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Performance of gladiolus cultivars under different planting dates for vegetative and floral characters under Chhattisgarh plains

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Abstract
The present experiment was carried out to study the Performance of gladiolus cultivars under different planting dates for vegetative and floral characters under Chhattisgarh Plains was Horticulture Farm, Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). India during *Rabi* season 2011-12 and 2012-13. Having four different planting times (30th September, 15th October, 30th October, 15th November) and six gladiolus genotypes (American Beauty, White Prosperity, Candyman, Dull Queen, Her Majesty, and Red Majesty). The field experiments were laid out in Factorial Randomized Block Design with three replications having 24 treatment combinations. Planting of gladiolus on 30th September (D_1) showed minimum days to 50% sprouting of corms and maximum number of leaves per plant, length and width of leaves. However, maximum plant height, was noted on 30th October (D_3), Growth characters of gladiolus were significantly enhanced by different cultivars. In case of cultivars, the minimum days to 50% sprouting of corms, length of leaves were noted with cultivar Red Majesty (V_6). However, plant height, number of leaves per plant and width were found maximum with cultivar Candy man (V_3) and was superior to other cultivars. The flower characters *i.e.*, days to spike emergence, number of spike per plant, spike length, number of florets per spike, were significantly superior in planting on 30th September (D_1). The cultivar Dull Queen (V_4) was found significantly superior to exhibit the earliest spike emergence, than rest of the other cultivars. The maximum number of spike per plant, spike length, number of florets per spike was found in cultivar Candy man (V_3), which was significantly superior to the rest of cultivars. The interaction between dates of planting and cultivars D_2V_3, D_1V_5, D_1V3, D_2V_2, D_1V_4, D_1V_1, D_1V_3, D_2V_3 show the best result for plant height, number of leaves per plant, length of leaves, width of leaves, days to spike emergence, number of spike per plant, spike length, number of florets per spike respectively.

Keywords: cultivars, gladiolus, planting dates

1. Introduction
Gladiolus (Gladiolus *grandiflorus* L.) belongs to family Iridaceae. It is one of the most popular flowers with magnificent inflorescence, referred as "Queen of bulbous flowers". It is native of South Africa and Tropical Africa. The name gladiolus was originally coined by Pliny the Elder (A.D.23-79), from the Latin word gladius, meaning a sword, also known as 'Sword lily' on account of the sword-like shape of the foliage. 'Corn flag' is another common name in Europe because it is found wild as weed in the corn-fields. It is herbaceous plant which develops from axillary buds on the corm, usually unbranched leafy, leaves basal and cauline and sword shaped (Goldblatt *et al.*, 1998). Gladiolus possesses a great potential for export market, to European countries especially during winter. In Holland and other European countries it is very popular and ranks next to Tulip. In India too, gladiolus has become an important cut flower crop in the domestic flower market. In Indian plains, during winter the climatic parameters are ideal for gladiolus cultivation thus providing a comparative advantage for export to European countries. It is highly valued for its elegant spikes which are being used for making flower arrangements and in bouquets. The modern Gladiolus cultivars offer a diversity of colours, shapes, and sizes available in few other flowering plants. Gladiolus can be grown in a wide range of climatic condition from tropical to temperate. Among the climatic factors, temperature plays an important role. Better growth and flowering are obtained in mild climate at a temperature of 15° to 25 °C. Very hot or too cool atmospheric conditions adversely affect its growth and flowering. It prefers sunny days and require at least 85% of sunlight for its proper growth and development. Insufficient light, it may result in abortion of flower spikes and constant high atmospheric humidity promotes infection by pathogens. Though many genotypes of gladiolus can be grown in particular agro-climatic region, all are not suited for

cut flower purpose or for garden display or for exhibition purposes thus, there is a need for evaluation of genotypes and suitable time of planting for particular agro-climatic condition.

