



## Varietal Screening of *Gladiolus* under Sikkim Agro-Climatic Conditions

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**ABSTRACT:** *Gladiolus* is an important cut flower commercially grown in Sikkim for local market and for export to the other part of the country. However lack of scientific studies and crop improvement program seems depriving for proper utilization of the available varieties for quality production. The aim of the study was to find out the suitability of ten *Gladiolus* varieties for cultivation under Sikkim conditions in terms of growth and flowering characters for cut flower production. Among the selected varieties, Wed in Bouquets obtained maximum plant height (59.09 cm) but maximum spike length (117.56 cm), spike weight (107.94 g) and maximum vase life (14.2 days) were obtained in Puppy Tears, whereas maximum numbers of florets were produced by Wed in Bouquets (13.33). Priscilla produced highest number of cormlets (63.87) among all the selected varieties. The variability and both PCV and GCV were highest for number of parameters among the different varieties. Heritability estimates were high among the selected varieties and was highly positive correlation for corm sprouting, days taken for harvesting, spike emergence, number of florets per spike, corm sprout, plant height, spike emergence. There was a significant difference among the varieties with respect to floral and vegetative characters which can be utilize in breeding program for further plant improvement.

**Keywords:** Varietal screening, *Gladiolus*, Variability, PCV, GCV, Heritability and Correlation.

### INTRODUCTION

Flowers have been part of Indian culture and are entwined in the social fabric of our customs. It was there since the Vedic time and still been blended with our culture and rituals so inextricably that we see our part of divinity in it. Today when whole world has come up into much accessible global village. Floriculture has become a dignified and major commercial industry. Indian flower industry has also been transforming from traditional cultivation to high-tech commercial oriented cultivation and has wielded on the 18<sup>th</sup> rank with contributing 0.6 percent share in global floriculture trade. During the last decade, export increased at a CAGR of 4.33 percent. The nation's domestic market is also increasing at the rate of 25 per cent per year as a whole (Vahoniya *et al.*, 2018). Presently there are many ornamental crops which are commercially for cut flowers production. Out of many cultivated cut flower crops, *Gladiolus* is one of the majorly grown crop for cut flower production which is also known as queen among the bulbous flower and occupies the fifth position in the international floriculture trade. *Gladiolus* is commercially grown in tropical, subtropical and hilly parts of the world. The exquisite and majestic beauty of *Gladiolus* spikes, different shades, varying number of florets, size and better keeping quality has made *Gladiolus* the most popular bulbous flower crop grown worldwide. The Genus *Gladiolus* contains about 260 species, of which 250 are native to sub-Saharan Africa, mostly South Africa. About 10 species of *Gladiolus* is endemic to southern Africa and 76 to tropical Africa. Today's commercial varieties are complex hybrids which has diversified magnitude of variation which can be seen in its overall performance in different region and climatic conditions. In Sikkim this crop majorly grown for cut flower purpose, however due to lack of scientific studies and crop improvement program demand of the cut flower is dropping rapidly. Thus the current work is conducted to evaluate the performance various *Gladiolus* varieties under Sikkim agro-climatic conditions.

### MATERIALS AND METHODS

The experiment was carried out on eight varieties of *Gladiolus* viz, Tiger Flame (V1), White Prosperity (V2), Priscilla (V3), Red Ginger (V4), Puppy Tear (V5), Orange Beauty (V6), Wed in Bouquets (V7), Her Majesty (V8) Candy man (V9) and Peter Pears (V10) at Assam Linzey East District of Sikkim. The elevation of the farm is 3486 meters above mean sea level at a longitude of 27 16.700°North and latitude of 088 36.265° East under open field condition. The experiment was laid out in randomized block design with three replications. Appropriate size of corm is planted at a distance of 30× 30 on the prepared raised beds of 30 cm height and 1 m width to a length of 2 m with the walking space of 60 cm between beds. Eight plants from each bed were selected randomly and were tagged for recording the observations. The average was worked out and results were used to study genetic parameters on various vegetative growth, flowering and vase life. Parameters of variability and Heritability in broad sense were calculated as per formula given by Burton and Devane (1953).

