

Comparative Evaluation of Growth, Yield and Quality Characteristics of Various Gerbera (*Gerbera jamesonii* L.) Cultivars under Protected Condition

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Ten gerbera cultivars ('Labinel', 'Lilla', 'Alp', 'Alberino', 'Bonnie', 'Avemaria', 'Mammut', 'Lexus', 'Terramixa' & 'Sarolta') were evaluated for their growth, yield and quality characteristics under protected conditions during 2011. Among the cultivars studied, there were highly significant variations observed for growth, yield and quality parameters. Longest stalk length (60.3 cm) was exhibited by the cultivar 'Alberino' followed by 'Lexus' (59.0) and 'Mammut' (54.0 cm). The same cultivar also produced flowers with maximum diameter. With respect to vegetative parameters like number of leaves per plant and plant spread were also more in the same cultivar. Maximum number of flowers 135 per square meters was recorded in cv. 'Avemaria' (135) followed by 'Alberino' (125). Maximum vase life was recorded in cultivars 'Alberino' and 'Lexus' (6.6) followed by 'Mammut' (5.6) and "Sarolta" (5.6). Excellent quality flowers were observed in cultivar 'Alberino' (4.8) followed by 'Lexus' (4.4). Cultivar 'Alberino' and 'Lexus' were found superior with respect to growth, yield and vase-life characteristics under protected conditions.

Abstract

Keywords: Cultivars, Gerbera, Growth, Protected conditions, Vase life.

INTRODUCTION

Gerbera (*Gerbera jamesonii* L.) also commonly known as Transvaal Daisy is an important cut flower grown throughout the world (Pattanashetti *et al.*, 2012) scattered from Africa to Madagascar (Khosa *et al.*, 2011) into tropical Asia and South America (Tjia and Joiner, 1984). Variety in color has made this flowering plant attractive for use in garden decorations, such as herbaceous borders, bedding, and pots and for cut flowers as it has a long vase life (Bose *et al.*, 2003; Chung *et al.*, 2005; Chauhan, 2005). It ranks fourth in the international cut flower market and a popular cut flower in Holland, Germany and USA (Choudhary and Prasad, 2000). Modern gerbera arose from *Gerbera jamesonii* hybridized with *Gerbera viridifolia* and possibly other species (Leffring, 1973).

It is difficult to get good quality cut flowers of gerbera under open-field conditions. To meet the qualitative and quantitative standards, hybrid cultivars have to be grown under protected conditions (Pattanashetti, 2009). Previously, in a performance study of gerbera varieties, Singh and Ramachandran (2002), Singh and Mandhar (2002) and Kandpal *et al.* (2003) grew gerbera under protected conditions and observed better growth, yield and quality characteristics under protected. In protected conditions, gerbera grows faster and produces larger and greener leaves with high dry matter content. As a result, the yield of the flowers increases and more side shoots will be formed. Protected conditions provide favorable environment for the growth of the plants by protecting the crop from heavy winds, pests, diseases and other climatic conditions (Khan, 1995). Good drainage in the protected house is also essential for gerbera cultivation (Labeke and Dambre, 1999).

The market requirement for cut flowers is very specific and it can be met consistently, only when the crop is grown under protected conditions. In places where the natural weather remain considerably cooler for most parts of the year as in parts of USA, UK and Australia the crop is being grown under fully protected climate in controlled green houses. In places near equator, with warmer sunny climate, semi protected conditions are successfully employed to cultivate the crop. Performance of gerbera varies with the region, season and other growing conditions (Horn *et al.*, 1974).

Gerbera as a cut flower has tremendous demand in domestic and international markets. Though, different cultivars of gerbera exist in Pakistan, none has been officially released till date. Lack of potential variety is one of the main constraints towards its production in Pakistan. Hence, it is needed to evaluate cultivars for their vegetative, yield and quality characters and finally to recommend the suitable variety for the agro-climatic conditions of Punjab, Pakistan. Considering the above facts, the present research work was undertaken to study the performance of different cultivars of gerbera under protected conditions.

