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V Vijaya Bhaskar
Department of Floriculture and Landscape Architecture
College of Horticulture, Dr. YSR Horticultural University,
Venkataramannagudem,
West Godavari District,
Andhra Pradesh, India

AVD Dorajeerao
Department of Floriculture and Landscape Architecture
College of Horticulture, Dr. YSR Horticultural University,
Venkataramannagudem,
West Godavari District,
Andhra Pradesh, India

T Suseela
Department of Floriculture and Landscape Architecture
College of Horticulture, Dr. YSR Horticultural University,
Venkataramannagudem,
West Godavari District,
Andhra Pradesh, India

Zahra Salma
Department of Floriculture and Landscape Architecture
College of Horticulture, Dr. YSR Horticultural University,
Venkataramannagudem,
West Godavari District,
Andhra Pradesh, India

Correspondence
V Vijaya Bhaskar
Department of Floriculture and Landscape Architecture
College of Horticulture, Dr. YSR Horticultural University,
Venkataramannagudem,
West Godavari District,
Andhra Pradesh, India

Performance of gladiolus cultivars under the coastal tropical humid climatic conditions of Andhra Pradesh

V Vijaya Bhaskar, AVD Dorajeerao, T Suseela and Zahra Salma

Abstract
The present investigation was carried out using nine hybrid cultivars of gladiolus in a randomized block design with three replications. Cultivars used in the present investigation were 'American Beauty', 'Arun', 'Darshan', 'Green Star', 'Limoncello', 'Meridiana', 'Pink Lady', 'White Prosperity' and 'Dhiraj' as a check cultivar. The analyzed data has revealed that plant height (125.60 cm) and leaf area (1189.00 cm^2 per plant) were found significantly highest with 'White Prosperity' when compared with other hybrid cultivars. Number of leaves produced per plant was found significantly highest with 'Green Star' (9.30) and was found at par with 'White Prosperity' (9.20). Among the floral parameters evaluated 'Limoncello' recorded significantly lowest number of days required for appearance of floral spikes (51.55 days), whereas 'Meridiana' recorded significantly highest number days taken for appearance of floral spikes (70.43 days). Cultivar 'White Prosperity' recorded significantly highest spike length (106.33 cm), rachis length (45.43 cm), highest number of florets per spike (13.40), highest floret length (1.10 cm), number of floral spikes per plant (2.07), number of spikes per plot (49.63), number of spikes per hectare (1.66 lakhs) with highest vase life (10.13 days). Further, cv. 'White Prosperity' recorded significantly highest corm weight per plant (101.33 g) and corm diameter (5.77 cm).

Keywords: Corm weight, floral spike, gladiolus, yield of spikes, white prosperity

Introduction
Gladiolus commonly called as 'sword lily' was derived from the Latin word 'Gladius' which means sword because of its leaf shape. Gladiolus belongs to the family *Iridaceae* and sub-family *Ixioideae*. It is one of the most popular ornamental bulbous plants grown commercially for its fascinating flowers in many parts of the world. The major countries cultivating gladiolus for its cut flowers are the USA, Holland, Italy, France, Poland, Bulgaria, Brazil, Australia and Israel. India is bestowed with suitable agro-climatic conditions for cultivation of gladiolus and thus it occupies third place in area and production of cut flowers grown in India after rose and carnation. In many parts of India, gladiolus is cultivated as a winter season crop. In Andhra Pradesh, Venkataramannagudem which comes under coastal zone of Andhra Pradesh, is a potential region with rich crop diversity. It is endowed with tropical humid climatic conditions and red sandy loam soils. Several reports of good performance by the modern cut flowers are available from this region. To meet the growing demand for cut flowers in the fast growing cities of coastal Andhra Pradesh it is necessary to introduce the new flowers for cultivation which are non-traditional to this region. The major states growing gladiolus are Uttar Pradesh, Himachal Pradesh, Haryana, Delhi, Karnataka, Punjab, West Bengal, Assam, Sikkim and Meghalaya (Kolavalli *et al.*, 1991) [4] and the cities which possess high demand for gladiolus cut flowers are Delhi, Chennai, Kolkata, Mumbai, Bangalore and Pune. Gladiolus was found very rich in its varietal wealth and every year there is an addition of new varieties and hybrids for successful cultivation. Hence evaluation of hybrid cultivars of gladiolus becomes necessary to find out their suitability for a particular region. Improvement of any crop is a continuous process, hence there is lot of scope to improve the existing cultivars or genotypes of gladiolus. Several research workers evaluated different genotypes of gladiolus under different conditions in various parts of India which include Ganesh *et al.* (2014) [2], Susila (2013) [10], Bhujal *et al.* (2013) [1] and Sindhu *et al.* (2014) [9]. Their recommendation with regard to a particular hybrid or variety has witnessed some ambiguity with regard to performance of the same variety under different conditions. Keeping a large diversity observed in the performance of gladiolus genotypes for different characters under different conditions, the present investigation was planned to evaluate different gladiolus genotypes (hybrids/varieties) for cut flower production under the tropical humid coastal climatic conditions of Andhra Pradesh. The main objective of the experiment was to evaluate gladiolus hybrids/varieties for their vegetative growth, flower

