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Research Article

FIELD PERFORMANCE OF GLADIOLUS CULTIVARS FOR GROWTH, YIELD AND QUALITY CUT FLOWER PRODUCTION UNDER HUMID AGRO CLIMATIC CONDITIONS OF GOA

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Abstract: Present investigation was carried out to study the performance of improved cultivars of gladiolus for growth, yield and quality cut flower production under agro climatic conditions of Goa. Ten cultivars of Gladiolus namely Jester yellow, Novalux yellow, Red ginger, Summer pearl, Charms glow, Coral sea, Jester gold, Arka Amar, Arka Gold and Darshan were evaluated for their adaptability and performance. The vegetative, flowering, corm and cormel characters studied showed significant differences among different cultivars. Arka Amar obtained maximum plant height, longest and broadest leaves with significantly maximum no. of leaves per plant. Results on floral characteristics showed that Arka Gold was earlier for emergence of spike (56.33 days) and was found earliest in heading. Arka Gold took minimum days (64.40 days) for opening of first pair of florets. Significantly maximum no. of spikes was recorded in Arka Amar. Longest spike was recorded in Darshan whereas Arka Gold produced shortest spike. Maximum florets per spike were produced by Darshan with maximum stalk length of the flower and floret length. Arka Amar recorded significantly higher weight of the flower spike and flower spikes remained attractive for longer time. Results on corm and cormel characteristics showed that Arka Amar produced maximum number of corms per plant, cormels per plant and gained maximum corm size and corm diameter. Cormel weight/ plant was significantly higher in Darshan. Keeping in view, the vegetative and reproductive characteristics recorded, Arka Amar and Darshan could be recommended for cut flower purpose under Goan conditions.

Keywords: *Corm, Cut spike, Floret, Spike length, Gladiolus*

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Introduction

Gladiolus (*Gladiolus hortensis* L.), the queen of bulbous flowers, belonging to the family *Iridaceae* and subfamily Ixoideae, is one of the most popular ornamental bulbous plants grown commercially for its fascinating flowers in many parts of the world. Most of the wild species (approximately 300) of gladioli have their centre of origin in Africa, particularly in and around South Africa, but a few species are also from the Mediterranean and adjoining areas of Europe. Ploidy in the genus ranges from diploid (2n = 30) to dedecaploid (2n = 12x = 180). The genus was named by Tournefort and this generic name is derived from the latin word 'gladius' meaning 'sword' on account of the sword like shape of its foliage. It is commonly called as Sword lily. It is a slender herbaceous perennial with sword shaped phyllode leaves, grown both for gardens and floral decorations. From the commercial point of view, mainly, it is very important due to its majestic flower spikes having florets of varying shapes, sizes, colours and excellent keeping quality. The flower spikes are large and one-sided with bisexual flowers, each subtended by two leathery, green bracts. Adaptation to varying environments makes bulbous plants invaluable in a garden. They can be planted under shrubs or between perennials in the flower border or can be adopted informally in lawns and orchards, or formally in seasonal bedding display [1]. The flowers are used in flower arrangement, in bouquets and for indoor decorations. Gladiolus is very popular as a cut flower, both with the consumer and the florist alike because of its many spike forms, colours and colour combinations, an advantage in every floral arrangement [2]. It has gained popularity all over the world as one of the main decorative flowers. Demand of its cut flower for bouquet and other floral arrangement is increasing day by day due to its long vase-life and economic value. At present scanty research works are available on recommendations of the suitable gladiolus cultivars for growth, floral and economic parameters under agro climatic conditions of Goa. Keeping in view the above facts, the present study was undertaken to evaluate the growth performance of different gladiolus cultivars and to identify the best cultivar having good growth, flowering attributes and vase life under humid agro climatic conditions of Goa.

Material and Methods

Plant Materials and Experimental Procedures

The study on Gladiolus (*Gladiolus hortensis* L.) was carried out in the experimental area of the Division of Horticulture, ICAR Research Complex for Goa, Ela, Old Goa during the year 2015-16. Ten cultivars of gladiolus namely Jester yellow, Novalux yellow, Red ginger, Summer pearl, Charms glow, Coral sea, Jester gold, Arka Amar, Arka Gold and Darshan were used in the experiment.

Details of the Experimental Procedure

The land was brought to a fine tilth by ploughing. A spacing of 50 cm between two replications was provided for laying out irrigation channels and working space. Healthy and uniform corms of 3 – 4 cm diameter of ten cultivars of gladiolus were taken and prepared by removing the dried scales present on them. These corms were then planted at a depth of 5 cm with spacing of 30 cm in row to row and 20 cm from plant to plant. Ten corms of each cultivar were planted in each replication and data were recorded from five randomly selected plants. Uniform cultural practice was adopted for all the cultivars throughout the experiment. Harvesting of the spikes was done when basal floret was fully opened for recording different parameters. Irrigation was withheld twenty days prior to lifting of the corms.