MATERIALS AND METHODS

The experiment was conducted at Kala Shah Kaku Research Station, Directorate of Floriculture, Lahore (31°62'N; 74°9'E) during 2011 in Complete Randomized Design (CRD). Ten plants were taken as treatment unit replicated three times to find out the suitable cultivar of gerbera for the commercial production under protected conditions. Dimension of protected house was 1250 sq. ft. (25 x 50 ft). The experiment consisted of ten gerbera cultivars ('Alp', 'Alberino', 'Avemaria', 'Bonnie', 'Labinel', 'Lexus', 'Lilla', 'Mammut', 'Sarolta' & 'Terra-mixa').

The data on stalk length (cm), number of leaves/plant, plant spread (cm), number of stalks plant⁻¹, flower diameter, number of flowers/m, vase life and quality of flowers were recorded. Flower quality was determine with the help of scale ranging from 1 to 5 very poor, poor, satisfactory, good, excellent respectively (Khosa *et al.*, 2011). A panel of five judges was asked to perform sensory assessment using the above mentioned scale. Stalk length of the flowers was measured from the point of origin of stalk to the point just below the flower head and the average stalk length of flowers was recorded and expressed in centimeter (cm). Number of leaves/plant was recorded from the tagged plants by counting the number of leaves and average number of leaves produced

per plant was worked out. Diameter of flower was recorded at full bloom stage from the flowers harvested at peak flowering. The readings were taken from the tagged plants and average was measured and expressed in centimeters.

Gerbera flowers for vase life evaluation were harvested when all the florets opened fully and were perpendicular to the stalk. The flowers were harvested early in the morning and were immediately placed in fresh water. Later these flower stalks were cut to have uniform stalk length. After that flowers were kept individually in flask containing tap water. Flowers were observed daily till they were found unfit for containing in vase. The vase life was expressed in terms of days from the date of harvesting to final observation.

The climatic data consisting of daily observations of average temperature and relative humidity were also recorded during the whole study period by weather station (VENTUS, W831, Denmark) (Fig. 2).

The physiological characteristics of soil were also determined. The pH value of soil was 7.4 with electrical conductivity 2.0 dS m^{-1} . The organic matter of the soil was 0.9%. Available phosphorus, calcium and potassium contents of the soil were 55, 220 and 120 mg kg^{-1} of dry soil, respectively. The soil was mixed with NPK as recommended doses to increase production (Dufault *et al.*, 1990). Weeding and irrigation were done when it was necessary.

The data were subjected to analysis of variance (ANOVA) using Genstat (release 31.1; Lawes Agricultural Trust, Rothamsted Experimental Station, Rothamsted, UK) by using one-way ANOVA. The effects of various treatments were assessed within ANOVA and Fisher's least significant differences were calculated following a significant ($P \leq 0.05$) F test (Steel *et al.*, 1997). All the assumptions of analysis were checked to ensure validity of statistical analysis.

RESULTS AND DISCUSSION

Stalk length

Among the ten cultivars of gerbera, maximum stalk length was recorded in 'Alberino' (60.3 cm), followed by 'Lexus' (59 cm), 'Mammut' (54.0 cm) and 'Terramixa' (49.6 cm) while it was minimum in 'Avemaria' (40.6 cm), 'Labinel' (41.3 cm) and 'Bonnie' (43.6 cm) under protected conditions (Table 1). In a performance study of five gerbera cultivars, observed almost same stalk length in gerbera cultivar 'Yanara' as observed by us in 'Alberino'. A similar variation in plant height among gerbera cultivars was observed by Reddy *et al.* (2003). The stalk length is a genetic factor therefore it is expected to vary among the cultivars as earlier observed by Sarkar and Ghimaray (2004). Stalk length is a very important factor for a cut flower, especially for gerbera flower. It decides the quality cut flowers. As there will be more stalk length more reserved food will be stored in the stalk which will later be available to the flower for longer time period.

