscored genotype were identified as potent parent for crossing

While studying contribution of individual characters towards divergence, among 13 characters (Table 4), number of corms/plant (40.18 %) contributed maximum followed by weight of corms/plant (21.60 %), weight of cormels/plant (10.28 %),

Table 2. Mean performance of cluster in gladiolus.

Cluster	Days to sprout	Days to flowering	Plant height (cm)	Length of spoke (cm)	Interfloret length (cm)	Size of 2nd floret (cm)	No. Of leaves /plant	No. Of corms /plant	Weight of corms /plant (gm)	No. Of cormels / plant	Weight of cormels /plant (gm)	Rachis length (cm)	No. Of florets /spike
1	13.88	73.22	115.48	95.41	5.02	10.14	7.04	1.75	60.47	69.74	23.47	49.87	15.83
2	13.15	72.42	101.48	81.72	5.14	9.75	7.21	2.02	53.48	104.86	28.21	41.75	14.49
3	14.21	74.33	132.49	112.93	6.25	10.36	7.25	2.06	51.84	243.15	48.51	57.02	16.75
4	14.42	78.53	123.47	102.71	6.15	9.85	7.45	1.69	44.53	67.45	18.41	59.41	18.83
5	14.37	72.44	92.46	69.75	4.99	9.44	6.55	2.59	64.95	94.82	30.02	37.42	13.42
6	13.54	73.55	110.47	90.72	6.26	9.95	7.14	1.92	54.86	201.54	32.84	44.26	14.26
7	14.56	78.35	130.42	109.73	5.45	10.09	7.04	2.89	119.47	112.84	46.03	54.81	17.05
8	14.49	84.22	137.94	115.82	7.11	1.031	7.65	1.39	54.82	54.65	14.03	61.91	18.52
9	15.08	82.04	135.82	112.72	5.01	9.80	7.85	1.19	72.84	136.94	79.48	61.79	18.89
10	14.41	71.61	127.34	106.14	6.95	10.21	7.55	4.03	94.82	397.82	113.64	46.05	16.41
11	14.41	79.48	145.82	123.92	5.85	10.84	8.21	0.88	49.24	326.68	33.06	59.88	15.94
12	13.35	66.47	104.73	90.73	4.41	9.24	7.31	5.87	92.34	376.24	60.59	39.72	15.47
13	12.41	80.25	107.41	105.82	3.91	8..65	7.31	1.43	22.42	18.88	1.45	37.94	13.89
14	15.35	83.71	145.92	123.92	7.75	11.26	8.85	2.41	166.72	66.75	28.06	63.86	18.04
15	16.35	78.21	99.81	102.75	7.05	9.41	7.23	2.41	123.83	166.84	30.01	53.76	17.06
16	14.35	68.34	124.91	103.95	7.00	8.66	7.88	4.85	105.49	453.97	53.21	63.42	15.88
17	14.35	86.21	97.82	75.82	8.95	9.49	6.88	1.43	35.71	31.83	16.49	45.82	18.41
18	13.42	73.84	106.43	78.42	7.05	9.01	7.04	2.84	96.52	307.84	46.82	42.04	13.51
G													
M	14.26	74.58	115.95	95.86	5.73	10.06	7.25	2.03	61.59	121.44	31.02	49.25	15.86

Table 3 . Average intra and inter cluster D values in 101 genotype of gladiolus.

Cluster	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII
I	20.05	36.84	46.76	27.42	57.44	27.66	36.79	49.22	47.51	45.72	67.55	36.72	30.61	61.72	25.97	49.71	48.56	46.48
II		20.76	71.42	52.84	30.54	31.45	63.48	78.43	72.55	63.42	94.21	38.51	53.74	90.76	47.04	67.54	27.84	26.86
III			16.89	31.94	94.83	51.69	29.22	25.28	35.48	35.14	29.62	50.88	32.55	34.81	34.56	33.52	85.46	76.74
IV				20.97	74.16	38.75	30.67	33.94	39.58	44.49	52.89	45.81	26.74	47.51	25.14	41.86	62.54	60.89
V					18.25	50.75	84.53	101.44	93.64	83.58	118.64	42.56	76.84	112.50	68.37	88.24	27.15	31.84
VI						23.81	48.68	60.79	60.23	49.54	73.59	26.69	38.41	73.42	31.58	46.53	43.54	33.75
VII							21.74	33.68	26.53	34.67	51.24	49.23	34.84	33.82	29.42	46.41	76.98	70.94
VIII								21.57	37.41	50.88	35.48	65.44	37.82	28.35	41.84	47.06	89.46	85.44
IX									21.96	35.36	55.42	61.71	43.86	37.57	43.86	57.64	85.78	82.46
X										19.66	56.27	41.83	45.91	52.44	38.42	44.83	79.05	66.71
XI											0.0	69.45	51.43	39.39	55.24	40.96	108.33	97.55
XII												0.0	42.55	74.82	31.76	39.56	55.84	33.49
XIII													0.0	52.27	31.46	47.84	67.25	63.86
XIV														0.0	48.72	54.86	102.61	96.48
XV															0.0	31.46	59.42	49.86
XVI																0.0	80.42	62.81
XVII																	0.0	30.55
XVIII																		0.0

Table 4. Contribution of each character to the divergence in gladiolus.

