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Flower quality, yield and Cormel production of different varieties of gladiolus as affected by different plant geometry under Prayagraj agro-climatic conditions

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Abstract
A field trial on gladiolus in Factorial Randomized Block Design was carried out during 2019-2020 in the Department of Horticulture, SHUATS. The trial had two factors, *viz.* first factor was different varieties (Extasy, Peter Pears, Ocilla, Charisma, White Prosperity) and second factor was different planting geometries (15 cm x 30 cm, 20 cm x 30 cm and 25 cm x 30 cm), with total of 15 combinations replicated thrice. Among the different varieties, variety Ocilla performed significantly better in earliness (55.7 days), no. of florets per spike (14.0) and spike length (95.2 cm). Variety White Prosperity reported better spike yield per hectare (2.7 lakhs) and more no. of corms per plant (1.9) while Peter Pears resulted in higher cormel production per hectare (24.4 quintal). Among the different planting geometries, gladiolus planted at 25 cm x 30 cm resulted in significant earliness (56.4 days), no. of florets per spike (13.2) and spike length (89.3 cm), better spike yield per hectare (2.3 lakh) and higher cormel yield (20.9 quintal).

Keywords: Gladiolus, varieties, plant geometry, spike yield, cormel yield

Introduction
Gladiolus bears unparallel elegance, aesthetic and economic value for its beauty. It is frequently used in landscape, bedding and gardens and is an excellent cut flower. It is also widely used in bouquets, flower arrangements, artistic garlands, etc. It has captured a major share in the local and world floriculture markets for its attractiveness and assortment of cultivars of colours (Halder, *et al.* 2007) [2]. It is one of the few cut flowers in India which can be grown under open field conditions without ruining quality. Varied agro-climatic conditions in India make it possible for this crop to be grown throughout the year in one part of the country or the other. This opportunity has led to its export to Middle East and European countries during summer and winter months, respectively, when production in these countries is not possible, thereby increasing its demand and the chance to farmers to fetch higher prices for their produce. However, gladiolus cut flower spike quality and its mass production is still troublesome due to non-availability of quality planting material. Due to the low production of corms and cormels, its commercial cultivation is still limited (Singh and Dohare, 1994) [12]. Healthy plants, quality spikes, corms and cormels production are governed by many factors, of which plant geometry is a significant one. Optimum plant geometry provides scope for efficient utilization of solar radiation and nutrients to the plants (Sanjib and Talukdar, 2002) [11] thus, resulting in enhanced quality production and yield.

Materials and Methods
A field trial under the project entitled "Refinement of planting material (corms & bulbs) production technology of gladiolus and tuberose and its demonstration at farmer's field", funded by UPCST, Lucknow, was carried out during 2019-2020 in the Department of Horticulture, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj (Uttar Pradesh), India. The design of the experiment was Factorial Randomised Block Design having two factors. Factor 1 consisted of 05 varieties *viz.* Extasy, Peter Pear, Ocilla, Charisma, White Prosperity, and Factor 2 comprised of three planting geometries *viz*., 15 cm x 30 cm, 20 cm x 30 cm, and 25 cm x 30 cm. Corms were planted in October, 2020, with different planting geometries at a depth of 5 cm. The observations on flowering and yield parameters were recorded and analyzed statistically.

Results and Discussion

Flower quality (earliness, no. of florets per spike and spike length)

The data presented in Table 1 shows that there was a significant difference in the performance of different varieties of gladiolus planted at different geometries. Earliness in flowering is an important character, which helps farmers to capture early market. Among the different varieties, variety Ocilla performed significantly better in earliness (55.7 days), no. of florets per spike (14.0) and spike length (95.2 cm). Among the different planting geometries, gladiolus planted at 25 cm x 30 cm resulted in significant earliness (56.4 days), no. of florets per spike (13.2) and spike length (89.3 cm). Interaction of varieties and planting geometry had significant effect on no. of florets per spike and spike length. Variety Ocilla planted at 25 cm x 30 cm resulted in more no. of florets per spike (14.7) and spike length (99.6 cm). The varietal difference in performance was also observed by Swaroop (2010) [13], Kadam *et al.* (2014) [3], Negi *et al*. (2014) [10] and Bhat *et al.* (2018) [1], in gladiolus. Different varieties performed better for different floral parameters which might be due to the inherent capacity of the particular variety as well as the prevailing climatic conditions during the growing period. The plants at medium and wide spacing grow more rapidly as there is more uptake of moisture, nutrients, and more amount of sunlight as compared to closer spacing resulting in better accumulation of carbohydrates leading to better quality spikes. Similar results with wider spacing for floral parameters have been reported by Karuppaiah and Krishna (2005) [5] in French marigold, Mane *et al.* (2007) [9] in tuberose, Khalaj *et al.* (2012) [6] in tuberose and Pal *et al*. (2015) [7] in gladiolus.