yield and corm characters to identify the best performing gladiolus hybrid/variety under the tropical humid climatic conditions of Andhra Pradesh.

Materials and Methods

The present investigation was carried out at College of Horticulture, Venkataramana Gudem, West Godavari district of Andhra Pradesh during the *Rabi* season of 2015-16. The present investigation was carried out using nine hybrid cultivars of gladiolus in a randomized block design with three replications. Cultivars used in the present investigation were 'American Beauty', 'Arun', 'Darshan', 'Green Star', 'Limoncello', 'Meridiana', 'Pink Lady', 'White Prosperity' and 'Dhiraj' as a check cultivar. One day before planting, the corms were treated with 2% carbendazim solution for 1 hour and were shade dried overnight. Planting was done in ridge and furrow method. Plot size was 2 m x 2 m and planted at a spacing of 30 cm x 20 cm on the ridge at a depth of about 5-6 cm. Recommended dose of manures and fertilizers were used in the experimentation for proper growth of the plant. During the last ploughing FYM was added at the rate of 10 kg/m^2 area. N: P: K fertilizers were applied at the rate of 30:20:20 g/m^2 as per the recommendation. All the cultural practices followed were uniform for all the genotypes. Five plants per replication were tagged and used for recording all the vegetative and floral parameters in the non-destructive method. All the parameters were recorded as per the standard method defined for a particular parameter. Mean values of three replications were exposed to statistical analysis to get a pooled mean value for a particular treatment. The treatments were compared using critical difference at 5% level.

Results and Discussion

The data pertaining to different vegetative growth parameters of gladiolus cultivars was presented in the Table. 1. Among the cultivars, 'Meridiana' recorded significantly lowest number of days taken for sprouting of corms (4.83 days) and was found at par with 'Limoncello' (5.23 days), whereas, 'American Beauty' has recorded significantly highest number of days (12.30 days) taken for sprouting of corms followed by 'White Prosperity' (10.70 days) which was found at par with 'Darshan' (10.57 days). Sprouting of corms is generally attributed to the genetic nature of the corms. Ram *et al*. (2001) [2] reported differences in the sprouting of corms for different gladiolus cultivars which might be due to the differences in the genetic composition of cultivars. These results were in found in close confirmation with the earlier findings of Lepcha *et al*. (2007) [5], Punam *et al*. (2009) [7], Tul *et al*. (2009) [12], Syed *et al*. (2013) [11] and Ganesh *et al*. (2014) [2] in gladiolus. Significant differences were observed in the plant height of different gladiolus cultivars. Among the cultivars, 'White Prosperity' recorded significantly tallest in the plant height (125.60 cm) followed by 'Pink Lady' (116.73 cm), whereas, 'Dhiraj' recorded significantly shortest in plant height (75.97 cm) and was found at par with 'American Beauty' (76.50 cm). Number of leaves recorded at harvest of flower spike in gladiolus differed significantly among different cultivars. Cultivar 'Green Star' recorded significantly highest number of leaves (9.30) per plant and was found at par with cv. 'White Prosperity' (9.20) and cv. 'Meridiana' (8.90). Significantly lowest number of leaves per plant was observed with cv. 'Arun' (7.03) and was found at par with cvs. 'Limoncello' (7.53), 'Dhiraj' (7.73) and 'Darshan' (7.93). Leaf area recorded at harvesting of gladiolus flower spikes recorded significant differences among the hybrid cultivars. Cultivar 'White Prosperity' recorded significantly highest leaf area (1189.00 cm^2) per plant at harvest of flower spikes and was found at par with cv. 'Green Star' (1127.10 cm^2), whereas cv. Darshan recorded significantly lowest leaf area (695.80 cm^2) per plant and was found at par with cvs. 'American Beauty' (734.03 cm^2), 'Dhiraj' (754.27 cm^2), 'Meridiana' (770.53 cm^2) and 'Arun' (791.40 cm^2). A positive association was observed among the characters *viz.*, plant height, number of leaves per plant and leaf area per plant which indicated a strong correlation among the characters indicating a positive approach towards increasing the production of carbohydrates which is vital in increasing the flower spike yield and quality of flowers. Thus, dwarf cultivars might have lower surface area of leaf which indicate lower rate of photosynthetic activity until and unless the cultivar possess a specific mechanism for increased photosynthetic activity. Further, differences observed in plant height, number of leaves per plant and leaf area per plant might be attributed to the genetic nature of cultivars rather than influence of environment. Genotypes possessing more leaf area per plant might have increased rate of photosynthesis thus producing more carbohydrates which help in increasing the plant height and number of leaves per plant in gladiolus. These findings were found in confirmation with the earlier reports of Kishan (2010) [3], Bhujal *et al*. (2013) [1], Susila (2013) [10] and Ganesh *et al*. (2014) [2] in gladiolus.