Character first in ranking	No. Of times appearing	Percent contribution
Days required for sprouting	10	0.198
Days required for flowering	111	2.198
Plant height	13	0.257
Length of spike	0	0.000
Interfloret length	248	4.911
Sixe of 2nd floret	110	2.178
No. Of leaves/plant	82	1.624
No. Of corms/plant	2029	40.178
Weight of corms/plant	1091	21.604
No. Of cormels/plant	410	8.119
Weight of cormels/plant	519	10.227
Length of rachis	375	7.426
No. Of florets/spike	52	1.030
total	5050	100

Table 5. Divergence classes in different cluster of gladiolus genotype.

Divergence class (DC)	Cluster
DC1 119.29(Y) – 73.73 (M+S)	(2,8),(2,11),(2,14),(3,5),(3,17),(3,18),(4,5),(5,7),(5,8),(5,9),(5,10),(5,11),(5,13),(5,14),(5,16),(6,11),(6,14),(7,17),(8,17),(8,18),(9,17),(10,17),(11,17),(11,18),(12,14),(14,17),(14,18),(16,17)
DC2 73.73(M+S) – 51.65(M)	(1,5),(1,8),(1,11),(1,14),(2,3),(2,4),(2,7),(2,7),(2,9),(2,10),(2,13),(2,16),(3,6),(4,11),(4,17),(4,18),(5,6),(5,15),(6,8),(6,9),(7,11),(7,12),(7,18),(8,12),(9,11),(9,12),(9,16),(10,11),(10,14)10,18,()11,12,(11,13),(11,15),(12,17),(13,14),(13,17),(13,18),(14,16),(15,17)
DC3 51.65(M) – 29.58(M-S)	(1,2),(1,3),(1,7),(1,9),(1,10),(1,12),(1,13),(1,16),(1,17),(1,18),(2,5),(2,6),(2,12),(3,4),(3,7),(3,9),(3,10),(3,11),(3,12),(3,13),(3,14),(3,15),(3,16),(4,6),(4,7),(4,8),(4,9),(4,10),(4,12),(4,14),(4,16),(5,12),(5,18),(6,7),(6,10),(6,13),(6,15),(6,16),(6,17),(6,18),(7,8),(7,9),(7,10),(7,13),(7,14),(7,15),(7,16),(8,9),(8,10),(8,11),(8,13),(8,15),(8,16),(9,10),(9,13),(9,14),(9,15),(10,12),(10,13),(10,15),(10,16),(11,14),(11,17),(12, 13),(12,15),(12,16),(,12,18),(13,15),(13,16),(14,15),(15,16),(15,18),(,16,18
DC4 29.58(M-S) – 17.26(X)	(1,4),(1,6),(1,15),(2,17),(2,18),(3,8),(4,13),(4,15),(5,17),(6,12),(8,14),

number of cormels/plant (8.12 %), length of rachis (7.43 %) and interfloret length (4.91%).

However, the characters, days to sprout, plant height, number of leaves/plant, number of florets/spike and days to flowering exhibited very meager contribution to the divergence. The variation may be due to the different genotypes studied and the environmental conditions. Since more than 92.5 per cent contribution to divergence was from number of corms/plant, weight of corms/plant, weight of cormels/plant, number of cormels/plant, length of rachis and interfloret length, necessary attention should be paid to these characters in high yielding genotypes in gladiolus. Looking to the per say performance, the genotypes GK-GL-4, 19, 21, 25, 42, 55, 66, 97 and 101 performed best and may be exploited for general cultivation.

In order to select best diverse parents for hybridization, divergence classes (DC_1, DC_2, DC_3, and DC_4) were formed, as suggested by Arunachalam and Bandopadhyay (1984). The hybrids and segregants obtained from clusters grouped in DC_2, and DC_3, will be more efficient than those between others (Arunachalam and Bandopadhyay, 1984). All the 101 genotypes studied were grouped in 18 different clusters and in the divergence class analysis it is interesting to note that all the clusters were grouped in DC_2, and DC_3, (Table 5) suggesting that intimating between the high per se performance genotypes from each cluster will more heterotic as compared to others. On the basis of performance of different genotypes of 18 clusters, 28 genotypes were identified as potent parents for hybridization (Table 1). The intermating between these genotypes may produce better hybrids with the other practical considerations viz., rachis length, diseases resistance/reaction, etc. This will help in further restricting the number of crosses to be effected. Keeping in view the above aspects the genotypes No. 94-8, 24 and 94 from (Cluster-I); No.94-19, 57 and 99 from Cluster-II; No.94-10 and 51 from. Cluster-III; No.94-12, 29, 32 and 68 from Cluster- IV; No.94-76 from Cluster-V; No.94-5 and 15 from Cluster-VI, No.94-28 and 81 from Cluster- VII; and No.94-55, 4, 41, 42, 47, 54, 66, 72, 77, 96, and 101, respectively from Clusters-VIII to XVIII deserve to be considered as potent parents for crossing to get high yield**.**

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