

Comparative Evaluation of Gladiolus Hybrids and Genotypes for North Indian Plains

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Abstract – Gladiolus is an important bulbous flower grown throughout the world. It occupies a prime position among commercial flower crops which has high demand in both domestic and international markets for cut flower trait. It is also important to develop Indian hybrids and evaluate them with the existing cultivar for their superior desirable characters. Therefore, present experiment was designed and Agricultural Research Institute, New Delhi during the year 2017-18 and 2018-19. The gladiolus hybrids/cultivars conducted at the research farm of the division of floriculture and landscaping, ICAR-Indian assessed for various vegetative, flowering and corm characters indicated that Melody Open Seedling, Chandni x Snow Princess and P-16-1 x Eurovision had flowered in 78.66, 84.50 and 87.50 days respectively after planting. The maximum spike length 134.99, 133.83, 132.66, 131.50 and 124.50 cm was recorded in hybrids such as Salmon Queen Open Seedling, Bindiya x Creamy Green, Yellow Stone x Melody, Green Pasture x Regency and Pink Parassol Open Seedling respectively. Among the genotypes, many cultivars were seen as higher multiplier of corms which had produced more number of corms per plant such as Aldebaran (3, 82 corms/ plant), followed by Fedelia, Punjab Glad-2 and Praha which had produced 3.49 corms/plant each. Vink's Glori produced 3.00 corms per plant, whereas; it was minimum in cultivar Limon Cello (1.66).

Keywords – Gladiolus, Hybrids, Genotypes, Flowering traits, Corms.

I. INTRODUCTION

Gladiolus (*Gladiolus hybridus* L.) is one of the important flowers in India and cultivated in various parts of the country because of its attractive, elegant and delicate florets of various shades and good keeping quality of cut spikes (38). It is also ideal for garden display as well as making high quality bouquet (20). Gladiolus is very rich in varietal wealth and every year, there is an addition of new varieties (17). It has high demand in both domestic and international markets (39). It is also one of the most popular landscape and cut flower industry plant (21). Its spikes are used in flower arrangements (32). Multiplication of planting material of gladiolus is most important, because the cut flower trade of gladiolus is lagging behind over the recent years, owing to the unavailability of sufficient quality planting material at large scale (6). Moreover, new varieties also come from other countries, and the performance of these varieties depends upon climatic conditions of the region under which they are grown. As a result, cultivars, which perform well in one region, may not perform same in other regions of varying climatic conditions (13). It is also important to develop Indian hybrids and evaluate them with the existing cultivar for their superior desirable characters (5). Genetic variability or divergence existing in the population will help in selecting suitable parents for hybridization programme according to climate change. The main emphasis in gladiolus improvement has been on development of varieties having attractive colour and large number of florets mainly for cut flower, long spikes, and good corm multiplication ability. As demand for this cut flower is rising due to socio-economic status and change in life style of people. Evaluation is a basic tool for assessing the genetic variability present in any crop species, which could be exploited for its commercialization (1). Proper screening and evaluation of germplasm/ lines would provide an estimate of their potential value as suitable genotypes for commercial production and also for utilization in varietal development

(40). Hence, the present experiments were planned and conducted with objective to compare the genotypic assessment of new gladiolus hybrids and cultivars under North Indian conditions for further commercial cultivation for different traits.

II. MATERIALS AND METHODS

The experiments were conducted at the research farm of the division of floriculture and landscaping, ICAR-Indian Agricultural Research Institute, New Delhi during the year 2017-18 and 2018-19 and assessed for their growth, flowering and corm yield characters. Thirty gladiolus hybrids including check viz, Swarnima x Viola, White Oak x Flirt, Smokey Lady x Oscar, Howards x White Oak, AVE x Mayur, Vidushi (Mutant), Bindiya x Creamy Green, Yellow Stone x Melody, Green Pasture x Regency, Pearl Beauty x Lucky Shamrock, Snow Princes x Howard, P-16-1 x Eurovision, Cignet x RTS, Chandni x Snow Princess, Smokey Lady x Heady Wine, Mayur x Howard, Canada x Green Willow, (Green Willow x Cignet) x Little Fawn, Smokey Lady x Mayur, Urmil x Smokey Lady, Cignet x Miss America, Pink Parassol Open Seedling, Melody Open Seedling, Salmon Queen Open Seedling, Green Lilac Open Seedling, Howard Open Seedling, RTS Open Seedling, Berlew Open Seedling and two check as white prosperity and Pusa Kiran. Among the varieties, thirty nine cultivars such as Yellow Star, Punjab Morning, Nauvalux, Fire Flam, Lady John, Arka Tilak, Arka Ayush, Arka Sapna, Arka Nazrana, Kalima, Roshni, Amethyst, Neelima, Pink Lady, GS-2, Limon Cello, Ocilla, Malviya Kiran, Algarve, Malviya Shatabdi, Malviya Kundan, Fedelia, Necola, True Love, Aldebaran, Tiger Flam, Victor, C.P.G., Punjab Pink Elegance, Punjab Lemon Delight, J.V.G., Punjab Glad-1, Anglia, Punjab Glance, Punjab Glad-2, Praha, Vink's Glori, and two check varieties as Pusa Kiran and white prosperity were evaluated in order to identify suitable genotypes for various traits and further improvement programme. The evaluation trials were laid out in randomized block design with three replications. All the cultural operations were carried out uniformly during the experimental period for raising the successful crop. Healthy corms of 5-6 cm diameter were selected for planting and spaced at 50 cm in double row system keeping plant to plant distance at 12 cm. Planting depth was kept as 5-8 cm in soil. Well rotten F.Y.M. @ 300 quintal/ha was added in the soil at the time of field preparation. Chemical fertilizers depend upon the fertility of the field, however, according to a general recommendation it was applied as 120 kg N, 100 kg P and 100 kg K/ha. The half quantity of N and full of P and K was given before planting and the remaining quantity of N was applied at the time of earthing up or 45 days after planting. Data were recorded on various growth and flowering characters viz., plant height, spike length, rachis length, number days taken to first floret opening, number of florets per spike, florets remains open at a time, number of corms and cormels per plant. The collected data were subjected to statistical analysis as suggested by Panse and Sukhatme (27).