## RESULTS AND DISCUSSION

**Vegetative Characteristics.** The statistical data revealed highly significant difference in the duration of days taken for corm sprouting and days taken for spike harvesting. Minimum duration (32.5 Days) taken for corm sprouting with the minimum days (71.33 Days) for harvesting was recorded under variety V8. The maximum days (56.97) for corm sprouting and spike harvesting (118.67 Days) was recorded under variety V4. The variation in days to sprouting of corm amongst various varieties might be due to the genotypic differences as suggested by Nazir and Dwivedi 2006; Negi *et al.*, 2014. Another probable reason for variation among the varieties might be the environmental conditions prevailed during sprouting period of corms that could have contributed to different genotype- environmental interactions. Plant height is attributed to be an important varietal character that depends upon the genetic constitution and environmental interaction. The maximum plant height was recorded under variety V7 (59.09 cm) and minimum plant height was observed under variety V1 (44.17 cm). Though the data pertaining to the number of leaves per plant reveals that no significant difference whereas the leaf area was recorded maximum (146.56 sq cm) in the variety V2. Differences in vegetative growth characters of different varieties might be due to varied growth rates because of their genetic make-up as reported by Kumar and Kulkarni (2009); Swain *et al.*, (2008) in *Gladiolus*.

**Table 1: Average value for vegetative characteristic of selected varieties of *Gladiolus*.**

Varieties		Days taken to corm sprouting	Days taken harvesting	Day 15 <sup>th</sup>	Day 30 <sup>th</sup>	Day 45 <sup>th</sup>	Day 60 <sup>th</sup>	No. of leaves at the time of harvesting	Leaf area
V1	Tiger Flame	49.07	90.67	13.44	23.06	28.37	9.57	133.83	77
V2	White Prosperity	50.63	95.33	25.75	39.16	48.07	10.6	146.56	72.33
V3	Priscilla	41.37	99.33	16.84	26.92	34.50	8.93	125.21	82.33
V4	Red Ginger	56.97	118.67	9.63	25.07	33.50	9.17	117.55	107.33
V5	Puppy Tear	40.23	85	23.94	32.38	40.81	9.70	125.93	58.1
V6	Orange Beauty	40.2	109.33	18.83	27.27	47.90	11.77	125.54	93.9
V7	Wed in Bouquets	40.40	110	20.67	33.08	32.81	8.93	141.62	96.83
V8	Her Majesty	32.5	71.33	18.37	25.09	35.90	10.57	120.08	53.67
V9	Candy man	44.23	78.33	19.56	26.21	34.72	10.93	98.73	68.67
V10	Peter Pears	36	73	18.31	25.56	48.17	9.93	137.83	79.33
S. Em.±		1.313	2.466	3.042	2.259	4.459	1.509	0.282	11.636
CD at 5%		3.90	7.33	9.04	6.71	13.25	4.48	0.839	34.57

