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Studies on Growth, Flowering and Yield Parameters of Different Genotypes of Gerbera (*Gerbera jamesonii* Bolus)

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A B S T R A C T

Gerbera is one of the important commercial cut flower which is in great demand in domestic as well as international market. Though suited for a wide range of climates, the crop's performance varies in different locations and climatic conditions. The present investigation was conducted during *Rabi* season of 2010–11and 2011-12 at Greenhouse Complex, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat with an object to evaluate suitable varieties on the basis of growth, flower and yield parameters of gerbera under South Gujarat conditions. Among the varieties, the tallest plant (54.68 cm) was observed in Venezia which was followed by (49.72 cm) CF Gold while the maximum clumps per plant (7.05) were recorded in Stanza followed by (6.71) Lion and (5.73) CF Gold. The variety Torbin has significantly superior flower diameter (10.86, 10.81 and 10.84 cm in 2010-11, 2011-12 and pooled analysis, respectively) while the number of ray florets were highest (79.48, 79.39 and 79.43 during 2010-11, 2011-12 and pooled analysis, respectively) in variety CF Orange. The results revealed that the variety Venezia recorded significantly highest stalk length (63.91, 63.41 and 63.66 cm) as well as stalk diameter (6.57, 6.60 and 6.58 mm), during both the individual years of experiment and pooled data, respectively. The variety Stanza was superior variety with respect to production of number of flowers per plant (42.13, 41.54 and 41.84 flowers /plant /year) as well as number of flowers per square meter per year (252.80, 249.26 and 251.03 flowers /m^2 /year) which was followed by CF Gold and Fana during both the experimental years and in pooled data, respectively while the lowest yield was recorded in Cherany (20.28 flowers /plant/year and 121.65 flowers/m^2/year).

Introduction

Gerbera (*Gerbera jamesonii* L.) is one of the important ornamental plants with colorful and beautiful flowers that are used as cut, pot and garden flower. It belongs to the Asteraceae family and originates from Southern Africa and Asia, is a herbaceous, vivacious plant that grows to a height of approximately 45 cm. The elongated leaves are arranged in rosettes, reaching up to 40 cm in length. Furthermore, leaf blades exhibit variations in size and color depending on the cultivar. The flower buds originate in the axils

of some leaves, develop large scapes, and exhibit a terminal inflorescence known as a capitulum. The floral stem is slightly hairy, and its length and diameter vary depending on the cultivar, plant age, and growth conditions. Some long-stem cultivars grow to approximately 60 cm in height and are appropriate for use as cut flowers, whereas the most compact cultivars are used as pot flowers.

The performance of cultivars of any crop differs from one region to another region as well as also their growing conditions. When different cultivars are grown under identical conditions, it is the genetic factor that expresses the morphological differences. Hence selection of variety is an important criterion for successful cultivation of any flower crop. Several varieties of gerbera have released for commercial cultivation. However their performance with respect to growth, yield and quality cut flowers has not been tested much under protected structures. Hence, the present investigation was carried out with twelve genotypes involving systematic investigation to evaluate suitable varieties.

Materials and Methods

The present investigation was conducted at Greenhouse Complex, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat) during the *Rab*i season of year 2010-11 and 2011-12. Twelve genotypes of tissue cultured plantlets viz., Stanza, Fana, CF Gold, Diego, Cherany, CF Orange, Lion, Venezia, Torbin, Jaffana, Kento and Ice Queen, were planted a year before in 2009 before the commencement of the present study. Eight week old plantlets of these twelve genotypes were procured from Germini Agro Pvt. Ltd., Pune and planted in raised bed of 45 cm height, 60 cm width and 30 cm pathway at a spacing of 30 cm x 30 cm in double row zig-zag system in completely randomized system with three replications. The recommended package of practices was followed for raising the crop. Twenty plants from twelve genotypes were selected randomly from net plot and were tagged for recording the observations, during the two years. The average was worked out and results of pooled analysis were used to study genetic parameters on various vegetative growth, flowering, quality and yield characters as per genotypes.

Results and Discussion

Vegetative characters

The response of different gerbera cultivars under the study of two growth attributes *viz.*, plant height and number of clumps per plant, varies with each other. The tallest plant (54.68 cm) was observed in Venezia which was followed by (49.72 cm) CF Gold. While the maximum clumps per plant (7.05) were recorded in Stanza followed by (6.71) Lion and (5.73) CF Gold (Table 1).

