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Maqeem Nazir
Division of Floriculture and Landscaping, SKUAST-Jammu, Chatha, Jammu, Jammu and Kashmir, India

Sheetal Dogra
Division of Floriculture and Landscaping, SKUAST-Jammu, Chatha, Jammu, Jammu and Kashmir, India

RK Pandey
Division of Floriculture and Landscaping, SKUAST-Jammu, Chatha, Jammu, Jammu and Kashmir, India

Subash Kashyap
Division of Plant Breeding and Genetics, SKUAST-Jammu, Chatha, Jammu, Jammu and Kashmir, India

Nomita Laishram
Division of Floriculture and Landscaping, SKUAST-Jammu, Chatha, Jammu, Jammu and Kashmir, India

Arvinder Singh
Division of Floriculture and Landscaping, SKUAST-Jammu, Chatha, Jammu, Jammu and Kashmir, India

Ali Haider Shah
Division of Floriculture and Landscaping, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Corresponding Author:
Sheetal Dogra
Division of Floriculture and Landscaping, SKUAST-Jammu, Chatha, Jammu, Jammu and Kashmir, India

Study of heritability and genetic variability among yield and biochemical characters of gladiolus (*Gladiolus grandiflorus* L.)

Maqeem Nazir, Sheetal Dogra, RK Pandey, Subash Kashyap, Nomita Laishram, Arvinder Singh and Ali Haider Shah

Abstract
The present investigation was carried out at Experimental Farm, Division of Vegetable Science & Floriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology. Chatha during 2018-19 to study the variability studies in Gladiolus (*Gladiolus grandiflorus* L.). The experiment was laid out in a Randomized Block Design with three replications. Twenty-five genotypes of gladiolus were evaluated for 21 yield and flowering related traits to study their genetic parameters such as variability, heritability and coefficient of variation, Analysis of variance for all the traits showed significant differences among genotypes for all the flower and yield related traits. Heritability in broad sense varied between 30.80% to 98.60%. High heritability for number of cormels per plant, followed by number of corms per plant, stem diameter, durability of first floret, spike length, leaf area, number of florets per spike, plant height and days taken to spike emergence. Genetic advance was high for spike length followed by rachis length, durability of first floret, leaf area, plant height and days taken to spike emergence.

Keywords: Genetic variability, heritability, genetic advance, *Gladiolus grandiflorus*

Introduction
Gladiolus (*Gladiolus grandiflorus* L.), the queen of the bulbous ornamentals, is the leading geophytes grown worldwide for cut flower trade and garden displays. The word gladiolus was originally coined by Pliny the Elder (AD 23-79) from the Latin word "Gladius" meaning "Sword". So, it is also known as "sword lily" on the basis of shape of its leaves (Randhawa and Mukhopadhyay, 1986) [23]. In Europe it is normally called as corn flag (Bose and Yadav, 1989). *Gladiolus spp*. were recognized over 2000 years ago, growing in the fields of Asia Minor and were called as "corn lilies" (Wilfret, 1980) [23]. Gladiolus was introduced into cultivation at the end of sixteenth century (Innes, 1985) however, in India its cultivation dates back to 19th century. The modern hybrids have been derived from at least 12 species which are now called as *Gladiolus grandiflorus* (Wilfret, 1986) [23]. A huge amount of variability exists in this crop with respect to shape, growth habit, flowering behavior, yield of spikes and quality. Knowledge of correlation studies helps the plant breeder to ascertain the real components of yield and provide an effective basis of selection. Heritability estimates give a measure of transmission of characters from one generation to the other as consistency in the performance of the selection depends on the heritable portion of the variability, thus enabling the plant breeder in isolating the elite selections in the crop. Thus, the magnitude of the variation and the estimates of the heritability, genetic advance were the important parameters on which the prospect of selection lies. So, present study was undertaken to study association among flower and yield contributing traits in gladiolus genotypes.

Materials and Methods
Experimental material consisting of twenty five genotypes planted in Randomized Complete Block Design (RBD) with three replications in a plot size of 1.20 m x 1.20 m at spacing of 20 cm x 30 cm on 22nd October, 2018 at the experimental farm of Division of Vegetable Science and Floriculture, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu during Rabi 2018-2019. Recommended package of practices and plant protection measures were followed for healthy crop growth during the season.