**Flowering Characteristics:** The experiment towards days taken for spike emergence showed highly significant as the maximum of days taken by V4 (107.33) and minimum was in V8 (53.67). Similar results on varietal difference for spike emergence have reported by Chourasia *et al.*, (2015). Time required for spike emergence is an important varietal character in *Gladiolus* that might be primarily governed by the genetic makeup of the varieties and primarily dependent on food reserves. The number of florets per spike is one of the important characteristic of a good variety and the data recorded for number of florets per spike found maximum in V7 (13.33) while the minimum was recorded in V8 (8.44). The variation in number of florets per spike might be due to hereditary traits of the varieties (Rani and Singh, 2005; Nazir and Dwivedi, 2006). Apart from the number of florets per spike, length of the spike is also an important characteristic of a good commercial variety. The maximum spike length recorded in V5 (117.56 cm) and the minimum was in V6 (81.39 cm). The variation in spike length could be due to differences among the varieties for number of nodes and inter nodal length and may be due to better nutrient assimilation trait of the variety (Kumar *et al.*, 2007; Swain *et al.*, 2008). The data obtained shows significant against rachis length which was recorded maximum in variety V5 (58.00 cm), whereas the minimum was in V8 (28.00cm). The results indicated that, rachis length was closely associated with other morphological characters like number of florets per spike, spike length and plant height in the varieties (Rao and Sushma, 2015). The result obtained on the spike weight of *Gladiolus* varieties was significant and the maximum weight of spike was recorded under variety V5 (107.94 g) as compared to other varieties. The data obtained was significant for weight change of *Gladiolus* varieties. The maximum weight change of spike was recorded under variety V5 (34.27g), whereas the minimum weight change was recorded under variety V4 (11.6g) which might be due to the transpiration loss and water balance in the flower spike. Similarly the maximum water uptake was recorded under variety V9 (27.58 ml), whereas the minimum was recorded under variety V2 (14.6 ml). The variations may be due to the genetic constituent of the varieties and water balance involving physiological processes including the absorption capacity, ability to transport water and finally losses through transpiration (Patel *et al.*, 2016). The selected varieties also varied significantly for number of florets open per spike.

The maximum number of opened florets per spike was found under variety V10 (34.6). The vase life is another important character for considering the success of cut flower to fulfil the market demand. Under the present investigation, longest vase life was recorded in V5 (14.2 days) and minimum in V4 (6.37 days) which may be due to genetic makeup of the varieties (Patra and Mohanty, 2015).

**Corm Characteristics.** The study for corm characters among the selected varieties showed highly significant differences. The maximum diameter of corm was found in V3 (63.87cm) and the minimum in V6 (33.47cm). Size of corm might be mainly governed by the genotypic makeup of the varieties and partitioning of the food material and its less availability for accumulation into individual corm which is similar with the findings of Kumar and Yadav (2005). The number of cormlet found to be maximum in V5 (73.73) whereas the minimum number of cormlet was recorded in variety V2 (7.11). The results are in accordance with the finding of Bhujbal *et al.*, (2013).

**Table 2: Average value for flowering and corm characteristics of selected varieties of *Gladiolus*.**

Varieties		Days taken to spike emergence	No of florets per spike	Spike length (cm)	Rachis length (cm)	Spike weight (g)	Weight change (%)	Water uptake (ml)	No. of florets open per spike	Vase life (days)	Weight of corms (g)	Diameter of corms (mm)	No. of cormlets
V1	Tiger Flame	77	102.42	35.17	82.02	17.3	21.42	8.44	9.93	23.12	40.06	10.11	9
V2	White Prosperity	72.33	103.3	42.22	91.9	29.53	14.6	9.11	13.1	21.12	39.41	7.11	10.66
V3	Priscilla	82.33	97.55	36.67	84.44	18.64	19.13	9.67	11.23	18.13	63.87	45.89	9.33
V4	Red Ginger	107.33	90.97	36.2	51.87	11.6	23	11.00	6.37	17.69	42.77	25.87	12
V5	Puppy Tear	58.1	117.56	58.00	107.94	34.27	23.8	10.78	14.2	21.09	37.91	73.73	11.33
V6	Orange Beauty	93.9	81.39	29.78	65.83	16.33	16.35	8.00	10.43	22.33	33.47	14.45	8.66
V7	Wed in Bouquets	96.83	103.39	38.11	93.17	23.36	19.23	12.22	10.22	16.24	37.12	29.67	13.33
V8	Her Majesty	53.67	92	28.22	62.96	12.16	22.98	7.27	11.33	25.7	41.59	19.77	8.44
V9	Candy man	68.67	96.76	35.11	81.48	15.8	27.58	8.78	13.77	21.93	41.02	48.67	9.33
V10	Peter Pears	79.33	93.43	38.78	77.00	14.41	15.02	34.6	10.22	29.59	44.25	24.67	10
S. Em.±		2.466	0.878	5.920	4.384	2.033	0.749	1.544	0.635	11.089	2.901	7.003	1.776
CD at 5%		7.33	2.61	17.59	13.03	6.04	2.22	4.59	1.89	0.89	8.62	20.81	5.28