Leaf production of any crop decides the spread of plant; leaves are the prime important functional units for photosynthesis, transpiration, respiration which greatly influence the growth and flower yield. The leaf area was measured highest (145.67 cm^2) in Venezia which was statistically at par (144.50 cm^2) with Stanza. Whereas, the lowest leaf area (100.33 cm^2) was measured in variety, Cherany, which was statistically at par (101.33 cm^2) with Jaffana and (101.83 cm^2) Lion.

The widest plant spreading (N-S direction) (52.94 cm) was found in Lion, which was at the same bar (52.31 cm) with Stanza and (51.56) Jaffana (Table 2). Similar finding was also observed by Kumar and Yadav (2003)

who attributed these variations due to additive gene effect in gerbera varieties. This effect may be attributed to the genetic makeup of the cultivars and the growing condition provided. Variation in clumps production per plant has also been reported in Gerbera (Kumar and Deka, 2012; Kumar and Yadav, 2003; Kandpal *et al.*, 2003; Naik *et al.*, 2006; Magar *et al.*, 2010).

Thus, the comparative changes in vegetative parameters are merely associated with reproductive phase. These results clearly indicated genetic inheritance and influence of the cultivar with respect to growth parameters. It is all known fact that the variation among cultivars can be attributed to differences in genetic makeup and its constituents. These kinds of results are in agreement in gerbera (Nair and Medhi, 2002; Kumar and Yadav, 2003; Kandpal *et al.*, 2003; Naik *et al.*, 2006).

Flower quality parameters

The different flowering parameters viz., flower diameter and number of ray florets per flower were significantly influenced by different varieties (Table 2). The variety Torbin has significantly superior flower diameter (10.86, 10.81 and 10.84 cm in 2010-11, 2011-12 and pooled analysis, respectively). This parameter, which has moral power to decide the size of flower and without this a flower, cannot attract the consumers.

The other quality parameter, which greatly influences the quality of cut flowers, is density of ray florets or on the other hand number of ray florets per flower. The number of ray florets were recorded highest (79.48, 79.39 and 79.43 during 2010-11, 2011-12 and pooled analysis, respectively) in variety CF Orange.

The variety Venezia recorded significantly highest stalk length (63.91, 63.41 and 63.66 cm) as well as stalk diameter (6.57, 6.60 and 6.58 mm), during both the individual years of experiment and pooled data, respectively (Table 3). This could be mainly due to genetic make-up. The results confirmed the reports of Nair and Medhi (2002) in gerbera cultivars in the Bay Islands as well as Bhayani *et al.*, (2008) and Patil *et al.*, (2010) in gerbera.

Petals are the floral organs, which primarily determine the commercial longevity of flowers and as a consequence, it is necessary to study the vase life of cut flowers that determine their quality and ability to satisfy consumer preferences. Significantly maximum vase life (12.60 days) was recorded in variety Venezia, which was followed by (12.19 days) Jaffana and (11.91 days) Stanza, in pooled analysis (Table 3). Minimum vase life (6.82 days) was observed in Kento, which was followed by (7.37 days) Torbin and (7.69 days) Fana, in pooled analysis. Variation in different floral characters might be attributed to the divergence in these genotypes or wide range in nature of growth. The result was in accordance of Nair and Medhi (2002), Kandpal *et al.*, (2003) and Naik *et al.*, (2006) and Magar *et al.*, (2010) in gerbera.

Chlorophyll content in leaves

Chlorophyll (Chl) is the principle green foliage pigment (Teixeira da Silva, 2003). Maximum chlorophyll content in leaf tissue (Table 4) was measured in variety V_1 (Stanza), V_8 (Venezia) and V_3 (CF Gold). It may be attributed to good vegetative growth and yield in these varieties especially Stanza having the highest record with respect to yield.