Data pertaining to floral parameters of gladiolus hybrids/varieties was presented in Table 2. The data were found significant for all the floral parameters. Among the gladiolus hybrids/varieties, 'Limoncello' recorded significantly lowest number of days taken for first appearance of spike (51.53 days), whereas 'Meridiana' recorded significantly highest number of days taken for first appearance of spike (70.43 days) and 'Green Star' (68.13 days) was found at par with 'Meridiana'. Remaining all other hybrids/varieties were found intermediate. The data presented in the table has indicated that there were significant differences among the hybrids/varieties for appearance of floral spike which was governed by the genetic make-up of genotypes. These results were found in confirmation with the earlier findings of Lepcha *et al.* (2007) [5], Punam *et al.* (2009) [7], Tul *et al.* (2009) [12], Syed *et al.* (2013) [11], Ganesh *et al.* (2014) [2] and Naresh *et al*. (2015). Significantly highest spike length, rachis length and number of florets per spike (106.33 cm, 45.43 cm and 13.40 respectively) were recorded with 'White Prosperity'. Significantly lowest spike length (62.43 cm) was recorded by 'American Beauty', whereas significantly lowest rachis length and number of florets per spike (32.37 cm & 8.83 respectively) were recorded with 'Limoncello' and was found at par with 'Dhiraj' (33.53 cm) with regard to rachis length and 'Green Star' (8.80) with regard to number of florets per spike. In gladiolus, spike length, rachis length and number of florets per spike were considered as commercially important characters in trading the flower spikes. From the present study, it can be noticed that taller the spike length more the rachis length and more number of florets per flower spike with some minor exceptions. Spike length, rachis length and number of florets per spike were found to be governed by genetic architecture of the genotype. These results were found in consonance with the earlier findings of Lepcha *et al.* (2007) [5], Punam *et al.* (2009) [7], Ganesh *et al.* (2014) [2] and Naresh *et al.* (2015) [6].

Data pertaining to flower quality parameters of gladiolus hybrids/varieties was presented in Table 3. Data were found significant for all the parameters. Among the gladiolus

genotypes, 'White Prosperity' recorded significantly highest floret length, highest number of spikes per plant, highest number of spikes per plot and highest number of spikes per hectare (10.10 cm, 2.07, 49.63 and 1.66 lakhs/ha respectively), whereas shortest floret length, lowest number of spikes per plot and lowest number of spikes per hectare (8.63 cm, 33.33 and 1.11 lakhs/ha) were noticed with 'Meridiana'. 'Limoncello' recorded significantly lowest number of spikes per plant (1.10) and was found at par with all other genotypes but differing significantly with 'White Prosperity'. In gladiolus, number of spikes produced per plant depends on the number of shoots the corm has produced (Shiramagondi and Hanamashetti, 1999). Further, spike yield per plant is a dependent character on many variable independent characters which include vegetative, reproductive and environment factors prevailing in the crop growing area. Present result was found in consonance with the earlier findings of Punam *et al,* (2009) [7] and Naresh *et al,* (2015) [6].