**Variability and Heritability Studies.** The analysis of variance revealed that all the characters exhibited highly significant difference among the genotypes, which was evident from the higher range for all the characters. The estimates of PCV and GCV values for all the characters under study were almost same indicating little influence of environment and consequently greater role of genetic factors influencing the expression of these characters. The GCV and PCV magnitudes were highest for number of florets open per spike followed by number of cormlets, weight change, and diameter of bulb. Both the variance was of medium range for spike length, rachis length, spike emergence, vase life, water uptake, days taken for harvesting, number of florets per spike, spike weight, days taken to corm sprout. Similar results of low PCV and GCV for the characters like days to flowering, number of leaves and number of florets were also observed earlier by Kadam *et al.*, (2014).

The genotypic coefficient of variation does not offer full scope to estimate the variation that is heritable, and therefore, estimation of heritability becomes necessary. The magnitude of heritability ranged from 99.23% (number of florets open per spike) to 71.87% (number of cormlets). All the other characters under study showed high amount of heritability (99.23 to 71.87%). High heritability suggests the major role of genetic constitution in the expression of characters, and such traits are considered to be dependable from breeding point of view. According to Pattanaik *et al.*, (2015) heritability used in conjunction with genetic advance provides better information for selecting the best individuals than the heritability alone.

**Table 3: Estimation of Phenotypic and Genotypic Coefficient of Variation and Heritability (broad scenes) for sixteen characters in selected varieties of *Gladiolus*.**

Parameter	PV	GV	PCV	GCV	$h^2_{BS}$
Days taken for harvesting	853.93	780.04	3.13	2.99	91.35
Spike emergence	874.75	856.52	3.74	3.70	97.92
days taken to corm sprout	161.95	156.79	2.94	2.90	96.81
Numbers of leaves	2.64	2.41	1.62	1.55	91.29
Spike length	350.8	245.67	1.91	1.60	70.03
Rachis length	239.38	181.72	4.09	3.56	75.91
Number of florets	9.19	6.88	2.96	2.56	74.86
Number of cormlets	523.12	375.99	7.62	6.46	71.87
Water uptake	57.98	50.84	3.51	3.51	87.69
Spike weight	274.27	261.88	2.07	2.02	95.48
Diameter of bulbs	209.14	199.69	4.822	4.71	95.48
Number of florets open per spike	157.03	155.82	10.46	10.41	99.23
Vase life	16.98	14.79	3.71	3.47	87.10
Plant height	50.12	43.29	1.37	1.27	86.37
Weight change	169.32	167.64	6.72	6.69	99.01

**Correlation Studies:** Correlation measures the degree of association between the characters which ensure simultaneous improvement in one or two or more variables and negative correlation bring out the need to obtain a compromise between the desirable traits. The days taken for spike emergence were positively correlated with days taken for harvesting and vase life. The number of florets per spike exhibited highly significant positive correlation with plant height. The spike length positive association with rachis length and weight change of spike. The rachis length was also significantly and positively correlated with spike length and weight change. The spike weight was positively correlated with rachis length and vase life. The change in spike weight was positively correlated with spike length, rachis length, and vase life. The vase life was significantly positive correlated with weight change.

