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EFFECT OF GENOTYPE AND PLANTING GEOMETRY ON FLOWER QUALITY AND VASE LIFE OF GLADIOLUS (*GLADIOLUS* X *HYBRIDUS* HORT.)

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ABSTRACT

A field experiment was conducted during winter season of 2014-15 to study "Effect of genotype and planting geometry on flower quality and vase life of gladiolus(*Gladiolus* x *hybridus* Hort.)" having 12 treatment combinations of two genotypes (V_1- American Beauty and V_2- *Psittacinus* Hybrid-1) and six spacings (S_1- 15 cm x 15 cm, S_2- 20 cm x 20 cm, S_3- 30 cm x 15 cm, S_4- 30 cm x 20 cm, S_5- 30 cm x 30 cm, S_6- 40 cm x 30 cm) laid out in factorial randomized block design with three replications at College of Horticulture & Forestry, Jhalawar (Raj.). The treatment $V_1S_1$was recorded minimum days to spike emergence (64.07 days), days to first floret opening from spike emergence (12.20 days) while maximum was recorded in V_2S_6. Whereas the treatment V_1S_6 was noticed maximum number of florets per spike (15.60), floret diameter (9.84 cm), number of florets opened at a time in field (5.93), vase life of spikes (13.67 days), water uptake by spikes (35.50 ml) and number of florets open at a time (5.53) while minimum was recorded in V_2S_1. Therefore, it may be concluded that the treatment combination cv. American Beauty with 40 cm x 30 cm spacing could be suggested for imprudent of flower quality and vase life of gladiolus.

INTRODUCTION

Gladiolus (*Gladiolus* x *hybridus* Hort.) is an important cut flower crop, grown commercially in many parts of the world. It has gained popularity owing to its incomparable beauty, attractive colours, various sizes and shapes of florets, variable spike length and long vase life. Gladiolus produces beautiful spikes from December to March in the plains and from June to September in the hills of India. The genus *Gladiolus* belongs to family Iridaceae and comprises about 250 species with more than 10,000 cultivars out of which about 20 species are grown commercially for cut flower purpose. They are widely distributed in central Europe, the Mediterranean region, central and south Africa. It has the basic chromosome number n = 15. European species are tetraploids have chromosome ranges from 2n = 30 to 120. (diploid, triploid, tetraploid, pentaploid, haxaploid, octaploid and hyper anuploid). The genus was named by Tournefort and the generic name is derived from the Latin word 'gladius' meaning 'sword' on account of the sword-shaped foliage. Gladiolus was also called 'xiphium' based on the greek word 'Xiphos' also meaning sword. It is herbaceous bulbous plants which develop from axillary buds on the corm. The leaves of the plant overlap at the base depending on types the number varies from 1 to 12. The inflorescence is a spike and originates as a terminal axis and the floret number may be up to 20 or more (Bhattacharjee and De, 2003).

Gladiolus requires well drained soil for achieving healthy plants. Proper plant spacing is an important practice for providing good open position for sunlight, availability of moisture and nutrients vital for successful crop production and quality (Dogra, *et al.,* 2012). Planting density has very close relationship with the flower quality and vase life of gladiolus. Because of small holdings of the grower, peoples are trying to produce large number of plants area-1 for getting more spikes and corm yield (Bijimol and Singh, 2001). This practice badly affects the quality of spikes. For proper utilization of space and production of quality spikes, there is still need for identification of proper planting distances/density for this area. Although, work has been done on other aspects of gladiolus (Sudhakar and Kumar, 2012) but little or no work has been done on planting density by considering the soil and climatic conditions of this area (Sudhakar and Kumar, 2012).

There are many excellent varieties of gladiolus with magnificent inflorescence in exhaustive range of colours, different shades, varying number of florets and size of the florets, arrangement of the florets, spike length, post-harvest life and adaptability to different seasons. The performance of any crop or variety largely depends on genotypic and environmental interaction (Geeta, *et al.,* 2014). As a result, cultivars, which perform well in one region, may not perform same in other regions of varying climatic conditions (Geeta, *et al.,* 2014). Hence, it is very much necessary to collect and evaluate the available varieties to find out the suitable variety for the specific region. Thus the testing of varieties was carried out to study the performance of two genotypes with plant geometry of gladiolus under South-eastern Rajasthan conditions (Pragya *et al.,* 2010). Keeping in view the present studies were started to determine of genotype and planting geometry on flower quality and vase life of gladiolus under Jhalawar condition.

