Studies on growth, flowering and yield parameters of different genotypes of gerbera (Gerbera jamesonii Bolus)

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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 45-60 cm. The elongated leaves are arranged in rosettes, reaching up to 40 cm in length. Furthermore, these leaves exhibit variations in size and color depending on the cultivars. The flower buds originate in the axils of some leaves, develop large scarps 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 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 conducted with the objective to evaluate suitable varieties.

Materials & Methods

The present investigation was conducted at Greenhouse Complex, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat) during the Rabi 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 procured from Germini Agro Pvt. Ltd., Pune and planted in a 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 results revealed that the variety Venezia recorded significantly higher 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/m²/year) which was followed by CF Gold and Fana during both the experimental years and in pooled data, respectively. The variety Stanza was superior variety with respect to growth, flowering 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/m²/year) which was followed by CF Gold and Fana during both the experimental years and in pooled data, respectively.
Results and Discussions

Vegetative characters: The response of different gerbera cultivars under the study of twogrowth 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 as shown in 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 cm) Jaffana as shown in 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 by Kumar & Deka 2012; Kumar and Yadav 2003; Kandpal et al., 2003, Naik et al., 2006, Magar et al., 2010 in Gerbera. 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 with Nair and Medhi 2002; Kumar and Yadav 2003; Kandpal et al., 2003; Naik et al., 2006 in gerbera.

Flower quality parameters: The different flowering parameters viz., flower diameter and number of ray florets per flower were

| 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 |
| Stanza  | 49.93 | 50.07 | 50.00 | 7.00 | 7.09 | 7.05 | 144.67 | 144.33 | 144.50 |
| Fana    | 46.77 | 46.30 | 46.53 | 3.62 | 3.68 | 3.65 | 115.83 | 115.00 | 115.33 |
| CF Gold | 49.70 | 49.73 | 49.72 | 5.68 | 5.77 | 5.73 | 112.50 | 112.33 | 112.50 |
| Diego   | 47.83 | 47.67 | 47.75 | 3.94 | 4.00 | 3.97 | 112.67 | 112.33 | 112.50 |
| Cherany | 41.80 | 41.30 | 41.55 | 2.31 | 2.39 | 2.35 | 100.33 | 100.00 | 100.33 |
| CF Orange | 46.50 | 46.80 | 46.15 | 2.66 | 2.74 | 2.70 | 101.83 | 101.67 | 101.83 |
| Lion    | 45.10 | 44.53 | 44.82 | 6.64 | 6.77 | 6.71 | 101.33 | 101.00 | 101.33 |
| Venezia | 54.77 | 54.60 | 54.68 | 4.61 | 4.69 | 4.65 | 101.33 | 101.00 | 101.33 |
| Torbin  | 48.90 | 48.23 | 48.57 | 4.28 | 4.37 | 4.33 | 101.33 | 101.00 | 101.33 |
| Jaffana | 43.03 | 41.87 | 42.45 | 5.31 | 5.37 | 5.34 | 101.33 | 101.00 | 101.33 |
| Kento   | 45.57 | 44.90 | 45.23 | 2.95 | 3.08 | 3.02 | 101.33 | 101.00 | 101.33 |
| Ice Queen | 41.27 | 40.47 | 40.87 | 4.58 | 4.63 | 4.60 | 101.33 | 101.00 | 101.33 |
| S.Em. (+) | 0.521 | 0.861 | 0.503 | 0.013 | 0.129 | 0.093 | 1.25 | 0.898 | 1.186 |
| C.D. at 0.05 | 1.52 | 2.51 | 1.43 | 0.39 | 0.38 | 0.26 | 0.9 | 0.9 | 0.9 |
| CV (%) | 1.93 | 3.22 | 2.65 | 5.19 | 4.91 | 5.05 | 3.06 | 1.25 | 2.34 |

| Variety | Plant spread (cm) | Flower diameter (cm) | No. of ray florets/flower (cm$^2$) |
|---------|------------------|---------------------|-------------------------------|
|         | 2010-11 | 2011-12 | POOLED | 2010-11 | 2011-12 | POOLED | 2010-11 | 2011-12 | POOLED |
| Stanza  | 52.60 | 52.01 | 52.31 | 10.39 | 10.34 | 10.36 | 70.46 | 70.07 | 70.26 |
| Fana    | 45.68 | 45.37 | 45.53 | 10.52 | 10.45 | 10.48 | 74.56 | 74.36 | 74.46 |
| CF Gold | 49.33 | 49.03 | 49.18 | 10.74 | 10.67 | 10.71 | 74.56 | 74.36 | 74.46 |
| Diego   | 46.87 | 46.08 | 46.37 | 9.90 | 9.88 | 9.89 | 53.78 | 53.51 | 53.64 |
| Cherany | 40.79 | 40.57 | 40.68 | 9.71 | 9.66 | 9.68 | 59.83 | 59.61 | 59.72 |
| CF Orange | 46.14 | 45.98 | 46.06 | 9.49 | 9.44 | 9.46 | 79.48 | 79.39 | 79.43 |
| Lion    | 53.01 | 52.87 | 52.94 | 8.71 | 8.62 | 8.66 | 54.89 | 54.63 | 54.76 |
| Venezia | 39.79 | 39.70 | 39.75 | 10.08 | 10.03 | 10.06 | 62.16 | 61.87 | 62.01 |
| Torbin  | 40.83 | 40.67 | 40.75 | 10.86 | 10.81 | 10.84 | 65.05 | 64.82 | 64.94 |
| Jaffana | 52.02 | 51.10 | 51.56 | 10.28 | 10.24 | 10.26 | 50.21 | 49.92 | 50.07 |
| Kento   | 46.53 | 45.61 | 46.07 | 9.22 | 9.17 | 9.19 | 44.33 | 44.07 | 44.20 |
| Ice Queen | 45.03 | 44.05 | 44.54 | 8.91 | 8.85 | 8.88 | 49.72 | 49.33 | 49.53 |
| S.Em. (+) | 0.483 | 0.851 | 0.489 | 0.165 | 0.189 | 0.125 | 1.87 | 1.666 | 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 |
significantly influenced by different varieties as shown in 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 as shown in Table 3. This could be mainly due to genetic make-up. The results confirmed the reports of Nair & Medhi (2002) in gerbera cultivars in the Bay Islands as well as Bhayani et al. (2008), 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 (as shown in 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), 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 as shown in Table 4 was measured in variety V₁ (Stanza), V₈ (Venezia) and V₃ (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.

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/m²/year), which was followed by CF Gold and Fana during both the experimental years and in pooled data, respectively as shown in Table 4. The lowest yield was recorded in Cherany (20.28 flowers/plant/year and 121.65 flowers/m²/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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