2. Materials and Methods

The present investigation was conducted in Horticulture Farm, Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) India during *Rabi* season 2011-12 and 2012-13. The treatment consisted of 24 treatment combinations (D_1V_1, D_1V_2, D_1V_3, D_1V_4, D_1V_5, D_1V_6, D_2V_1, D_2V_2, D_2V_3, D_2V_4, D_2V_5, D_2V_6, D_3V_1, D_3V_2, D_3V_3 , D_3V4, D_3V_5, D_3V_6, D_4V_1, D_4V_2, D_4V_3, D_4V_4, D_4V_5, D_4V_6) comprising of four different planting times *i.e.* 30th September (D_1), 15th October (D_2), 30th October (D_3), 15th November (D_4) and six gladiolus genotypes *viz*. American Beauty (V_1), White Prosperity (V_2), Candyman (V_3), Dull Queen (V_4), Her Majesty (V_5) and Red Majesty (V_6). The field experiments were laid out in Factorial Randomized Block Design with three replications. Observations were recorded on Vegetative growth characters *viz*. Days to 50% sprouting of corms**,** Plant height (cm), Number of leaves per plant, Length of leaves (cm), Width of leaves (cm)**.** Flower yield and quality parameters *viz*. Days to spike emergence, Number of spike per plant, Length of spike (cm), Number floret per spike. The results are presented in pooled mean basis of two year field experiment 2011-12 and 2012-13.

3. Result

3.1 Vegetative growth characters

3.1.1 Days to 50 per cent sprouting of corms

Planting of gladiolus on 30th September (D_1) exhibited the minimum days (12.13) to 50 per cent sprouting, whereas the maximum days (13.52) to 50 per cent sprouting was noted under 15th November planting (D_4), in case of different cultivars Red Majesty (V_6) exhibited the minimum days (11.25) to 50 per cent sprouting. On the other hand, cultivar American Beauty (V_1) required the maximum days (16.83) to 50 per cent sprouting. The interaction between dates of planting and cultivars was exhibited non significant impact in respect to 50 per cent sprouting. Corms planted at an early date *i.e.* on 30th September showed early response for sprouting in this study may be due to prevailing favorable conditions particularly optimum temperature, humidity and photoperiod, available to the plants under the above treatments. Ahmad *et al.*, (2011) [1] reported that the early sprouting of corms may be due to higher temperature, which eventually promoted germination, as increase in temperature has a positive effect on the germination of corms. Saini *et al.*, (1988) [13] also reported that the corms planted on 20th October took significantly the minimum number of days to sprouting than the corms planted on later dates. The variation among the cultivars regarding sprouting may be due to the differential response of various genotypes to environmental conditions. Arora and Sandhu (1987) [3] reported that some of the cultivars sprouted earlier and some of the cultivars later, when they were planted at the same dates.

3.1.2 Plant height (cm)

The data in respect to gladiolus plant height, at 60 DAP, as influenced by dates of planting and cultivars. The data revealed that the plant height at 60 DAP was significantly influenced by dates of planting. The maximum plant height (65.38 cm) was recorded in planting on 30th October (D_3). Whereas the minimum plant height (61.95 cm) was noted in planting on 15th November (D_4). In case of different cultivars, significant difference was observed. The highest plant height (77.57 cm) was recorded in cultivar Candyman (V_3) and was significantly superior to rest of the cultivars and the minimum plant height (43.68 cm) was noted with cultivar American Beauty (V_1). The interaction between dates of planting and cultivars was found significant. The maximum plant height (80.95 cm) was observed in planting on 15th October with cultivar Candyman (D_2V_3). On the other hand, the minimum plant height (42.74 cm) was observed in planting on 30th September with cultivar American Beauty (D_1V_1). The significant differences in plant height among various cultivars may be due to the hereditary trait, and favourable climatic conditions, particularly optimum temperature, humidity and photoperiod prevailing during this period which provides ideal condition for photosynthesis resulted in the maximum growth for plant height. Similar findings were reported by Sheikh and Jhon (2005) [15], Kumar and Yadav, (2006) [7], Ahmad *et al*. (2011) [1] and Kumari *et al.*, (2011) [8].

3.1.3 Number of leaves

The data on number of leaves at 60 days after planting revealed that there was significant impact on number of leaves due to different dates of planting, the highest number of leaves (6.55) were observed at planting on 30th September (D_1). On the other hand, the lowest number of leaves (5.84) was noted in planting on 15th November (D_4), in case of cultures the maximum number of leaves (6.51) was obtained in cultivar Candyman (V_3)**.** Whereas the lowest number of leaves (5.88) was observed in cultivar Dull Queen (V_4). Interaction effect between dates of planting and cultivars, at 60 days after planting was showed significant, the maximum number of leaves (6.93) was noted in planting on 30th September with cultivar Her Majesty (D_1V_5) While, the lowest number of leaves (5.53) was recorded in planting on 15th November with cultivar Dull Queen (D_4V_4). Variation in number of leaves among cultivars may also be due to role of interaction between genotype and environment. Zubair *et al.*, (2013) [17] reported that these variations may be definitely due to the variation in the genotypes and prevailing environmental condition. Similar results were also reported by Sheikh and Jhon (2005) [15].