III. RESULTS

Hybrids

The results of the two year study varied significantly for growth, flowering and corm characters and the data presented in the Table 1 to 4. Among all the hybrids, results indicated that Melody Open Seedling, Chandni x Snow Princess and P-16-1 x Eurovision had flowered in 78.66, 84.50 and 87.50 days respectively after planting; whereas Pink Parassol Open Seedling took 113.83 days, Smokey Lady x Mayur 112.16 days and Swarnima x Viola flowered in 110.83 days after planting. The hybrids such as Salmon Queen Open Seedling,

Yellow Stone x Melody, Bindiya x Creamy Green, Green Pasture x Regency, Pink Parassol Open Seedling and Smokey Lady x Heady Wine recorded maximum plant height, 152.33, 147.50, 144.50, 143.66, 136.66 and 132.66 cm respectively. The maximum spike length 134.99, 133.83, 132.66, 131.50 and 124.50 cm was recorded in hybrids such as Salmon Queen Open Seedling, Bindiya x Creamy Green, Yellow Stone x Melody, Green Pasture x Regency and Pink Parassol Open Seedling respectively, while it was minimum 57.33 cm in Swarnima x Viola. Two year mean data recorded maximum rachis length in hybrids such as yellow stone x Melody 81.50 cm, Bindiya x Creamy Green 79.83 cm, Howard Open Seedling 70.16 cm and Vidushi (Mutant) 66.99 cm, while minimum rachis length 47.16 cm was recorded in Swarnima x Viola, AVE x Mayur 47.66 cm and Cignet x Miss America 48.50 cm respectively (Table 2). The mean data of two year showed the maximum number of florets per spike such as 20.83, 20.66, 20.16, 19.66, 19.33 and 19.16 in hybrids such as yellow stone x Melody, Bindiya x Creamy Green, Salmon Queen Open Seedling, Melody Open Seedling, Green Lilac Open Seedling, Ave x Mayur and Smokey Lady x Heady Wine respectively. The maximum number of florets remains open at a time revealed that hybrids such as Smokey Lady x Oscar (9.00), Salmon Queen Open Seedling (8.83), AVE x Mayur (8.33), Snow Princess x Howard (8.16) and Howard x White Oak (8.00), while Swarnima x Viola recorded minimum (5.50) florets per spike at a time. Further in Table 4 indicated that more number of corms per plant as 3.49 produced by many hybrids such as Bindiya x Creamy Green, Yellow Stone x Melody and Melody Open Seedling, while it was minimum in check cultivar i.e. White Prosperity (1.83 corms per plant). The maximum number of cormels per plant recorded in hybrids such as yellow stone x Melody (89.00 cormels/plant), Smokey Lady x Heady Wine (79.66 cormels/plant), Canada x Green Willow (75.66 cormels/plant), Vidushi Mutant (71.83 cormels/plant) and Bindiya x Creamy Green (69.50 cormels/plant), while it was minimum in hybrid P-16-1 x Eurovision (15.50 cormels/plant).

Table 1. Evaluation of gladiolus hybrids for days to first flowering and plant height.