MATERIALS AND METHODS

A field experiment was conducted during winter season of 2014-15 at College of Horticulture & Forestry, Jhalawar at 331.14 m above mean sea level in the South Eastern Rajasthan. Maximum temperature range in the summer is 43-48^{0}C and minimum 3-5^{0}C during winter while, the mean maximum and minimum relative humidity range between 63.14 and 24.57 %. Corms of gladiolus cultivars were collected from Navsari Agriculture University, Navsari (Gujarat). Healthy and uniform size corms of 3-4 cm diameter were planted in third week of October at differents plant spacings. The experiment was conducted in open field of black cotton soil having pH 7.9, Organic carbon (0.30%), total nitrogen (258.66kg ha^{-1}), available phosphorus (20.83 kg h^{-1}) and potash (298 kg ha^{-1}).The experiment consisted of 12 treatment combinations (V_1S_1, V_1S_2, V_1S_3, V_1S_4, V_1S_5, V_1S_6, V_2S_1, V_2S_2, V_2S_3, V_2S_4, V_2S_5, V_2S_6) comprising of two genotypes (V_1- American Beauty and V_2-*Psittacinus* Hybrid-1) and six spacings (S_1- 15 cm x 15 cm, S_2- 20 cm x 20 cm, S_3- 30 cm x 15 cm, S_4- 30 cm x 20 cm, S_5- 30 cm x 30 cm and S_6- 40 cm x 30 cm) laid out in factorial randomized block design with three replications. The observations were recorded as the number of days taken for spike emergence, number of days taken from spike emergence to opening of first basal floret on spike, diameter of the second floret of spike, number of florets remaining open at a time after start of wilting of basal floret up to terminal three florets remaining unopened on the spike, vase-life of spikes was measured by counting the number of days up to which the cut-spikes remained fresh (having at least three florets fresh and open), Water uptake by cut spikes was measured in milliliter (ml) by measuring cylinder at every two days interval from start of vase life study till last three florets remained fresh on the spike and later on total water uptake was calculated by summing all the values. The experimental data were subjected to statistical analysis of variance and test of significance through the procedure described by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Flower quality parameters

The genotypes, planting geometries and their interactions had significant effect on Flower quality of gladiolus (Table 1).The interaction effects were found to be non-significant for number of days taken for spike emergence but the genotypes had highly significant effect on number of days to spike emergence with two-third time required in cv. American Beauty (66.54 days) as compared to cv. *Psittacinus* Hybrid-1 (102.04 days). Early spike emergence might have been primarily dependent on food reserves in plant that could be related to growth rate of plants regulating accumulation of the requisite level of carbohydrates for slipping (Pragya *et al.*, 2010). The results on varietal differences for spike emergence are in line with Kumar

Table 1: Effect of genotype and planting geometry flower quality of gladiolus

Treatment	Days to spike emergence	Days to first floret opening from spike emergence	Floret diameter (cm)	Number of florets per spike
Genotype				
V_1	66.54	14.20	9.21	14.04
V_2	102.04	15.40	7.02	13.12
CD at 5%	4.28	2.45	0.95	0.94
Spacing				
S_1	82.17	13.00	7.31	11.97
S_2	83.57	13.67	7.58	12.53
S_3	84.15	14.23	7.96	13.40
S_4	84.60	15.20	8.06	14.13
S_5	85.00	16.10	8.40	14.57
S_6	86.27	16.60	9.40	14.90
CD at 5%	2.47	1.41	0.55	0.54
Interaction				
V_1S_1	64.07	12.20	8.52	12.00
V_1S_2	65.27	12.93	8.94	12.67
V_1S_3	66.30	13.07	9.13	13.93
V_1S_4	67.00	14.53	9.27	14.80
V_1S_5	67.67	16.07	9.58	15.27
V_1S_6	68.93	16.40	9.84	15.60
V_2S_1	100.27	13.80	6.09	11.93
V_2S_2	101.87	14.40	6.22	12.40
V_2S_3	102.00	15.40	6.79	12.87
V_2S_4	102.20	15.87	6.84	13.47
V_2S_5	102.33	16.13	7.21	13.87
V_2S_6	103.60	16.80	8.96	14.20
CD at 5%	NS	NS	0.77	0.76

Table 2: Effect of genotype and planting geometry on Vase life of spike of gladiolus

Treatment	Number of florets remaining opened at a time in field	Vase life of spike	Number of floret remaining open at a time	Water uptake by spike (ml)
Genotype				
V_1	5.21	10.33	4.70	31.77
V_2	4.25	8.33	4.10	22.45
CD at 5%	0.52	0.91	0.45	1.80
Spacing				
S_1	4.08	9.33	3.77	23.65
S_2	4.40	9.67	4.03	25.26
S_3	4.63	9.83	4.27	26.66
S_4	4.83	10.83	4.50	28.04
S_5	5.13	11.67	4.80	29.25
S_6	5.30	12.00	5.03	29.81
CD at 5%	0.30	0.53	0.26	1.04
Interaction				
V_1S_1	4.27	10.33	3.93	27.33
V_1S_2	4.80	10.67	4.20	29.67
V_1S_3	5.13	11.00	4.47	30.97
V_1S_4	5.40	12.33	4.80	32.83
V_1S_5	5.73	13.33	5.27	34.33
V_1S_6	5.93	13.67	5.53	35.50
V_2S_1	3.90	8.33	3.60	19.97
V_2S_2	4.00	8.67	3.87	20.86
V_2S_3	4.13	8.67	4.07	22.35
V_2S_4	4.27	9.33	4.20	23.25
V_2S_5	4.53	10.00	4.33	24.17
V_2S_6	4.67	10.33	4.53	24.13
CD at 5%	0.42	0.75	0.37	1.47

and Yadav (2005).The earliest spike emergence was noticed with the closest spacing of S_1 (82.17 days) while the latest spike emergence in S_6 (86.27 days). The early spike emergence in closely spaced plants might be due more competition for nutrition, light and water which could have created an impulse in plants to complete their life cycle in short period (Kumari *et al.,* 2013). Similar findings were also reported by Anwar and Maurya (2005) in gladiolus.