3.1.4 Length of leaves

The data revealed that length of leaves was significantly influenced during this study. The maximum lengths of leaves (46.42 cm) was recorded at planting on 30th September (D_1). On the contrast, the minimum length of leaves (44.04 cm) was observed at planting on 30th October (D_3). In case of cultivars, the highest length of leaves (50.74 cm) was recorded in cultivar Red Majesty (V_6). While the lowest length of leaf (36.76 cm) was recorded with cultivar American Beauty (V_1) during this study. Interaction between different dates of planting and cultivars was found significant. The maximum lengths of leaves (57.20 cm) was recorded at planting on 30th September with cultivar Candyman (D_1V_3). However, the minimum lengths (34.20) of leaves were recorded at planting on 15th October with cultivar American Beauty (D_2V_1) on pooled mean basis.

3.1.5 Width of leaves

In respect of planting dates, significant impact was observed. The maximum width of leaves (2.46 cm) was noted in gladiolus planting on 30th September (D_1). While the

minimum width of leaves (2.32 cm) was noted at planting on 15th November (D_4). As regards different cultivars, the highest width of leaves (2.89 cm) was exhibited by cultivar Candyman (V_3). In contrast, the minimum width of leaves (2.03 cm) was noted with cultivar American Beauty (V_1). Interaction effect between dates of planting and cultivars in respect to width of leaves was exhibited significant. The highest value (2.98 cm) for width of leaves was observed at planting on 15th October with cultivar White Prosperity (D_2V_2). On the other hand, minimum values (1.42 cm) width of leaves was noted under planting on 15th November with cultivar American Beauty (D_4V_1). The more length and width of the leaves might be due to genetic and environmental interaction during the period of investigation. Growth and yield performance of gladiolus is strongly influenced by different climatic conditions and besides the genetic makeup, environmental conditions are also important factors, which determine the growth and development of gladiolus under specific conditions Saleem *et al*., (2013) [14]. Similar findings were also reported by Arora and Sandhu (1987) [3] who reported that influence of climate and edaphic factors on the performance of different cultivars of gladiolus.

4. Floral characters under

4.1 Days to spike emergence

Dates of planting showed significant influence on days to spike emergence during this experiment. The earlier spike emergence (59.16 days) was observed in planting on 30th September (D_1). While the maximum days (61.45 days) required to spike emergence was observed in planting on 15th November (D_4). Amongst the different cultivars, significantly the minimum days (53.42) was taken by cultivar Dull Queen (V_4) to spike emergence. Whereas the maximum days (66.95) required to spike emergence was observed in cultivar Candyman (V_3). Interaction between dates of planting and cultivars showed non-significant. The variation in the response of cultivars on spike emergence may be due to genetic constitution of the cultivars and environmental conditions, during the growing period, *viz*. higher temperature and long day lengths during end of September than later dates. These findings also collaborate with the results of Arora and Khanna (1985) [2], Arora and Sandhu (1987) [3] and Saleem *et al.,* (2013) [14]. Zubair *et al.,* (2006) [17] who reported that different time taken for first spike emergence of the cultivars under prevailing agro-climatic condition and growing of different cultivar with different genetics. Similar findings were also reported by Rao and Janakiram (2006) [11], Swaroop *et al.,* (2005) [16] and Kumar *et al.,* (2008) [6].

4.1.2 Number of spike per plant

Gladiolus planting on D_1 (30th September) produced the maximum number of spike per plant (1.47) and was significantly superior to rest of the dates of planting However, the minimum number of spike per plant (1.19) was observed in D_4 (15th November) planting. In case of different cultivar, American Beauty (V_1) proved to be the best in producing higher number of spike per plant (1.89) than rest of the cultivars tested. While the minimum number of spike (1.10) per plant was observed in her Majesty (V_5). The interaction between planting dates and cultivars of gladiolus was observed significant. It was found that planting of 30th September with American Beauty (D_1V_1), produced greater number of spike per plant (2.07) and were significantly higher than rest of the treatment combinations of planting dates and cultivars. On the contrast, the minimum number of spike per plant was observed 15th November with cultivar Her Majesty (D_4V_5), was observed minimum number of spike per plant (1.05). More number of spikes per plant produced may be due its genetic constitution of genotypes attributes that might be correlated with growing environment conditions promoted to produce more number of spikes per plant. Similar results was also reported by Kumari *et al.,* (2011) [8].