S.N.	Hybrids	Days to First Flowering			Plant height (cm)		
		2017-18	2018-19	Mean	2017-18	2018-19	Mean
1.	Swarnima x Viola	110.00	111.66	110.83	118.33	118.00	118.26
2.	White Oak x Flirt	97.00	99.33	98.16	106.00	107.00	106.50
3.	Smokey Lady x Oscar	101.66	100.33	100.99	105.66	104.00	104.83
4.	Howard x White Oak	100.00	100.33	100.16	106.00	106.66	106.33
5.	AVE x Mayur	105.66	104.66	105.16	105.33	107.33	106.33
6.	Vidushi (Mutant)	108.66	108.00	108.33	129.00	130.00	129.50
7.	Bindiya x Creamy Green	106.66	107.00	106.83	144.00	145.00	144.50
8.	Yellow Stone x Melody	107.66	108.00	107.83	149.00	146.00	147.50
9.	Green Pasture x Regency	103.66	102.33	102.99	143.00	144.33	143.66
10.	Pearl Beauty x Lucky Shemrock	105.00	108.00	106.50	103.33	104.00	103.66
11.	Snow Princess x Howard	98.66	97.00	97.83	113.33	115.00	114.16
12.	P-16-1 x Eurovision	86.00	89.00	87.50	120.00	121.00	120.50
13.	Cignet x RTS	100.66	101.00	100.83	117.66	116.66	117.16

S.N.	Hybrids	Days to First Flowering			Plant height (cm)		
		2017-18	2018-19	Mean	2017-18	2018-19	Mean
14.	Chandni x Snow Princess	84.00	85.00	84.50	102.66	103.00	102.83
15.	Smokey Lady x Heady Wine	106.00	108.00	107.00	132.33	133.00	132.66
16.	Mayur x Howard	96.33	97.00	96.66	108.00	107.00	107.50
17.	Canada x Green Willow	104.00	105.00	104.50	129.66	129.00	129.33
18.	(G. Willow x Cignet) x Little Fawn	101.00	100.00	100.50	104.00	103.00	103.50
19.	Smokey Lady x Mayur	112.00	112.33	112.16	116.33	117.00	116.66
20.	Urmil x Smokey Lady	92.33	93.00	92.65	120.00	121.33	120.66
21.	Cignet x Miss America	105.00	108.00	106.50	122.00	121.66	121.83
22.	Pink Parassol Open Seedling	113.66	114.00	113.83	135.33	138.00	136.66
23.	Melody Open Seedling	78.33	79.00	78.66	122.66	124.00	123.33
24.	Salmon Queen Open Seedling	92.33	93.00	92.66	153.66	151.00	152.33
25.	Green Lilac Open Seedling	96.33	97.00	96.66	122.00	121.66	121.83
26.	Howard Open Seedling	92.33	92.66	92.49	125.00	124.33	124.66
27.	RTS Open Seedling	99.66	100.00	99.83	126.66	125.00	125.83
28.	Berlew Open Seedling	101.66	100.00	100.83	113.33	112.66	112.99
29.	White Prosperity (Check)	105.00	104.00	104.50	106.66	104.00	105.33
30.	Pusa Kiran (Check)	86.33	88.00	87.16	117.00	116.00	116.50
	C. D. at 5 %	2.259	1.909		3.079	1.554	
	C.V.	1.372	1.181		1.555	0.924	

Table 2. Evaluation of gladiolus hybrids for spike length and rachis length.

S.N.	Hybrids	Spike Length (cm)			Rachis Length (cm)		
		2017-18	2018-19	Mean	2017-18	2018-19	Mean
1.	Swarnima x Viola	103.66	104.00	57.33	46.33	48.00	47.16
2.	White Oak x Flirt	93.00	94.00	93.50	52.00	51.33	51.66
3.	Smokey Lady x Oscar	97.00	98.00	97.50	52.00	50.66	51.33
4.	Howard x White Oak	95.00	94.00	94.50	52.66	53.00	52.83
5.	AVE x Mayur	94.33	91.00	92.66	48.33	47.00	47.66
6.	Vidushi (Mutant)	117.66	115.66	116.66	67.33	66.66	66.99
7.	Bindiya x Creamy Green	133.66	134.00	133.83	79.66	80.00	79.83
8.	Yellow Stone x Melody	132.33	133.00	132.66	81.00	82.00	81.50
9.	Green Pasture x Regency	131.00	132.00	131.50	62.00	63.00	62.50