**Table 4: Phenotypic correlation co-efficient between different characters in selected varieties of *Gladiolus*.**

Pearson's r	Days for corm sprout	Days for harvest	Plant height	No of leaves	Leaf area	Spike emerge	No of florets	Spike length
Days for corm sprout	-	0.591	-0.208	-0.221	-0.009	0.494	0.331	0.066
Days for harvest	0.591	-	0.322	-0.268	0.176	0.858	0.503	-0.195
Plant height	-0.208	0.322	-	-0.329	0.286	0.406	0.687*	0.087
Number of leaves	-0.221	-0.268	-0.329	-	-0.261	-0.284	-0.591	-0.461
Leaf area	-0.009	0.176	0.286	-0.261	-	0.150	0.337	0.259
Spike emerge	0.494	0.858**	0.406	-0.284	0.150	-	0.452	-0.435
Number of florets	0.331	0.503	0.687*	-0.591	0.337	0.452	-	0.445
Spike length	0.066	-0.195	0.087	-0.461	0.259	-0.435	0.445	-
Rachis length	0.100	-0.076	0.253	-0.322	0.230	-0.271	0.497	0.856**
Spike weight	-0.156	-0.205	0.266	-0.223	0.361	-0.404	0.308	0.866
Weight change	0.042	0.028	0.252	-0.110	0.435	-0.310	0.414	0.818**
Water uptake	0.090	-0.200	-0.319	-0.088	-0.811	-0.292	-0.023	0.228
Open florets	-0.288	-0.330	0.382	-0.162	0.311	0.098	0.131	-0.071
Vase life	-0.373	-0.568	-0.037	0.364	-0.093	-0.774*	-0.216	0.530
Number of cormlets	-0.214	-0.187	0.287	-0.270	-0.438	-0.305	0.227	0.550
Diameter of corm	-0.040	-0.045	0.098	-0.500	-0.108	0.007	-0.187	-0.012

\* =Significant at 5% level,\*\*=significant at 1% level

Pearson's r	Rachis length	Spike weight	Weight change	Water uptake	Open florets	Vase life	No of cormlets	Diameter of corm
Days for corm sprout	0.100	-0.156	0.042	0.090	-0.288	-0.373	-0.214	-0.040
Days for harvest	-0.076	-0.205	0.028	-0.200	-0.330	-0.568	-0.187	-0.045
Plant height	0.253	0.266	0.252	-0.319	0.382	-0.037	0.287	0.098
Number of leaves	-0.322	-0.223	-0.110	-0.088	-0.162	0.364	-0.270	-0.500
Leaf area	0.230	0.361	0.435	-0.811	0.311	-0.093	-0.438	-0.108
Spike emerge	-0.271	-0.404	-0.310	-0.292	0.098	-0.774**	-0.305	0.007
Number of florets	0.497	0.308	0.414	-0.023	0.131	-0.216	0.227	-0.187
Spike length	0.856**	0.866	0.818**	0.228	-0.071	0.530	0.550	-0.012
Rachis length	-	0.768	0.841**	0.066	0.142	0.459	0.652	-0.065
Spike weight	0.768**	-	0.885	-0.042	0.008	0.723*	0.504	-0.015
Weight change	0.841**	0.885	-	-0.140	-0.154	0.635*	0.403	-0.187
Water uptake	0.066	-0.042	-0.140	-	-0.430	0.157	0.551	-0.021
Open florets	0.142	0.008	-0.154	-0.430	-	-0.170	-0.013	0.095
Vase life	0.459	0.723	0.635*	0.157	-0.170	-	0.468	-0.066
Number of cormlets	0.652	0.504	0.403	0.551	-0.013	0.468	-	0.243
Diameter of corm	-0.065*	-0.015	-0.187	-0.021	0.095	-0.066	0.243	-

\*=Significant at 5% level,\*\*=significant at 1% level

## CONCLUSION

Study was based on overall performance of ten different varieties of *Gladiolus* under the climatic conditions of Sikkim. Keeping in view of the results obtained for different growth, flowering characteristics Puppy Tears, Her Majesty and Wed in Bouquets can be recommended for quality cut flower cultivation among the selected varieties in Sikkim.

Moreover the studies for variability and both PCV and GCV were highest for number of parameters among the different varieties. Heritability estimates were also high among the selected varieties for the numbers of characters under study. There was highly positive correlation for corm sprouting, days taken for harvesting, spike emergence, number of florets per spike, corm sprout, plant height, spike emergence. This relationship is necessary for further crop improvement for quality cut flower production.

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