Number of leaves/plant

There was significant difference among the cultivars of gerbera for number of leaves per

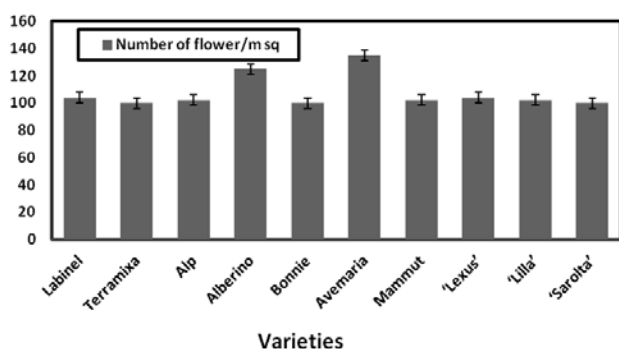


Fig. 1. Number of flowers per m^2 of ten gerbera cultivars under protected conditions.

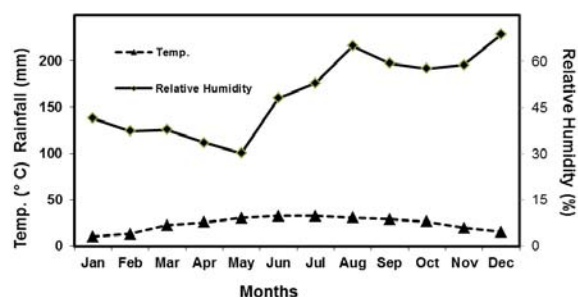


Fig. 2. The average temperature and relative humidity of Kala Shah Kaku region, during January to December, 2011.

Table 1. Growth characteristics of ten gerbera cultivars under protected conditions.

Cultivars	Stalk length(cm)	Number of leaves plant ⁻¹	Plant spread (cm)
'Labinel'	41.3 fg	20.6 de	43.0 f
'Terramixa'	49.6 c	21.3 cd	40.0 g
'Alp'	45.3 de	18.3 ef	47.0 e
'Alberino'	60.3 a	28.6 a	60.0 a
'Bonnie'	43.6 ef	21.0 d	43.0 f
'Avemaria'	40.6 g	23.6 bc	50.0 cd
'Mammut'	54.0 b	20.0 def	48.0 de
'Lexus'	59.0 a	25.0 b	55.0 b
'Lilla'	46.0 de	19.3 def	52.0 c
'Sarolta'	48.0 cd	17.6 f	43.3 f
(P ≤ 0.05)	2.85	2.08	2.17

Means with different letters in a column differ significantly at P<0.05.

plant. With respect to cultivars, maximum number of leaves were recorded in 'Alberino' (28.6) followed by 'Lexus' (25), 'Avemaria' (23.6) and 'Terramixa' (21.3) while it was minimum in 'Sarolta' (17.6) followed by 'Alp' (18.3) and 'Avemaria' (19.3) (Table 1).

Plant spread

Significant difference was also observed among cultivars for plant spread. With respect to cultivars, maximum plant spread was recorded in 'Alberino' (60.0 cm) followed by 'Lexus' (55.0 cm), 'Lilla' (52 cm) and 'Avemaria' (50 cm) while it was least in 'Terramixa' (40 cm) followed by 'Labinel' and Bonnie which are statistically at par (Table 1). This difference among the cultivars may be due to bigger sized leaves produced by respective cultivars. The results are in accordance with the findings of Singh and Ramachandran (2002) and Thomas *et al.* (2004).

Flower diameter

Maximum flower diameter was recorded in variety 'Alberino' (9.6 cm), followed by 'Lilla' and 'Avemaria' (9.0 cm and 8.3 cm, respectively) while it was minimum in the variety 'Sarolta' (5.3 cm) (Table 2). The size of these flowers may be due to bigger ray florets which are in conformity with the findings of Singh and Ramchandran (2002) in gerbera. The bigger diameter of 'Alberino' might be due to the inherent characters of individual cultivars. These findings are also in accordance with the results of Gotz (1983), who also reported large differences in the flower diameter of different gerbera cultivars under greenhouse conditions.

Table 2. Flowering and yeild characteristics of ten gerbera cultivars under protected conditions.