Table.1 Variation in plant height (cm), Clumps per plant and leaf area (cm^2) in different varieties of *Gerbera jamesonii* Bolus

S. No.	Variety	Plant Height (cm)			Clumps per plant			Leaf Area (cm^2)		
		2010-11	2011-12	POOLED	2010-11	2011-12	POOLED	2010-11	2011-12	POOLED
1	Stanza	49.93	50.07	50.00	7.00	7.09	7.05	144.67	144.33	144.50
2	Fana	46.77	46.30	46.53	3.62	3.68	3.65	116.00	115.67	115.83
3	CF Gold	49.70	49.73	49.72	5.68	5.77	5.73	112.67	112.33	112.50
4	Diego	47.83	47.67	47.75	3.94	4.00	3.97	141.00	140.67	140.83
5	Cherany	41.80	41.30	41.55	2.31	2.39	2.35	100.67	100.00	100.33
6	CF Orange	46.50	45.80	46.15	2.66	2.74	2.70	133.33	133.00	133.17
7	Lion	45.10	44.53	44.82	6.64	6.77	6.71	102.00	101.67	101.83
8	Venezia	54.77	54.60	54.68	4.61	4.69	4.65	146.00	145.33	145.67
9	Torbin	48.90	48.23	48.57	4.28	4.37	4.33	121.67	121.00	121.33
10	Jaffana	43.03	41.87	42.45	5.31	5.37	5.34	101.67	101.00	101.33
11	Kento	45.57	44.90	45.23	2.95	3.08	3.02	138.67	138.00	138.33
12	Ice Queen	41.27	40.47	40.87	4.58	4.63	4.60	134.67	134.00	134.33
S.Em. (+)		0.521	0.861	0.503	0.134	0.129	0.093	2.196	0.898	1.186
C.D. at 0.05		1.52	2.51	1.43	0.39	0.38	0.26	6.41	2.62	3.38
CV (%)		1.93	3.22	2.65	5.19	4.91	5.05	3.06	1.25	2.34

Table.2 Variation in plant spread (cm), flower diameter (cm) and number of ray florets per flower in different varieties of gerbera (*Gerbera jamesonii*Bolus)

Sr. No.	Variety	Plant Spread (cm)			Flower Diameter (cm)			Number of ray florets per flower		
		2010-11	2011-12	POOLED	2010-11	2011-12	POOLED	2010-11	2011-12	POOLED
1	Stanza	52.60	52.01	52.31	10.39	10.34	10.36	70.46	70.07	70.26
2	Fana	45.68	45.37	45.53	10.52	10.45	10.48	51.60	51.40	51.50
3	CF Gold	49.33	49.03	49.18	10.74	10.67	10.71	74.56	74.36	74.46
4	Diego	48.67	48.08	48.37	9.90	9.88	9.89	53.78	53.51	53.64
5	Cherany	40.79	40.57	40.68	9.71	9.66	9.68	59.83	59.61	59.72
6	CF Orange	46.14	45.98	46.06	9.49	9.44	9.46	79.48	79.39	79.43
7	Lion	53.01	52.87	52.94	8.71	8.62	8.66	54.89	54.63	54.76
8	Venezia	39.79	39.70	39.75	10.08	10.03	10.06	62.16	61.87	62.01
9	Torbin	40.83	40.67	40.75	10.86	10.81	10.84	65.05	64.82	64.94
10	Jaffana	52.02	51.10	51.56	10.28	10.24	10.26	50.21	49.92	50.07
11	Kento	46.53	45.61	46.07	9.22	9.17	9.19	44.33	44.07	44.20
12	Ice Queen	45.03	44.05	44.54	8.91	8.85	8.88	49.72	49.33	49.53
SEm. (+)		0.483	0.851	0.489	0.165	0.189	0.125	1.870	1.686	1.259
C.D. at 0.05		1.41	2.48	1.39	0.48	0.55	0.36	5.46	4.92	3.58
CV (%)		1.79	3.19	2.58	2.88	3.32	3.10	5.43	4.92	5.18

Table.3 Variation in stalk diameter (cm), stalk length (cm) and vase life (days) in different varieties of *Gerbera jamesonii* Bolus