The corms and cormels were lifted from the ground when the foliage turned to yellow colour, 40 days after completion of flowering. The observations were recorded timely on vegetative growth, yield, flower quality, corm and cormel parameters.

Evaluation of vegetative, floral, corm and cormel characteristics

Data on vegetative parameters was collected with respect to plant height (cm), number of leaves per plant, leaf width (cm) and leaf length (cm). Floral parameters studied were days required for first spike emergence, days required for opening of first pair of florets, number of spikes per plant, length of the flower spike (cm), number of florets per spike, diameter of the flower (cm), length of the flower (cm), weight of the flower spike (g), weight of individual florets (g) and vase life (days). Spike length was measured in centimetre with the help of meter scale from the juncture of the second pair of the leaf from the ground at full opening of the top most floret. Corms were harvested 40 days after completion of flowering for recording corm and cormel parameters. Corm and cormel characteristics recorded were diameter of the corm, number of corms per plant, number of cormels per plant, weight of the corm and weight of cormels. Diameter of corms was measured with the help of Digital Vernier Calliper.

Experimental Design and Data Analysis

The experiment was laid out according to Randomized Block Design (RBD) with ten treatments and three replications. The data was subjected to statistical analysis as per the established procedure [3]. The results have been presented and discussed at a probability level of 0.05 or 5 % probability.

Results and Discussion

Vegetative characteristics

Gladiolus is very rich in varietal wealth and every year there is addition of newer varieties, hence varietal evaluation becomes necessary to find out suitable cultivar for the specific region [4]. Vegetative attributes like plant height, number of leaves per plant, leaf width and leaf length are considered as some of the important factors which ultimately decide the yield and quality of flower spikes. Ten cultivars namely Jester yellow, Novalux yellow, Red ginger, Summer pearl, Charms glow, Coral sea, Jester gold, Arka Amar, Arka Gold and Darshan were grown under the same agro climatic conditions. Vegetative and floral characteristics were recorded for these cultivars. Genetic makeup and environment are the key factors which play important role in the performance of a variety [5]. Statistically significant variations in vegetative attributes like plant height, number of leaves per plant, leaf width and leaf length were recorded under this study (Table 1). Out of the 10 cultivars evaluated for their vegetative characteristics, the maximum plant height, longest and broadest leaves were recorded in Arka Amar (87.58 cm, 80.56 cm and 3.72 cm), whereas, Darshan and Arka Gold gave shortest (52.32 cm) and narrowest (2.81 cm) leaves respectively. Significantly maximum no. of leaves per plant (19.60) was recorded in Arka Amar. The highly significant variation in plant height, leaf length, leaf width and number of leaves per plant among various cultivars may be due to the hereditary traits, which is further modified by prevailing environmental condition. Variation in vegetative parameters is thus due to their genetic alignment, which interacts differently to soil and climatic conditions [6]. Differences in vegetative characters of different cultivars may be due to varied growth rate and their genetic makeup [7]. The results of the present findings were also in conformity with the findings reported earlier in gladiolus [8] and tuberose [9]. Number of leaves per plant, leaf length and leaf area were significantly different among different cultivars due to the genetic variation and difference in adaptation to the agro-climatic condition [10] and [11]. Similar results were also reported in gladiolus [12] wherein it was observed that different cultivars showed variable responses for vegetative characteristics.