10.	Pearl Beauty x Lucky Shemrock	92.66	94.00	93.33	55.00	54.00	54.50
11.	Snow Princess x Howard	103.00	101.00	102.00	49.66	50.00	49.83
12.	P-16-1 x Eurovision	103.33	102.00	102.66	58.66	59.00	58.83
13.	Cignet x RTS	104.00	103.00	103.50	60.33	61.00	60.66
14.	Chandni x Snow Princess	89.00	90.00	89.50	52.00	52.33	52.16
15.	Smokey Lady x Heady Wine	117.00	116.66	116.83	61.66	62.33	61.99
16.	Mayur x Howard	97.00	98.33	97.65	58.00	59.33	58.66
17.	Canada x Green Willow	119.00	118.00	118.50	55.33	54.66	54.99
18.	(G. Willow x Cignet) x Little Fawn	88.00	89.00	88.50	62.00	61.99	61.99
19.	Smokey Lady x Mayur	106.66	107.00	106.83	52.00	51.66	51.83
20.	Urmil x Smokey Lady	109.00	110.00	109.50	52.66	53.33	52.99
21.	Cigent x Miss America	112.33	113.00	112.66	49.00	48.00	48.50
22.	Pink Parassol Open Seedling	125.00	124.50	124.50	50.66	51.00	50.83
23.	Melody Open Seedling	114.66	115.00	114.83	61.33	60.66	60.99
24.	Salmon Queen Open Seedling	135.00	134.33	134.99	57.00	56.33	56.66
25.	Green Lilac Open Seedling	110.00	109.00	109.50	61.66	62.00	61.83
26.	Howard Open Seedling	117.66	118.00	117.80	70.00	70.33	70.16
27.	RTS Open Seedling	115.33	116.33	115.83	57.33	56.66	56.99
28.	Berlew Open Seedling	95.00	96.00	95.50	53.66	52.66	53.16
29.	White Prosperity (Check)	95.00	94.00	94.50	53.33	52.00	52.66
30.	Pusa Kiran (Check)	108.00	105.00	106.50	59.66	56.00	57.83
	C. D. at 5 %	3.400	2.135		3.803	1.784	
	C. V.	1.911	1.423		4.023	2.300	

Table 3. Evaluation of gladiolus hybrids for number of florets per spike and florets remains open at time.

S. N.	Hybrids	Number of Florets Per Spike			Number of Florets Remains Open at a Time		
		2017-18	2018-19	Mean	2017-18	2018-19	Mean
1.	Swarnima x Viola	14.66	14.00	14.33	5.00	6.00	5.50
2.	White Oak x Flirt	17.33	18.00	17.66	7.33	7.33	7.33
3.	Smokey Lady x Oscar	18.00	17.66	17.83	9.00	9.00	9.00
4.	Howard x White Oak	17.66	18.33	17.99	8.00	8.00	8.00
5.	AVE x Mayur	19.33	19.33	19.33	8.66	8.00	8.33

S. N.	Hybrids	Number of Florets Per Spike			Number of Florets Remains Open at a Time		
		2017-18	2018-19	Mean	2017-18	2018-19	Mean
6.	Vidushi (Mutant)	19.00	19.33	19.16	7.66	8.00	7.83
7.	Bindiya x Creamy Green	20.33	21.00	20.66	7.33	7.66	7.49
8.	Yellow Stone x Melody	20.66	21.00	20.83	7.33	8.00	7.66
9.	Green Pasture x Regency	17.00	17.33	17.16	6.66	7.00	6.83
10.	Pearl Beauty x Lucky Shemrock	17.66	17.66	17.66	7.33	7.00	7.16
11.	Snow Princess x Howard	18.33	18.33	18.33	8.66	7.66	8.16
12.	P-16-1 x Eurovision	16.33	17.00	16.66	6.66	7.00	6.83
13.	Cignet x RTS	17.00	17.33	17.16	6.66	6.00	6.33
14.	Chandni x Snow Princess	17.66	17.66	17.66	8.00	7.66	7.83
15.	Smokey Lady x Heady Wine	19.00	19.33	19.16	6.66	6.00	6.33
16.	Mayur x Howard	18.66	19.00	18.83	7.00	7.00	7.00
17.	Canada x Green Willow	16.66	17.00	16.83	5.33	6.00	5.66
18.	(G. Willow x Cignet) x Little Fawn	16.66	16.33	16.49	6.00	5.66	5.83
19.	Smokey Lady x Mayur	16.66	16.33	16.49	7.33	7.00	7.16
20.	Urmil x Smokey Lady	16.66	16.33	16.49	7.33	7.33	7.33
21.	Cigent x Miss America	17.00	17.00	17.00	7.00	7.00	7.00
22.	Pink Parassol Open Seedling	16.66	16.33	16.49	7.66	8.00	7.83
23.	Melody Open Seedling	19.66	19.66	19.66	7.66	7.00	7.33
24.	Salmon Queen Open Seedling	20.00	20.33	20.16	9.00	8.66	8.83
25.	Green Lilac Open Seedling	19.33	20.00	19.66	6.66	7.00	6.83
26.	Howard Open Seedling	18.33	18.66	18.49	7.00	6.66	6.83
27.	RTS Open Seedling	18.00	17.66	17.83	7.00	6.66	6.83
28.	Berlew Open Seedling	18.66	18.00	18.33	6.00	6.33	6.16
29.	White Prosperity (Check)	15.00	16.00	15.50	5.33	6.33	5.83
30.	Pusa Kiran (Check)	17.00	1.037	16.83	6.00	6.33	6.16
	C. D. at 5 %	1.112	3.977		1.021	0.786	
	C.V.	3.796			8.707	7.403	

Table 4. Evaluation of gladiolus hybrids for number of corms and cormels per plant.