Data pertaining to vase life and corm parameters of gladiolus genotypes was presented in Table 4 and the data were found significant for all the parameters. Among the gladiolus genotypes, 'White Prosperity' recorded significantly highest vase life (10.13 days) in plain water, whereas remaining all other genotypes were found at par with each other in their vase life. Variation in vase life can be attributed to differential accumulation of carbohydrates due to varied leaf production and sensitivity to ethylene production. These findings were found in agreement with the earlier findings of Lepcha *et al,* (2007) [5] and Naresh *et al,* (2015) [6] in gladiolus. With regard to corm parameters, 'White Prosperity' recorded significantly highest corm weight (101.33 g) per plant, whereas 'Meridiana' recorded significantly lowest corm weight (64.33 g) per plant. Among the gladiolus genotypes, 'White Prosperity' recorded significantly highest corm diameter (5.77 cm), whereas 'American Beauty' recorded significantly lowest corm diameter (4.00 cm). Gladiolus genotype 'Darshan' recorded significantly highest number of cormels per corm (2.33) and was found at par with 'White Prosperity' (2.10), whereas 'Green Star' recorded significantly lowest number of cormels (1.07) per corm. Number of corms produced per plant in gladiolus is decided by number of shoots produced per plant (Shiramagondi and Hanamashetti, 1999). Light coloured genotypes were observed to produce more number of cormels (bigger size only taken in to account) than the dark coloured genotypes in gladiolus.

Based on vegetative and floral parameters evaluation in the genotypes of gladiolus, 'White Prosperity' has been found to be good in many of the attributes which ultimately increased the flower spike yield in gladiolus, hence may be recommended to grow profitably under the coastal tropical humid climatic conditions of Andhra Pradesh during *rabi* season.

Table 1: Evaluation of different gladiolus hybrids/varieties for vegetative growth

Treatment (Cultivars)	Days to sprouting of corms	Plant height (cm)	Number of leaves per plant	Leaf area (cm^2)
American Beauty	12.30	76.50	8.03	734.03
Arun	9.07	105.00	7.03	791.40
Darshan	10.57	98.70	7.93	695.80
Green Star	7.33	110.17	9.30	1127.10
Limoncello	5.22	97.07	7.53	958.87
Meridiana	4.83	92.67	8.90	770.53
Pink Lady	8.27	116.73	8.07	889.73
White Prosperity	10.70	125.60	9.20	1189.00
Dhiraj (Check)	9.30	75.97	7.73	754.27
Mean	8.62	99.82	8.19	878.97
SEm±	0.35	1.99	0.31	32.44
CD at 5%	1.06	5.96	0.93	97.27

Table 2: Evaluation of different gladiolus hybrids/varieties for floral parameters

Treatment (Cultivars)	Days taken for first appearance of spike	Spike length (cm)	Rachis length (cm)	Number of florets per spike
American Beauty	62.30	62.43	41.07	9.13
Arun	61.43	84.23	38.17	11.20
Darshan	62.13	77.70	41.43	11.73
Green Star	68.13	92.00	37.47	8.80
Limoncello	51.53	72.77	32.37	8.83
Meridiana	70.43	72.10	33.97	12.13
Pink Lady	60.73	92.40	38.57	11.67
White Prosperity	62.23	106.33	45.43	13.40
Dhiraj (Check)	63.03	62.83	33.53	10.80
Mean	62.44	80.31	38.00	10.86
SEm±	1.82	1.53	0.70	0.32
CD at 5%	5.47	4.59	2.09	0.95

Table 3: Evaluation of different gladiolus hybrids/varieties for flower quality

Treatment (Cultivars)	Floret length (cm)	Number of spikes per plant	Number of spikes per plot	Number of spikes per hectare (in lakhs)
American Beauty	9.47	1.27	41.20	1.37
Arun	9.40	1.17	41.07	1.37
Darshan	8.97	1.53	44.30	1.48
Green Star	8.80	1.20	36.17	1.21
Limoncello	9.43	1.10	34.60	1.15
Meridiana	8.63	1.20	33.33	1.11
Pink Lady	9.17	1.23	35.80	1.19

White Prosperity	10.10	2.07	49.63	1.66
Dhiraj (Check)	8.80	1.40	41.17	1.37
Mean	9.20	1.35	39.70	1.32
SEm±	0.20	0.11	1.48	0.05
CD at 5%	0.59	0.32	4.43	0.15

Table 4: Evaluation of different gladiolus hybrids/varieties for vase life and corm parameters

Treatment (Cultivars)	Vase life (days)	Corm weight per plant (g)	Corm diameter (cm)	Number of Cormels/Corm
American Beauty	7.87	79.00	4.00	1.83
Arun	7.80	83.67	3.93	1.40
Darshan	7.70	73.00	3.87	1.87
Green Star	8.23	69.33	4.67	1.07
Lemoncello	7.87	56.67	5.07	1.27
Meridian	7.63	64.33	5.03	1.20
Pink Lady	8.60	77.00	5.30	1.40
White Prosperity	10.13	101.33	5.77	2.10
Dhiraj(Check)	8.17	70.67	4.60	2.33
Mean	8.22	75.00	4.69	1.61
SEm±	0.17	1.35	0.09	0.09
CD at 5%	0.51	4.04	0.26	0.28

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