The genotypes had significant effect on opening of first floret. The cv. American Beauty (14.20 days) recorded earlier first floret opening as compared to cv. *Psittacinus* Hybrid-1 (15.40 days). Variation in time required for first floret opening from spike emergence might be attributed to the genetic constitution of varieties which govern the vegetative and reproductive growth and phase and phase transformation (Sindhu *et al.*, 2014). The results also find support from (Bhujbal, *et al.,* 2013) in gladiolus. The minimum number of days to first floret opening from spike emergence was noticed with the narrowest plant spacing of S_1 (13.00 days), Kumari *et al*. (2013) whereas the widest plant spacing of S_6 resulted in most delayed first floret opening (16.60 days). This might be due to higher competition among the plants for space, nutrition and light, propelling them for earlier and faster phase transformation and as a result earlier flower production. The results are in line with the findings of Anwar and Maurya (2005), Bhat *et al*. (2008), Dogra *et al*. (2012) and in gladiolus.

The maximum number of florets per spike was recorded with V_1S_6 (15.60) while the minimum with V_2S_1 (11.93). The number of florets per spike appeared to be positively correlated with plant height, spike length and number of leaves per plant as the plants in various treatments having more plant height, spike length and number of leaves per plant also had more number of florets per spike. The positive effect of wider spacing on number of florets per spike might be due to less competition for nutrients and availability of more photosynthates which ultimately support better development of the sink (flowers) which ultimately enhanced number of florets per spike. Further the variation in number of florets per spike might be due to hereditary traits of varieties as it is an important criterion for grading of gladiolus spikes and genotype description. The finding also find support from reports of Anwar and Maurya (2005), Chourasia *et al*. (2015) and Thakur *et al*. (2015) in gladiolus.

The largest floret diameter was recorded in V_1S_6 (9.84 cm) and the smallest in V_2S_1 (6.09 cm). The variation in floret diameter might be due to hereditary traits of the gladiolus varieties, as the gladiolus varieties and species are grouped on the basis floret sizes. Kumar and Yadav (2005) and Thakur *et al*. (2015) have also reported similar findings. Wider spacing provide more space to plant which help to utilize more soil water, nutrition, air and light for photosynthesis, cell division and enlargement and ultimately better development of the sink and enhanced floret size. Similar results were obtained by Anwar and Maurya (2005) in gladiolus.

The maximum number of florets remaining open at a time was recorded with V_1S_6 (5.93) while the minimum with V_2S_1 (3.90). More number of florets remaining open at a time on a spike could be attributed to higher carbohydrate reserves in widely spaced plants which could have been further influenced by the genetic constitution of varieties having different photosynthetic rates and accumulation of carbohydrate reserves, required for energy needs of flower opening. The results also find support from Kumar and Yadav (2005) and Kumari *et al*. (2013).

Vase life of spike

The genotypes, planting geometries and their interactions had significant effect on Vase life of spike of gladiolus (Table 2). The maximum vase life of spikes was recorded with V_1S_6 (13.67 days) and the minimum in V_2S_1 (8.33 days). The variation in vase life among the genotypes might be due to different levels of reserve carbohydrates in the cut-spikes. It could be due to variation among the genotypes for production of photosynthates due to variation in photosynthetic area (leaf number and size). Differential sensitivity of the varieties to ethylene could also be a probable reason of variation in vase life. Thus, it could be concluded that variation in vase life of spikes of the different the varieties might be primarily due to their genotypic constitution leading to differential accumulation of carbohydrates and disparity in sensitivity to ethylene. The results are in line with those of Kumar and Yadav (2005) and Horo *et al*. (2009) in gladiolus. The vase life of spike gradually increased with increasing plant spacing along with positive correlating with spike length. The results are in accordance with the finding of Maniram *et al*. (2012) in gladiolus.

The maximum (5.53) number of florets remaining open at a time was recorded with V_1S_6 and the minimum with V_2S_1 (3.60). The genotypes had significant effect on the number of florets remaining opens at a time. This variation might have been primarily governed by the genetic makeup of varieties accounting to varied accumulation of carbohydrates and sensitivity to ethylene. Similar results on varietal variation for number of florets remaining open at a time have also been observed by Kumar and Yadav (2005) and Horo *et al*. (2009) in gladiolus.

The maximum water uptake by spike was recorded with V_1S_6 (35.50 ml) and the minimum with V_2S_1 (19.97 ml). The variation in water uptake by spike might be due to more number of florets open at time as well as ambient room condition (temperature, relative humidity and air movement). The spikes harvested from wide spaced plants had more water uptake. It might be due to enhanced growth of spikes in the vases due to more reserve food in spikes harvested from widely spaced plants along with the higher number florets remaining open at a time which could have increased water uptake by the spikes.

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