Floral characteristics

The most important factors responsible for an economic flower yield are days required for first spike emergence, days required for opening of first pair of florets, number of spikes per plant, length of the flower spike, number of florets per spike, diameter of the flower, length of the flower, weight of the flower spike, weight of individual florets and vase life. Significant variations were reported in floral characteristics of gladiolus cultivars in this study (Table 2). Out of the 10 gladiolus cultivars evaluated for their floral parameters, Arka Gold took least no. of days for emergence of spike (56.33) and was found earliest in heading followed by Red ginger (57.66 days), while spike emergence was late in Novalux yellow (80.75 days). Days required for opening of first pair of florets was least (64.40 days) in Arka Gold followed by Red Ginger (66.33 days) whereas it was observed maximum in Novalux yellow (90.55 days). The variation in days to emergence of spike was primarily due to the different genetic make-up of the cultivars under study and prevailing environmental conditions. Number of days taken for emergence of spike differed significantly for different cultivars, might be due to the difference in genetic prospective and efficient utilization of natural resources and inputs [13]. Spike characters are important ones with regard to cut flower production in gladiolus. The different cultivars under study have shown significant differences with respect to spike length which is one of the important characters for quality assessment. The highest spike length (100.56 cm) was recorded in Darshan whereas Arka Gold produced shortest spike (88.77 cm). This variation in spike length among gladiolus cultivars may be due to different genetic make-up and prevailing environmental conditions. Out of the 18 gladiolus cultivars evaluated, 'Blue moon', 'Power puff', 'Friendship' and 'Red majesty' were found promising for spike characters [14]. Highly significant difference was observed among different cultivars with respect to number of marketable spikes produced per plant. Significantly maximum number of spikes (2.80) was recorded in Arka Amar, followed by Arka Gold (2.0). The genotypic differences existed with regard to production of marketable spikes per plant. Being genetically controlled factor variation occurred due to the hereditary traits of different cultivars under prevailing environment. Spike longevity and attractiveness depends on the length and number of florets of the inflorescence. In the present study, maximum no. of florets per spike was found in Arka Amar (14.02), whereas minimum was observed in Arka Gold (7.82). Unilateral arrangement of florets is another floral trait which decides marketability. Length and diameter should be high to have an attractive big floret. With respect to length of the floret the different gladiolus cultivars exhibited significant differences. Floret length (10.46 cm) and stalk length of the flower (3.24 cm) was significantly higher in Darshan whereas flower diameter (10.20 cm) was found to be significantly maximum in Arka Gold. Arka Amar exhibited maximum weight of individual florets (3.53 g). The variation in number of florets per spike, flower stalk length, floret length, flower diameter and weight of individual florets may be due to genetic variability among the different cultivars of gladiolus and prevailing environmental condition during field trial. Similar variations in spike quality parameters of gladiolus varieties were quoted in gladiolus [6] and [15]. Further, Arka Amar recorded significantly higher weight of the flower spike (67.56 g) followed by Arka Gold (59.82 g), while lowest were in cvs. Summer Pearl (23.60 g) and Novalux yellow (22.38 g). Variation in spike weight might be due to different genetic make-up of the different cultivars and prevailing environment conditions as reported earlier in gladiolus [4] and tuberose [9]. For a good cut spike of gladiolus flower, vase life is an important factor. The preference of consumers depends on the vase life of the cut spikes along with other good qualities of spikes as number of florets per spike, floret colour and spike length. In the present investigation, flower spikes lasted longest in Arka Amar (9.40 days) whereas Novalux yellow exhibited minimum lasting (4.00 days). Arka Amar showed the maximum vase life period which may be attributed to its longer spike length and a greater number of florets per spike which help the spike to retain attractiveness for a longer period. Vase life period was reported to vary between 7.6 to 11.6 days [16]. The highly significant variation for cut spike vase-life in plain water among gladiolus cultivars may be due to different genetic make-up with prevailing environmental conditions, which finally affects physiological processes like cell turgidity, water uptake through xylem tissue, water loss through transpiration, respiration and breakdown of the reserved food and senescence responsible enzyme which reduces vase-life under lab conditions.

Corm and cormel characteristics

All these vegetative and floral characteristics a good gladiolus variety should also produce big sized corms and good number of cormels for future planting.

Table-1 *Morphological and flowering attributes of different improved cultivars of Gladiolus under humid agro climatic conditions of Goa*

Treatments		Plant height (cm)	No. of leaves / plant	Leaf width (cm)	Leaf length (cm)	Days required for first spike emergence	Days required for opening of first pair of florets	No. of spikes/plant
T-1	Summer pearl	54.86	5.4	3.76	54.41	70.1	77.7	1
T-2	Red ginger	65.12	5.2	4.5	64.5	57.66	66.33	1
T-3	Jester yellow	64.52	5	2.54	63.92	65	90	1
T-4	Jester gold	65.36	6	3.86	64.48	62.4	76.6	1
T-5	Novalux yellow	71.28	7.2	3.32	70.66	80.75	90.55	1
T-6	Coral Sea	70.88	7.5	4.1	70.1	59.65	70.65	1
T-7	Charms glow	55.18	5.4	3.41	55.46	63.8	73.8	1
T-8	Arka Amar	87.58	19.6	3.72	80.56	73.56	78.82	2.8
T-9	Arka Gold	78.92	12.32	2.81	60.5	56.33	64.4	2
T-10	Darshan	71.64	13.72	3.36	52.32	79.04	84.42	1.2
SEm±		1.96	0.66	0.13	1.67	3.01	1.73	0.13
CD at 5%		5.87	1.98	0.39	5.01	9.04	5.18	0.39