Observations were recorded on twenty one parameters at appropriate stages of plant growth from five randomly selected plants in each plot from each replication.

Results and Discussion

The results obtained from the present investigation on various parameters exhibited significant differences among the genotypes.

Yield characters

The results showed highly significant differences in corm characters among the genotypes. Number of corms per plant ranged between 1.66 to 3.66 with a mean of 2.64. Number of cormels ranged between 9.67 to 22.80 with a mean value of 15.41. Similarly weight of corm per plant ranged between 11.63g to 33.63 g with a mean of 24.77 and diameter of corm ranged between 3.26 cm to 5.43 cm. highest number of cormels per plant, weight of corm per plant and diameter of corm was recorded in Jyotsana whereas the lowest values were observed in Surya Kiran. The variation observed in corm production amongst the genotypes studied might be due to differences in genetic as well as environmental factors.

Bhat *et al*. (2009) [3] reported the similar results regarding corm weight. The weight of corm appeared to be associated with diameter of corm and number of cormles as evident from the results. It could be due to the fact the larger corms might have deposited more food resulting into their correspondingly heavier weight and vice versa. Similar findings were reported by Singh *et al.*, (2017) [19], Naresh *et al.*, (2015) [13], Mishra *et al.*, (2014) [12], Kumar and Yadav (2005) [10], Bhubal *et al.*, (2013) [4], and Chourasia *et al.*, (2015) [6].

Biochemical characters

Twenty five genotype flowers were analysed for the biosynthesis of anthocyanin and chlorophyll content. Highest anthocyanin absorbance (OD) was determined in Novalux (Yellow; 0.118 However, minimum anthocyanin absorbance was estimated in White Prosperity (White; 0.004). Analysis of anthocyanin confirmed the findings revealed by Alkema *et al*., (1982). Anthocyanins are responsible for most red, blue and purple colour petals.

Chlorophyll content ranged between 41.90 - 58.6 SPAD value with a mean of 50.84. Highest chlorophyll content was observed in Mascagni and the lowest was recorded in Pusa Kiran. Analysis of chlorophyll content confirmed the findings revealed by Singh and Misra (2008) [18], Wani *et al*. 2016 [21]. Chlorophyll is responsible for most green colour in plants.

Coefficients of Variability

Estimates of genetic variability for various characters in gladiolus revealed that PCV was higher than corresponding GCV values for all the characters under study. High PCV and GCV (>20%) were found for characters like days taken to sprouting followed by weight of corm per plant and number of cormels per plant. Low PCV and GCV (<10%) was found for flower duration, days taken to bud showing colour and days taken to opening of first floret. It was moderate for rest of the characters. The difference between GCV and PCV gives an idea about the role of genotypic and environmental (G x E) factors on the character expression. Characters with high magnitude of GCV and PCV can be relied upon for further crop improvement. Several workers have reported higher magnitude of GCV and PCV in gladiolus. Balaram and Janakiram (2009) [1] studied genetic variability among different genotypes of gladiolus and recorded high degree of variability for most of the characters. Similar results were reported by Kumar *et al.*, (2011) [9]. Raj and Mishra (1996) [16] reported highest PCV and GCV for weight of cormels. Ishwarraddy *et al.*, 2018 [8] also reported PCV and GCV values high for weight of cormels. Lowest value of GCV and PCV was observed for spike length. The result obtained by Patil *et al.*, (2002) [15] is in conformity with the present finding. Similarly lower estimates of GCV and PCV have been reported for days taken for first floret to open (Pant and Lal, 1991) [14] whereas, Lal *et al.*, (1985) [11] reported it high for this trait.

Heritability

The heritability estimates determine the relative importance of genetic and environment factors in the expression of phenotypic differences among various plants. Heritability is the transmissibility of characteristics from parents to offsprings. Heritability in broader sense is the ratio of genotypic to phenotypic variance. It helps to separate out that part of total variability which is environmental and hence is unfixable. The success of any crop improvement programme not only depends on the amount of genetic variability present in the germplasm but also on the extent to which it is heritable, which sets the limit of progress that can be achieved through selection.