Table 1: Effect of different varieties and planting geometry on spike quality of gladiolus

Spacing / Varieties	15 x 30 cm²	20 x 30 cm²	25 x 30 cm²	Mean (V)	15 x 30 cm²	20 x 30 cm²	25 x 30 cm²	Mean	15 x 30 cm²	20 x 30 cm²	25 x 30 cm²	Mean
	No. of days to flower bud emergence				No. of florets per spike				Spike length (cm)			
Extasy	66.0	65.0	61.0	64.0	9.9	10.9	11.7	10.9	87.4	90.8	94.2	90.8
Peter Pears	69.0	65.0	59.0	64.3	12.4	13.3	13.9	13.2	70.4	74.4	77.9	74.2
Ocilla	58.0	56.0	53.0	55.7	13.1	14.2	14.7	13.9	90.7	95.4	99.6	95.2
Charisma	71.0	69.0	53.0	64.3	10.2	10.2	10.9	10.4	78.9	81.2	83.9	81.3
White Prosperity	62.0	58.0	56.0	58.7	12.2	13.4	14.8	13.4	84.4	85.7	91.2	87.1
Mean (S)	65.2	62.6	56.4		11.5	12.4	13.2		82.3	85.5	89.3	
$CD_{0.05}$												
Variety	4.341				0.236				0.071			
Spacing	3.362				0.183				0.055			
Variety x Spacing	N/A				0.410				0.123			

Table 2: Effect of different varieties and planting geometry on yield parameters of gladiolus

Spacing / Varieties	15 x 30 cm²	20 x 30 cm²	25 x 30 cm²	Mean (V)	15 x 30 cm²	20 x 30 cm²	25 x 30 cm²	Mean	15 x 30 cm²	20 x 30 cm²	25 x 30 cm²	Mean
	Spike yield per hectare (in lakhs)				Number of corms per plant				Cormel yield per hectare (quintal)			
Extasy	1.600	1.500	2.000	1.700	1.0	1.0	1.3	1.1	19.500	22.100	24.867	22.156
Peter Pears	1.600	1.500	2.000	1.700	1.0	1.3	1.0	1.1	22.133	25.167	25.967	24.422
Ocilla	2.000	2.000	2.000	2.000	1.3	1.3	1.7	1.4	15.400	18.267	20.200	17.956
Charisma	1.200	2.000	2.000	1.733	1.0	1.0	1.7	1.2	9.033	12.667	13.733	11.811
White Prosperity	2.400	2.500	3.333	2.744	1.7	2.0	2.0	1.9	14.767	17.067	19.967	17.267
Mean (S)	1.760	1.900	2.267		1.2	1.3	1.5		16.167	19.053	20.947	
$CD_{0.05}$												
Variety	0.506				0.383				0.333			
Spacing	0.392				N/A				0.258			
Variety x Spacing	N/A				N/A				0.577			

Yield parameters (spikes, corm and cormel)

Among the different varieties, better spike yield per hectare was reported in variety White Prosperity (2.7 lakhs). Among the different planting geometries, gladiolus planted at 25 cm x 30 cm resulted in significant spike yield per hectare (2.3 lakh) but there was no significant effect of varieties and spacing on spike yield. Healthy planting material is required for commercial cultivation of any crop besides, corm and cormel sale give additional farm income apart from sale of spikes and hence, higher production of corms and cormels is crucial for rapid multiplication of gladiolus and higher farm income. There was significant difference among the varieties in production of corms and cormels. Variety White Prosperity resulted in more no. of corms per plant (1.9) while Peter Pears resulted in higher cormel production per hectare (24.4 quintal). Similar results in variation in corm and cormel production among the cultivars were also reported by Kamble *et al.*, (2004) [4] and Pragya *et al.* (2010) [8]. Planting geometry had no effect on no. of corms produced per plant but it had significant effect on cormel yield, higher yield (20.9 quintal) was observed at a spacing of 25 cm x 30 cm. interaction of varieties and planting geometry had significant effect on cormel yield but not on no. of corms per plant. Variety Peter Pears planted at 25 cm x 30 cm gave higher cormel yield per hectare (26.0 quintal). Probable reason for this variation in gladiolus corm and cormel yield might be due to genetic makeup of the varieties and effect of environmental conditions prevailing during the period of investigation as reported by Hong, *et al.* (1989) in gladiolus. Wider spacing resulted in increased cormel production as at wider spacing, plants had lesser competition for nutrients, water and sunlight thereby, having better photosynthetic assimilation resulting in higher cormel yield.

Conclusion

Based on the above findings, it is concluded that varieties and planting geometry had significant effect on different flowering and yield parameters in gladiolus. Among the varieties, Ocilla performed better in flowering paramaters (earliness, no. of florets per spike and spike length) while

variety White Prosperity resulted in higher spike yield per hectare and no. of corms per plant whereas higher cormel yield per hectare was obtained in variety Peter Pears. Wider spacing of 25 cm x 30 cm improved flower quality, spike & corm production, and cormel yield per hectare while closer spacing is suitable for increasing productivity.

Acknowledgment
This field trial was a part of project entitled "Refinement of planting material (corms & bulbs) production technology of gladiolus and tuberose and its demonstration at farmers' field", funded by the Council of Science & Technology, Uttar Pradesh (UPCST), Lucknow.

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