4.1.3 Length of spike (cm)

Planting dates showed significant impact on length of spike, during the investigation. The longest length of spike (73.67 cm) was recorded at planting on 30th September (D_1) However, minimum length of spike (67.20 cm) was noted in late planting *i.e.,* on 15th November (D_4). Different cultivars of gladiolus differ significantly in producing length of spike. Cultivar Candyman (V_3) proved significantly superior over rest of the cultivars in producing longest spike length (84.68 cm). However, cultivar American Beauty (V_1) showed the lowest spike length (54.15 cm). The interaction between dates of planting and cultivar on length of spike was found significant. The longest spike (88.47cm) was recorded with the interaction of 30th September planting with cultivar Candyman (D_1V_3). Whereas the shortest spike (49.89 cm) was recorded in planting on 15th November with cultivar American Beauty (D_4V_1). The spike and rachis length of gladiolus is influenced with adequate genetic makeup of the cultivar and availability of adequate nutrient and suitability of environmental factors mainly the light and temperature. Superiority of some genotypes over other genotypes was also reported by Pant and Lal (1991) [9], Arora and Khanna (1985) [2] and Saaie *et al.,* (2011) [12].

4.1.4 Number of floret per spike

Significant difference in number of florets per spike was observed with different date of planting. The maximum number of florets per spike (13.81) was exhibited under planting on 30th September (D_1). While the minimum numbers of floret per spike (12.34) was noted in planting on 15th November (D_4). Different cultivars of gladiolus exhibited significant impact in respect to number of florets per spike. The maximum numbers of floret per spike (15.02) was observed in cultivar Candyman (V_3). However, minimum number of florets per spike (11.23) was noted in cultivar American Beauty (V_1). Interaction effect of the different dates of planting and cultivars in respect to number of florets per spike was found significant. The maximum number of floret per spike (15.50) was recorded in planting on 15th October with cultivar Candyman (D_2V_3). On the contrary, the minimum number of floret (10.61) was noted in planting on 15th November with cultivar American beauty (D_4V_1). The variation in number of florets per spike might be due to hereditary traits of the genotypes and it is directly correlated with favorable climatic conditions *viz.* temperature, humidity and photo period during the growth period. The results are in accordance with the findings of Rani and Singh (2005) [10], Bagde *et al.,* (2009) [4], Kumari *et al.,* (2011) [8] and saaie *et al.,* (2011) [12].

Table 1: Performance of Gladiolus cultivars under different planting dates for 50 per cent sprouting of gladiolus, Plant height (cm), Number of leaves, Length of leaves (cm) and Width of leaves (cm).

Treatments	Days to 50 per cent sprouting	Plant height (cm)	Number of leaves	Length of leaves (cm)	Width of leaves (cm)
	Pooled Mean	Pooled Mean	Pooled Mean	Pooled Mean	Pooled Mean
Dates of planting					
D_1 – 30 September	12.13	64.64	6.55	46.42	2.46
D_2 – 15 October	12.38	64.30	6.43	44.51	2.38
D_3 – 30 October	13.47	65.38	6.25	44.04	2.43
D_4 – 15 November	13.52	61.95	5.84	44.08	2.32
SEm±	0.29	0.37	0.06	0.61	0.07
CD at 5%	0.84	1.05	0.17	1.74	0.21
Cultivars					
V_1 – American Beauty	16.83	43.68	6.25	36.76	2.03
V_2 – White Prosperity	13.79	72.67	6.33	49.02	2.65
V_3 – Candyman	11.41	77.57	6.51	50.61	2.89
V_4 – Dull Queen	11.62	57.91	5.88	41.63	2.20
V_5 – Her Majesty	12.37	60.70	6.27	39.80	2.30
V_6 – Red Majesty	11.25	66.87	6.38	50.74	2.28
SEm±	0.36	0.45	0.07	0.75	0.03
CD at 5%	1.03	1.28	0.20	2.14	0.08
Interaction D x V	NS	S	S	S	S

Table 2: Interaction performance of Gladiolus cultivars under different planting dates for Plant height (cm), Number of leaves, Length of leaves (cm) and width of leaves (cm).