Sr. No.	Variety	Stalk Diameter (cm)			Stalk Length (cm)			Vase life (days)		
		2010-11	2011-12	POOLED	2010-11	2011-12	POOLED	2010-11	2011-12	POOLED
1	Stanza	6.03	6.02	6.03	59.49	59.37	59.43	11.97	11.85	11.91
2	Fana	5.60	5.54	5.57	58.53	58.27	58.40	7.73	7.64	7.69
3	CF Gold	5.24	5.22	5.23	54.16	53.87	54.01	10.88	10.83	10.86
4	Diego	5.39	5.52	5.46	55.51	55.31	55.41	11.69	11.59	11.64
5	Cherany	4.22	4.18	4.20	46.84	46.74	46.79	9.46	9.36	9.41
6	CF Orange	6.24	6.21	6.23	51.48	51.29	51.39	8.24	8.12	8.18
7	Lion	4.06	4.09	4.08	46.48	45.90	46.19	8.96	8.80	8.88
8	Venezia	6.57	6.60	6.58	63.91	63.41	63.66	12.68	12.52	12.60
9	Torbin	5.52	5.46	5.49	61.92	61.73	61.83	7.42	7.32	7.37
10	Jaffana	4.89	4.86	4.87	47.21	46.82	47.02	12.27	12.11	12.19
11	Kento	4.48	4.57	4.53	55.71	55.33	55.52	6.86	6.78	6.82
12	Ice Queen	4.63	4.59	4.61	42.22	41.74	41.98	10.21	10.11	10.16
S.Em. (+)		0.156	0.176	0.118	1.780	1.250	1.087	0.065	0.185	0.098
C.D. at 0.05		0.46	0.51	0.34	5.19	3.65	3.09	0.19	0.54	0.28
CV (%)		5.16	5.84	5.51	5.75	4.06	4.98	1.15	3.28	2.45

Table.4 Variation in chlorophyll content (mg/g) in leaf tissue, number of flowers per plant per year and number of flowers per square meter per year in different varieties of *Gerbera jamesonii* Bolus

Sr. No.	Variety Name	Chlorophyll content (mg/g) in leaf tissue			Number of flowers per plant per year			Number of flowers per square meter per year		
		2010-11	2011-12	POOLED	2010-11	2011-12	POOLED	2010-11	2011-12	POOLED
1	Stanza	9.74	9.95	9.85	42.13	41.54	41.84	252.80	249.26	251.03
2	Fana	8.55	8.60	8.58	32.77	32.38	32.58	196.62	194.30	195.46
3	CF Gold	9.43	9.48	9.46	33.65	33.13	33.39	201.89	198.78	200.34
4	Diego	7.17	7.11	7.14	28.78	28.26	28.52	172.68	169.58	171.13
5	Cherany	8.85	8.87	8.86	20.54	20.01	20.28	123.22	120.08	121.65
6	CF Orange	8.38	8.34	8.36	27.23	26.64	26.93	163.36	159.82	161.59
7	Lion	7.98	8.00	7.99	21.25	20.69	20.97	127.51	124.14	125.82
8	Venezia	9.55	9.49	9.52	24.86	24.35	24.60	149.17	146.08	147.62
9	Torbin	6.34	6.38	6.36	26.74	26.29	26.52	160.46	157.72	159.09
10	Jaffana	6.31	6.35	6.33	24.45	24.03	24.24	146.67	144.20	145.44
11	Kento	7.25	7.30	7.28	22.47	22.13	22.30	134.80	132.78	133.79
12	Ice Queen	8.73	8.67	8.70	22.19	21.73	21.96	133.14	130.40	131.77
S.Em. (±)		0.057	0.165	0.087	0.862	0.513	0.502	2.832	4.641	2.718
C.D. at 0.05		0.17	0.48	0.25	2.52	1.50	1.43	8.27	13.55	7.74
CV (%)		1.20	3.48	2.61	5.48	3.32	4.55	3.00	5.01	4.11

Yield attributes

The variety Stanza was superior variety with respect to production of number of flowers per plant (42.13, 41.54 and 41.84 flowers/plant/year) as well as number of flowers per square meter per year (252.80, 249.26 and 251.03 flowers/m^2/year), which was followed by CF Gold and Fana during both the experimental years and in pooled data, respectively (Table 4). The lowest yield was recorded in Cherany (20.28 flowers/plant/year and 121.65 flowers/m^2/year) (Kim *et al.,* 1990).

The higher yield is reflected by growth and environmental conditions under which the crop is raised. Even the genetic constituents of the cultivar will govern the growth and flower yield. It is the genetic factor that expresses their morphological differences, when different cultivars are grown under identical conditions. The selection of a cultivar for a particular region is of much significance as it grows considerable variability in several characters, when grown under a particular environment. The *per se* performance of genotypes Stanza, Venezia, Jaffana and CF Gold are best suited for South Gujarat conditions, since they perform better than other varieties with respect to some of the desirable characters like, number of flowers per plant, flower diameter, stalk length, number of leaves per plant, number of clumps per plant and leaf area, etc. The aim of the screening of gerbera varieties was to evaluate those varieties which exhibit novel and commercially valuable characteristics. Thus, the results will be useful for farmers and breeders to improve yield and minimize postharvest losses in gerbera.

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