S.N.	Hybrids	Number of Corms Per Plant			Number of Cormels Per Plant		
		2017-18	2018-19	Mean	2017-18	2018-19	Mean
1.	Swarnima x Viola	2.33	2.66	2.49	20.33	21.00	20.66
2.	White Oak x Flirt	2.66	2.66	2.66	21.66	21.00	21.33
3.	Smokey Lady x Oscar	3.00	3.00	3.00	48.00	49.00	48.50
4.	Howard x White Oak	2.33	2.33	2.33	39.00	40.00	39.50
5.	AVE x Mayur	2.66	2.66	2.66	29.00	28.00	28.50
6.	Vidushi (Mutant)	2.66	3.00	2.83	72.66	71.00	71.83
7.	Bindiya x Creamy Green	3.33	3.66	3.49	70.00	69.00	69.50
8.	Yellow Stone x Melody	3.33	3.66	3.49	90.00	88.00	89.00
9.	Green Pasture x Regency	3.00	3.33	3.16	40.00	42.00	41.00
10.	Pearl Beauty x Lucky Shemrock	2.66	2.00	2.33	44.00	46.00	45.00
11.	Snow Princess x Howard	2.66	2.33	2.49	40.00	41.00	40.50
12.	P-16-1 x Eurovision	3.00	3.33	3.16	15.00	16.00	15.50
13.	Cignet x RTS	2.66	2.66	2.66	27.00	28.00	27.50
14.	Chandni x Snow Princess	2.66	2.33	2.49	39.33	40.00	39.66
15.	Smokey Lady x Heady Wine	2.66	3.00	2.83	80.33	79.00	79.66
16.	Mayur x Howard	2.66	3.00	2.83	23.33	25.00	24.16
17.	Canada x Green Willow	2.66	2.66	2.66	75.33	76.00	75.66
18.	(G. Willow x Cignet) x Little Fawn	2.66	2.66	2.66	28.00	31.00	29.50
19.	Smokey Lady x Mayur	2.66	3.00	2.83	36.66	37.00	36.83
20.	Urmil x Smokey Lady	2.66	3.00	2.83	22.00	25.00	23.50
21.	Cigent x Miss America	2.33	2.33	2.33	29.33	26.00	27.66
22.	Pink Parassol Open Seedling	3.66	3.66	3.66	64.00	61.00	62.50
23.	Melody Open Seedling	3.66	3.33	3.49	19.00	22.00	19.50
24.	Salmon Queen Open Seedling	2.66	2.33	2.49	47.33	49.00	48.16
25.	Green Lilac Open Seedling	2.66	2.33	2.49	23.00	22.00	22.50
26.	Howard Open Seedling	2.66	2.66	2.66	73.33	74.33	73.83
27.	RTS Open Seedling	2.66	2.66	2.66	50.33	51.66	50.99
28.	Berlew Open Seedling	2.66	2.66	2.66	37.33	36.66	36.99

S.N.	Hybrids	Number of Corms Per Plant			Number of Cormels Per Plant		
		2017-18	2018-19	Mean	2017-18	2018-19	Mean
29.	White Prosperity (Check)	1.66	2.00	1.83	18.33	19.33	18.83
30.	Pusa Kiran (Check)	2.66	2.33	2.49	51.00	52.66	51.50
	C. D. at 5 %	0.710	0.727		2.491	3.516	
	C. V.	20.239	18.083		3.599	4.123	

Varieties

A comparative study was also conducted with thirty nine new cultivars collected from different sources including check varieties. Two year mean data (Table 5) indicated that among the cultivars, few had shown as earliness such as Punjab Glad-2 (83.75 days), Praha (83.75 days), Vink's Glory (88.25 days), Punjab Glance (88.75 days) and Roshni (88.75 days) after planting, whereas, late blooming cultivars were: Malviya Kundan (117.50 days), Malviya Kiran (117.00 days), Malviya Shatabdi (114.00 days), True Love (113.75 days), yellow star (113.50 days) and Lemon Cellow and Ocilla each (112.00 days). The maximum plant height 122.50 cm, 121.50 cm, 118.75 cm and 114.50 cm were recorded by Nauvalux, Tiger Flam, Malviya Kiran, Arka Tilak, GS-2 and J.V.G. cultivars respectively. Two year mean value also indicated the highest spike length (112.50 cm) in Nauvalux followed by (111.50 cm) in Tiger Flame, (106.75 cm) in Malviya Kiran and minimum (69.50 cm) in Punjab Glance. Rachis length was recorded maximum by Malviya Kiran (61.00 cm), Ocilla (60.60 cm), Kalima (60.10 cm), Algarve (58.90 cm) and Nauvalux (58.75 cm). More number of florets per spike (19.33, 19.00, 18.66, 18.00, 17.83 and 17.00) were recorded in Punjab Pink Elegance, Arka Ayush, C.P.G, Tiger Flam, Lady John, Pusa Kiran, Arka Tilak and Malviya Kiran cultivars respectively. Results also revealed more number of corms per plant in Aldebaran (3, 82 corms/plant), followed by Fedelia (3.49 corms/plant) and Vink's Glori (3.00 corms per plant).