Treatment combinations	Plant height (cm)	Number of leaves	Length of leaves (cm)	Width of leaves (cm)
	Pooled Mean	Pooled Mean	Pooled Mean	Pooled Mean
D_1V_1	42.74	6.38	36.55	2.21
D_1V_2	73.33	6.30	52.80	2.93
D_1V_3	75.16	6.79	57.20	2.77
D_1V_4	54.86	6.26	43.40	2.27
D_1V_5	60.20	6.93	37.37	2.33
D_1V_6	70.96	6.66	51.16	2.16
D_2V_1	43.60	6.54	34.20	1.91
D_2V_2	74.10	6.36	50.16	2.98
D_2V_3	80.95	6.70	48.00	2.50
D_2V_4	58.03	6.13	40.20	2.20
D_2V_5	60.73	6.36	40.13	2.23
D_2V_6	70.63	6.50	53.36	2.48
D_3V_1	47.53	6.28	38.63	2.28
D_3V_2	71.60	6.66	52.96	2.70
D_3V_3	78.92	6.53	47.76	2.81
D_3V_4	58.56	5.60	40.06	2.16
D_3V_5	61.26	6.10	39.30	2.36
D_3V_6	74.53	6.30	48.86	2.27
D_4V_1	59.49	5.73	37.65	1.42
D_4V_2	71.66	6.00	47.60	2.60
D_4V_3	76.63	6.03	47.10	2.90
D_4V_4	60.20	5.53	41.86	2.13
D_4V_5	60.60	5.70	42.46	2.29
D_4V_6	72.40	6.06	49.56	2.20
SEm±	0.90	0.14	1.50	0.07
CD at 5%	2.57	0.41	4.27	0.22

Table 3: Performance of Gladiolus cultivars under different planting dates for spike emergence, No. of spike per plant, length of spike (cm) and No. of florets per spike

Treatments	Days to spike emergence	No. of spike per plant	Length of spike (cm)	No. of florets per spike
	Pooled Mean	Pooled Mean	Pooled Mean	Pooled Mean
Dates of planting				
D_1 – 30 September	59.16	1.47	73.67	13.81
D_2 – 15 October	59.80	1.36	70.43	13.44
D_3 – 30 October	61.09	1.35	69.00	12.78
D_4 – 15 November	61.45	1.19	67.20	12.34
SEm±	0.35	0.02	0.36	0.10
CD at 5%	1.01	0.06	1.04	0.28
Cultivars`				
V_1 – American Beauty	58.39	1.89	54.15	11.23
V_2 – White Prosperity	61.16	1.31	79.92	14.57

V_3 – Candyman	66.95	1.30	84.68	15.02
V_4 – Dull Queen	53.42	1.27	60.75	12.30
V_5 – Her Majesty	57.91	1.10	65.85	12.44
V_6 – Red Majesty	64.41	1.18	75.07	13.00
SEm±	0.43	0.02	0.45	0.12
CD at 5%	1.23	0.05	1.28	0.35
Interaction D x V	NS	S	S	S

Table 4: Interaction performance of Gladiolus cultivars under different planting dates for days to spike emergence, Number of spike per plant, Length of spike (cm) and No. of florets per spike

Treatment combinations	Days to spike emergence	Number of spike per plant	Length of spike (cm)	No. of florets per spike
	Pooled Mean	Pooled Mean	Pooled Mean	Pooled Mean
D_1V_1	55.50	2.07	62.40	11.70
D_1V_2	59.33	1.41	81.86	15.06
D_1V_3	67.50	1.48	88.47	15.43
D_1V_4	52.50	1.42	61.63	13.93
D_1V_5	56.66	1.18	68.40	12.90
D_1V_6	63.50	1.24	79.63	13.86
D_2V_1	58.00	1.98	51.83	11.10
D_2V_2	60.66	1.35	80.66	14.56
D_2V_3	67.16	1.29	85.17	15.50
D_2V_4	53.16	1.26	62.76	12.66
D_2V_5	56.83	1.08	65.70	12.53
D_2V_6	63.00	1.15	76.06	14.30
D_3V_1	59.06	1.99	52.43	11.19
D_3V_2	61.66	1.33	80.98	14.60
D_3V_3	67.50	1.26	82.33	14.73
D_3V_4	53.16	1.23	60.95	11.40
D_3V_5	59.00	1.17	65.10	11.96
D_3V_6	66.16	1.20	72.36	12.96
D_4V_1	61.00	1.51	49.89	10.61
D_4V_2	63.00	1.14	76.13	14.06
D_4V_3	65.66	1.15	82.80	14.43
D_4V_4	54.86	1.16	57.63	11.23
D_4V_5	59.16	1.05	64.20	12.36
D_4V_6	65.00	1.10	72.23	11.16
SEm±	0.87	0.05	0.90	0.24
CD at 5%	NS	0.14	2.56	0.69

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