Table-2 *Floral characteristics of different improved cultivars of Gladiolus*

Treatments		Length of the flower spike (cm)	No. of florets per spike	Diameter of the flower(cm)	Length of the flower(cm)	Weight of the flower spike (g)	Weight of individual florets (g)	Vase life(days)
T-1	Summer pearl	61.77	9.40	7.51	7.55	23.60	1.68	5.60
T-2	Red ginger	56.18	10.65	7.50	6.05	50.26	3.23	6.75
T-3	Jester yellow	57.12	8.24	9.06	7.50	49.81	3.47	4.24
T-4	Jester gold	60.74	10.80	6.71	6.68	37.49	1.95	8.40
T-5	Novalux yellow	44.75	6.45	8.83	7.25	22.38	3.32	4.00
T-6	Coral Sea	58.45	11.65	8.60	7.83	48.17	5.26	6.65
T-7	Charms glow	67.98	9.70	8.17	7.39	25.61	2.15	5.30
T-8	Arka Amar	94.20	14.02	9.47	9.44	67.56	3.53	9.40
T-9	Arka Gold	88.77	7.82	10.20	9.83	59.82	1.93	7.20
T-10	Darshan	100.56	13.80	7.48	10.46	43.83	1.70	6.20
SEm±		3.14	0.53	0.40	0.34	3.79	0.29	0.38
CD at 5%		9.42	1.59	1.20	1.03	11.37	0.88	1.15

Table-3 *Corm and cormel characteristics of different improved cultivars of Gladiolus*

Treatments		Corm diameter	Number of corms/plant	Number of cormels /plant	Weight of corm	Weight of cormels
T-1	Summer pearl	3.79	2.94	18.76	15.51	1.41
T-2	Red ginger	4.20	2.46	9.20	30.99	0.89
T-3	Jester yellow	4.14	2.74	16.90	12.42	1.83
T-4	Jester gold	3.62	2.36	10.52	17.88	1.16
T-5	Novalux yellow	3.45	2.36	10.56	24.82	1.39
T-6	Coral Sea	4.06	1.74	1.02	27.29	0.68
T-7	Charms glow	3.57	2.64	12.16	21.66	1.75
T-8	Arka Amar	4.41	3.20	32.12	32.97	1.99
T-9	Arka Gold	3.78	1.40	2.66	30.25	0.75
T-10	Darshan	4.25	3.02	19.90	32.96	2.64
SEm±		0.18	0.30	4.74	2.70	0.16
CD at 5%		0.54	0.91	14.21	8.10	0.49

In the present investigation, the different cultivars have shown varied response with respect to the weight and number of cormels produced. Significant variation was noticed in corm and cormel characters by the different cultivars in the present study (Table 3). Largest corm diameter was given by Arka Amar (4.41 cm). The maximum corm weight per plant was recorded in Arka Amar (32.97 g) with maximum number of corms per plant (3 no's). The production of corms of more weight may be attributed to the good vegetative growth of the plants in the initial stages, which supplies good amount of photosynthates for storage in the corms which are also the storage organs. This is clearly evident from the results obtained as Arka Amar was having more plant height and a greater number of leaves in the early growth stages. Out of the eight cultivars evaluated for corm production in gladiolus, it was inferred that varieties Psittacinus Hybrid and Phule Tejas were superior in respect of quantitative yield of corms [17]. There should be good production of cormels to have the good amount of planting material for the next generations. Highest number of cormels per plant was recorded in the Arka Amar (32.12 no's) while Arka Gold exhibited minimum number of cormels (1.029). These cormels could be used to plant in the immediate planting season for spike production, though of a comparatively small size. Cormel weight per plant was significantly higher in Darshan (2.64 g). The variation in cormel weight per plant among different cultivars at corm harvesting stage might be due to the distinguished varietal genetic make-up of the cultivar. Varieties with more leaves improve photosynthetic activity, source sink relationship accumulate more carbohydrates and improve corm weight per plant under prevailing conditions. Wide variation was reported in cormel production [18] while working on different cultivars of gladiolus.

Conclusion

It is evident from the results that all the cultivars had significant differences for vegetative, floral, corm and cormel characters when evaluated under the agroclimatic conditions of Goa. Ten cultivars of gladiolus namely Jester yellow, Novalux yellow, Red ginger, Summer pearl, Charms glow, Coral sea, Jester gold, Arka Amar, Arka Gold and Darshan were evaluated for their adaptability and performance. On the basis of their performance it is concluded that all the cultivars can be grown under Goan agro climate but cultivar Arka Amar and Darshan was found to be promising in respect of growth, yield and quality cut flower production under agroclimatic conditions of Goa

Application of research: This research has identified promising gladiolus cultivars for commercial cultivation under humid agro climatic conditions of Goa.

Research Category: Performance evaluation, germplasm

Abbreviations:

RBD: Randomised block design , MAP: Months after planting

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Cultivar / Variety name: Arka Amar, Arka Gold and Darshan

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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