Table 5. Evaluation of gladiolus varieties for days to first flowering, plant height and spike length.

Cultivars	Days to First Flowering			Plant Height (cm)			Spike Length (cm)		
	2017-18	2018-19	Mean	2017-18	2018-19	Mean	2017-18	2018-19	Mean
Yellow Star	114.00	113.00	113.50	87.00	88.00	87.50	76.00	77.00	76.50
Punjab Morning	101.00	100.00	100.50	98.00	97.00	97.50	88.00	87.00	87.50
Nauvalux	108.00	107.00	107.50	123.00	122.00	122.50	113.00	112.00	112.50
Fire Flam	98.00	99.00	98.50	107.00	109.00	108.00	95.00	95.00	95.00
Lady John	110.50	109.00	109.75	100.00	101.00	100.50	90.00	92.00	91.00
Arka Tilak	110.00	108.00	109.00	115.00	114.00	114.50	101.00	100.00	100.50
Arka Ayush	107.00	106.00	106.50	102.50	103.00	102.75	92.00	92.00	92.00
Arka Sapna	89.00	90.00	89.50	105.00	104.00	104.50	95.00	94.50	94.75
Arka Nazrana	103.00	102.00	102.50	101.00	100.50	101.00	89.00	89.50	89.25
Kalima	108.00	106.00	107.00	113.00	112.50	112.50	104.00	103.50	103.75

Cultivars	Days to First Flowering			Plant Height (cm)			Spike Length (cm)		
	2017-18	2018-19	Mean	2017-18	2018-19	Mean	2017-18	2018-19	Mean
Roshni	88.50	89.00	88.75	109.00	110.00	109.50	98.00	99.00	98.50
Amethyst	109.00	107.00	108.00	91.00	92.00	91.50	86.00	88.00	87.00
Neelima	108.00	108.00	108.00	99.00	99.00	99.00	86.50	87.00	86.75
Pink Lady	107.00	106.50	106.75	107.00	105.00	106.00	95.00	94.00	94.50
GS-2	104.00	103.00	103.50	115.00	114.00	114.50	95.00	94.50	94.75
Limon Cello	111.00	113.00	112.00	108.50	109.00	108.75	98.50	99.50	99.00
Ocilla	113.00	111.00	112.00	113.00	113.00	113.00	104.00	104.00	104.00
Malviya Kiran	117.00	117.00	117.00	118.00	117.50	118.75	107.50	106.00	106.75
Algarve	112.00	110.00	111.00	109.00	109.50	109.25	98.00	98.00	98.00
Malviya Shatabdi	114.00	115.00	114.50	101.00	102.00	101.50	91.00	90.30	90.65
Malviya Kundan	118.00	117.00	117.50	112.00	114.00	113.00	99.00	98.00	98.50
Fedelia	106.00	106.00	106.00	84.00	84.00	84.00	92.50	92.00	92.25
Necola	99.00	100.00	99.50	101.00	100.00	100.50	91.00	90.40	90.70
True Love	114.50	113.00	113.75	102.00	101.50	101.75	92.00	91.00	91.50
Aldebaran	108.00	107.00	107.50	105.00	104.50	104.75	94.00	93.00	93.50
Tiger Flam	107.00	105.00	106.00	121.00	122.00	121.50	111.00	112.00	111.50
Victor	102.00	103.00	102.50	106.00	104.00	105.00	94.00	94.00	94.00
C.P.G.	100.50	101.00	100.75	106.50	105.00	105.75	94.66	93.00	93.83
Punjab Pink Elegance	96.00	97.00	96.50	101.00	102.00	101.50	86.00	85.00	85.50
Punjab Lemon Delight	94.00	94.00	94.00	98.00	98.00	98.00	86.00	84.00	85.00
J.V.G.	109.00	105.00	107.00	115.00	114.00	114.50	105.00	104.00	104.50
Punjab Glad-1	103.00	104.00	103.50	102.00	101.00	101.50	91.00	92.00	91.50
Anglia	105.00	104.60	104.80	104.00	104.50	104.25	93.00	92.00	92.50
Punjab Glance	89.00	88.50	88.75	82.00	83.00	82.50	70.00	69.00	69.50
Punjab Glad-2	84.00	83.50	83.75	98.00	97.00	97.50	88.00	87.00	87.50
Praha	83.50	84.00	83.75	102.00	101.50	101.75	91.00	90.20	90.60
Vink's Glori	88.50	88.00	88.25	108.00	107.50	107.75	96.00	96.00	96.50
Pusa Kiran (check)	106.00	105.00	105.50	105.00	106.00	105.50	92.00	95.00	93.50
White Prosperity (check)	103.00	103.00	103.00	107.00	106.00	106.50	96.00	95.00	95.50
C. D. at 5 %	2.66	2.72		4.01	3.99		3.60	3.72	

Table 6. Evaluation of gladiolus varieties for rachis length, number of florets per spike, and number of corms per plant.