In the present study, heritability varied from 30.80% to 98.60%. High heritability was recorded for number of cormels per plant followed by number of corms per plant, stem diameter, durability of first floret, spike length, leaf area, number of florets per spike and plant height, days taken to spike emergence and weight per corm. This showed that most of the characters have high heritability. These results are in conformity with the findings of Bhujbal *et al.*, (2013) [4] who reported that heritability varied for different characters *viz*., diameter of leaf, length of spike, plant height, diameter of flower and maximum heritability was observed in days taken to sprouting. Sheikh *et al.*, (1995) [17] reported high heritability (58.7 to 99.00%) for plant height, days to flower, spike length, number of florets per spike and floret size.

Genetic Advance

Genetic advance was high for spike length followed by rachis length, leaf area, plant height, days taken to spike emergence, days taken to bud showing colour, days taken to opening of first floret and weight of corm per plant. Very high Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone. High broad sense heritability coupled with high estimates of genetic advance was observed for plant height, leaf area, spike length, rachis length and durability of first floret. Patil *et al.*, (2002) [15] observed high heritability with medium genetic gain for number of days taken to spike initiation, opening of first floret, number of florets per spike, spike length and rachis length.

Table 1: Estimation of phenotypic and genotypic coefficients of variation, heritability, genetic advance and genetic advance as percent mean for various traits in gladiolus

Characters	Mean	Range	GCV	PCV	Heritability (Broad Sense)	Genetic Advance	Genetic Advance as percent mean
Days taken to sprouting	6.10	4.00-11.00	25.16	29.48	72.90	2.70	44.25
Plant height (cm)	110.96	79.13-125.10	10.16	10.56	92.50	22.33	20.12
No. of leaves	5.89	5.00-8.00	12.99	15.61	69.30	1.31	22.28
Leaf area (cm^2)	91.47	61.00-114.47	12.48	12.78	95.40	22.98	25.12
Days taken to spike emergence	100.76	85.80-123.20	10.76	11.51	87.30	20.86	20.71
Days taken to bud showing colour	119.02	102.02-136.25	7.37	8.72	71.40	15.26	12.82
Days taken to opening of first floret	125.56	106.94-142.70	6.82	8.24	68.50	14.60	11.63
No. of florets per spike	11.69	8.60-14.70	11.44	11.77	94.50	2.68	22.91
Spike length (cm)	90.90	59.13-105.10	12.50	12.71	96.60	23.01	25.31
Rachis length (cm)	58.92	33.63-71.90	18.63	18.79	98.30	22.42	38.05
Durability of first floret (days)	5.55	4.60-8.63	14.21	14.45	96.70	22.42	28.79
Flower duration (days)	15.23	12.07-17.83	8.92	9.30	92.00	2.68	17.63
Stem diameter (mm)	12.37	5.500-15.70	18.36	18.57	97.70	4.62	37.37
Floret size (cm)	58.98	8.56-11.30	9.53	13.63	73.00	1.34	13.72
Vase life (days)	8.563	6.80-9.96	9.89	10.26	92.90	1.68	19.64
Chlorophyll content (%)	50.84	41.90-58.6	7.03	12.67	30.80	4.08	8.03
Number of corms per plant	2.64	1.66-3.66	18.56	18.78	97.70	0.99	37.78
Weight of corm per plant (g)	24.77	11.63-36.63	23.30	26.10	79.70	10.62	42.86
Diameter of corm (cm)	4.37	3.26-5.43	10.86	12.61	74.30	0.84	19.29
Number of cormels per plant	15.41	9.68-22.80	23.66	23.82	98.60	7.46	48.42

Conclusion

High PCV and GCV were found for days taken to sprouting followed by weight of corm per plant. Whereas moderate values were obtained for days taken to sprouting, weight of corm, number of cormels per plant and rachis length, number of corms per plant, stem diameter, number of leaves per plant. Heritability in broad sense varied between 30.80% to 98.60%. High heritability was recorded for anthocyanin content followed by number of cormels per plant, number of corms per plant, stem diameter, durability of first floret, spike length, leaf area, number of florets per spike, plant height and days taken to spike emergence. Genetic advance was high for spike length followed by rachis length, durability of first floret, leaf area, plant height and days taken to spike emergence.

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