Cultivars	Flower diameter (cm)	Number of flowers plant ⁻¹	Vase life (cm)	Flower quality
'Labinel'	7.3 cde	15.0 ef	4.0 cd	4.0 bcd
'Terramixa'	6.3 efg	16.0 de	3.0 d	4.2 bcd
'Alp'	7.6 cd	14.3 f	5.0 bc	3.9 bcd
'Alberino'	9.6 a	24.6 a	6.6 a	4.8 a
'Bonnie'	6.0 fg	20.0 c	5.0 bc	4.0 bcd
'Avemaria'	8.3 bc	17.0 d	4.3 c	3.8 cd
'Mammut'	6.6 def	18.6 c	5.6 ab	3.7 d
'Lexus'	7.3 cde	22.0 b	6.6 a	4.4 ab
'Lilla'	9.0 ab	15.6 def	5.0 bc	3.7 d
'Sarolta'	5.3 g	19.0 c	5.6 ab	4.3 abc
(P ≤ 0.05)	1.28	1.45	1.16	0.53

Means with different letters in a column differ significantly at P<0.05.

Number of flowers/plant

Flower yield and its quality parameter decide the significance of the particular variety, which are suitable for commercial cultivation. Number of flower/plant was significantly varied within the cultivars. Maximum number (24.6/plant) of flower was recorded from the variety 'Alberino' followed by 'Lexus' (22.0), 'Bonnie' (20.0) and 'Sarolta' (19.0) while minimum (14.3/plant) was recorded from variety 'Alp' (Table 2). Maximum number of flowers per plant observed in variety 'Alberino' might be attributed to the greater leaf area and more number of leaves per plant as well as plant spread would have resulted in production and accumulation of maximum photosynthesis, resulting the production of more number of flowers with bigger size. The results are in accordance with the findings of Nair and Medhi (2002) in gerbera under protected conditions.

Number of flowers/m²

Maximum number of flowers per square meter were recorded in variety 'Alberino' (135), followed by 'Avemaria' (125), while it was minimum in 'Terramixa' (100) (Fig. 1). This appreciably good yield might be due favorable conditions under protected conditions.

Vase life

There was significant difference among the cultivars of gerbera regarding vase-life. Maximum vase-life was recorded in cultivars 'Lexus' (6.6) and Alberino (6.6), followed by variety 'Mammut' (5.6) while it was minimum in variety 'Terramixa' (3.0) (Table 2). The vase-life of the cut blooms terminated when the flower heads started drooping, which was followed by discolouration and fall of petals, which represented the end of effective vase-life of cut flowers. Variation in vase life among cultivars may be attributed to variations in their genetical make up. Jong (1985), Anuradha and Narayanagouda (1999) reported the similar results as that of the present investigation. Wankhede and Gajbhiye (2012) observed that among all the thirteen cultivars studied vino has more vase life.

Flower quality

Flower quality is an important parameter for evaluation of cut flower quality, for both domestic and export markets. Excellent quality flowers were found in gerbera variety 'Alberino' (4.8) followed by 'Lexus' (4.4) and 'Sarolta' (4.3) (Table 2). Flowers of cultivars 'Lilla' and 'Mammut' were of inferior quality (3.7). Similar results were also reported by Nair and Shiva (2003), Steinitz (1982) and Awad et al. (1986) in gerbera and zinnia, respectively. Among the eleven cvs. studied, Hemla Naik *et al.* (2006) observed best flower quality in cultivar 'Lexus' which is not in line with our results. Due to better vegetative growth cultivar 'Alberino' also has better flower quality.

CONCLUSIONS

The above mentioned findings indicated that considering the important characteristics, the 'Alberino' is the best variety having large stalk length, more number of leaves, plant spread, and yield per plant, Number of flowers/m², long vase life and better flower quality. While, 'Lexus' also exhibited acceptable physical and flowering quality characteristics, so it can also be cultivated under protected conditions. 'Alp' and 'Lilla' are completely rejected due to low yield and poor flower quality. Hence, 'Alberino' and 'Lexus' being better physical adaptation, high yield and excellent flower quality can be successfully cultivated under the protected conditions.

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