Cultivars	Rachis Length (cm)			Number of Florets Per Spike			Number of Corms Per Plant		
	2017-18	2018-19	Mean	2017-18	2018-19	Mean	2017-18	2018-19	Mean
Yellow Star	45.00	44.20	44.60	15.00	14.66	14.83	2.33	2.66	2.49
Punjab Morning	45.50	45.00	45.25	16.00	15.66	15.83	2.33	2.66	2.49
Nauvalux	59.00	58.50	58.75	16.00	15.66	15.83	2.66	2.66	2.66
Fire Flam	48.00	46.50	47.25	14.00	14.00	14.00	2.00	2.33	2.16
Lady John	45.00	46.20	45.60	18.00	17.66	17.83	2.00	2.00	2.00
Arka Tilak	48.00	47.20	47.60	17.00	17.00	17.00	2.00	2.00	2.00
Arka Ayush	51.00	50.00	50.50	19.00	19.00	19.00	2.66	2.66	2.66
Arka Sapna	57.00	56.20	56.60	16.33	17.00	16.66	2.66	2.66	2.66
Arka Nazrana	47.00	48.00	47.50	15.66	16.00	15.83	2.00	2.33	2.16
Kalima	60.00	60.20	60.10	16.33	17.00	16.66	2.33	2.66	2.49
Roshni	51.00	50.00	50.50	15.33	15.00	15.16	2.00	2.00	2.00
Amethyst	47.00	46.40	46.70	14.00	14.00	14.00	2.33	2.66	2.49
Neelima	45.00	44.30	44.65	16.00	16.00	16.00	2.00	2.00	2.00
Pink Lady	47.00	46.20	46.60	17.00	16.66	16.83	2.33	2.33	2.33
GS-2	56.20	55.50	55.85	13.00	13.00	13.00	1.66	2.00	1.83
Limon Cello	57.50	57.40	57.45	15.66	16.00	15.83	1.66	1.66	1.66
Ocilla	61.00	60.20	60.60	16.33	17.00	16.66	2.33	2.66	2.49
Malviya Kiran	61.50	60.50	61.00	17.00	17.00	17.00	2.33	2.66	2.49
Algarve	59.00	58.80	58.90	16.00	16.00	16.00	2.00	2.00	2.00
Malviya Shatabdi	50.00	51.00	50.50	14.00	15.00	14.50	2.33	2.33	2.33
Malviya Kundan	46.00	44.00	45.00	14.66	14.66	14.66	2.00	2.33	2.16
Fedelia	52.33	52.00	52.16	15.33	16.00	15.66	3.33	3.66	3.49
Necola	51.00	51.30	51.15	13.33	14.00	13.66	2.66	2.66	2.66
True Love	52.00	52.20	52.10	13.66	14.00	13.83	2.66	2.99	2.82
Aldebaran	49.00	48.50	48.75	13.00	13.33	13.16	3.66	3.99	3.82
Tiger Flam	57.00	56.80	56.90	18.00	18.00	18.00	2.33	2.33	2.33
Victor	51.00	50.10	50.50	15.00	15.00	15.00	2.33	2.33	2.33
C.P.G.	49.00	48.90	48.95	18.33	19.00	18.66	2.33	2.66	2.49
Punjab Pink Elegance	46.00	45.20	45.60	19.66	19.00	19.33	2.66	2.99	2.82

Cultivars	Rachis Length (cm)			Number of Florets Per Spike			Number of Corms Per Plant		
	2017-18	2018-19	Mean	2017-18	2018-19	Mean	2017-18	2018-19	Mean
Punjab Lemon Delight	47.00	46.70	46.85	12.33	13.00	12.66	2.33	2.33	2.33
J.V.G.	50.00	50.40	50.20	16.33	16.00	16.16	2.66	2.99	2.82
Punjab Glad-1	57.00	58.80	57.90	15.66	16.00	15.83	2.33	2.66	2.49
Anglia	49.00	48.00	48.50	17.00	16.66	16.83	2.66	2.99	2.82
Punjab Glance	32.50	32.00	32.25	12.66	13.00	12.83	2.66	2.66	2.66
Punjab Glad-2	48.00	47.00	47.50	16.00	17.00	16.50	3.33	3.66	3.49
Praha	48.00	48.00	48.00	16.00	16.00	16.00	3.33	3.66	3.49
Vink's Glori	42.00	43.00	42.50	12.00	12.33	12.16	3.00	3.00	3.00
Pusa Kiran (check)	51.00	50.00	50.50	18.66	17.00	17.83	2.66	2.66	2.66
White Prosperity (check)	59.00	58.00	58.50	16.00	15.66	15.83	1.66	2.00	1.83
C. D. at 5 %	1.62	1.73		0.79	0.85		0.981	0.980	

IV. DISCUSSION

All the hybrids and varieties of gladiolus were having the significant difference in their growth, flowering behavior and corm yield variation. It is the genetic factor that expresses the phenotypic difference and results clearly indicated that the genotypic difference existed with regard to all these characters. The similar results were reported by Kishan and Singh (16). Number of days taken for first floret initiation and the hybrids such as Melody Open Seedling, Chandni x Snow Princess and P-16-1 x Eurovision had shown as early flowering. There is a particular set of period for each hybrid for flowering and results are in conformity with findings of Shaukat et al., (35) and Poonam, K. (19). Results were also in line with the work of Arora and Khanna (2) and Rani et al., (31) who reported superiority of some genotypes over other genotypes due to variation of genotypes of hybrids. Similar results have also been reported by Nagaraju and Parthasarthy (24), Kumar and Yadav (17), Arora and Sandhu (3), Kem et al., (15). The maximum and minimum plant height in hybrids may be due to the hereditary traits or prevailing environmental conditions of the growing location Kumari and Kumar (18). The hybrids studied had shown highly significant difference with respect to spike and rachis length that are important characters for quality assessment. The maximum spike length was recorded in hybrids such as Salmon Queen Open, Bindiya x Creamy Green, and yellow stone x Melody respectively and rachis length, was recorded maximum in hybrids such as Yellow Stone x Melody, Bindiya x Creamy Green and Howards Open Seedling, these results are in accordance with the findings of Nair and Shiva (26) in gladiolus. In International market, the number of florets per spike should be more than 16. But, the hybrids developed at IARI recorded maximum number of florets per spike as 20.83, 20.66, 20.16, 19.66 and 19.33 in hybrids namely yellow stone x Melody, Bindiya x Creamy Green, Salmon Queen Open Seedling, Green Lilac Open Seedling, Melody Open Seedling and Ave x Mayur respectively. The variation in number of florets per spike might be due to hereditary traits of the hybrids. Similar results on number of florets per spike were reported by Rani and Singh (30) and Ram et al., (28). Number of florets remains open at a time were seen maximum in hybrids such as Smokey Lady x Oscar,

Salmon Queen Open Seedling, AVE x Mayur and Snow Princess x Howard. More number of corms per plant produced by many hybrids such as Pink Parassol Open Seedling, yellow stone x Melody, Bindiya x Creamy Green, Melody Open Seedling, Green Pasture x Regency, P-16-1 Eurovision and Smokey Lady x Oscar. The variation in number of corm and cormels per plant in various hybrids of gladiolus might be due to the genetic makeup of hybrids. Similar results were also reported by Zubair et al., (41).

Among thirty nine cultivars evaluated for their flowering characters and few of them had shown as earliness or late. The maximum plant height and spike length were recorded by Nauvalux, Tiger Flam, Malviya Kiran, Arka Tilak and GS-2 cultivars respectively and similar variations for plant height was also observed by Kalasaraddi (14) and Shiramgond (36), Sidhu and Arora (37) in different gladiolus cultivars. Variation in gladiolus cultivars generally revealed exotic nature and exhibit genetic basis for the expression of certain traits even in useful traits, Misra and Singh (23) and Anuradha and Gowda (4) also observed the same results. Rachis length is another important crucial character for cut flower genotype and variation in results are in accordance with the findings of Gupta et al., (9), Hegde (10). More number of florets per spike had recorded in Punjab Pink Elegance, Arka Ayush, C.P.G and Tiger Flam cultivars respectively. Many cultivars were seen as higher multiplier of corms and cultivars as Aldebaran, Fedelia, Punjab Glad-2, Praha and Vink's Glori and similar results were also obtained by Gupta et al., (8) in gladiolus. More over cultivars varied in the corm production depending upon their hereditary traits. Rao and Sushma (29), Jana and Das (12), Shaukat et al., (35), Hossain et al., (11) also observed variations in the number of corms of different gladiolus cultivars. These findings confirm the results of present investigation. Similar results have also been reported by Momin et al., (22), Churasia et al., (7), Naresh et al., (25), Saleem et al., (33), Sarkar and Chakraborty (34).

V. CONCLUSION

It can be concluded from the two year experiments and on the basis of comparative study that hybrids such as yellow stone x Melody, Salmon Queen Open Seedling, Bindiya x Creamy Green, Green Pasture x Regency, Pink Parassol Open Seedling, Melody Open Seedling, Vidushi (Mutant), P-16-1 x Eurovision and Smokey Lady x Oscar performed well for various flowering and corms traits. In varieties Punjab Pink Elegance, Arka Ayush, C.P.G, Tiger Flam and Lady John were found promising and found suitable for North Indian conditions for different traits.

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