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**VARIETAL EVALUATION OF GERBERA**  
**(*Gerbera jamesonii* BOLUS)**  
**UNDER LOW COST GREEN HOUSE**

**By**  
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**THESIS**

**Submitted in partial fulfilment of the**  
**requirement for the degree of**

**Master of Science in Horticulture**

**Faculty of Agriculture**  
**Kerala Agricultural University**

**Department of Pomology & Floriculture**  
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**KERALA, INDIA**

**2003**

## DECLARATION.

I hereby declare that the thesis entitled “**Varietal evaluation of gerbera (*Gerbera jamesonii* Bolus) under low cost green house**” is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other University or Society.

Vellanikkara



**Mini Sankar**

## CERTIFICATE

Certified that the thesis, entitled “**Varietal evaluation of gerbera (*Gerbera jamesonii* Bolus) under low cost green house**” is a record of research work done independently by **Mrs. Mini Sankar**, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.




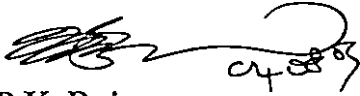
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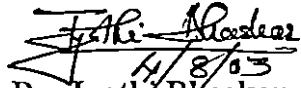
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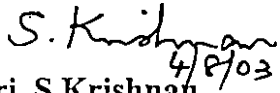
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We, the undersigned members of the Advisory Committee of Mrs. Mini Sankar, a candidate for the degree of Master of Science in Horticulture with major field in Pomology and Floriculture, agree that the thesis entitled "Varietal evaluation of gerbera (*Gerbera jamesonii* Bolus) under low cost green house" may be submitted by Mrs. Mini Sankar, in partial fulfillment of the requirement for the degree.

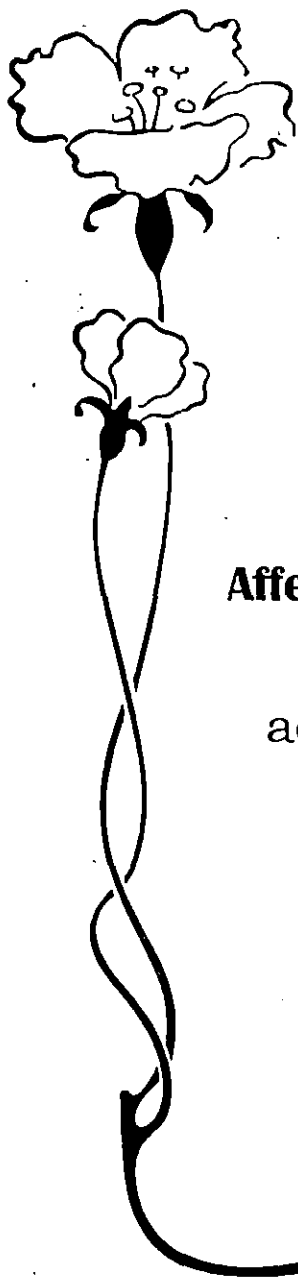
  
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**Affectionately dedicated**

To my beloved  
achan, amma and  
loving husband

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# *Introduction*

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## INTRODUCTION

Gerbera commonly known as Transvaal Daisy/ Barberton Daisy/African Daisy is native to South African and Asiatic region. It belongs to the family Asteraceae. The genus *Gerbera* consists of about forty species of half hardy and perennial flowering plants. Out of these species, *Gerbera jamesonii* Bolus is under commercial cultivation. Gerbera plants are stemless, leaves are radical, petioled, lanceolate, deeply lobed, sometimes leathery, narrower at the base, wider at the top, arranged in a rosette at the base. Flower heads are solitary, having outer rows of ray florets and inner disc florets. Based on the arrangement of florets, flower heads may be grouped in to single, semi double and double cultivars (Loeser, 1986a). Gerbera is a beautiful cut flower and garden flower and makes excellent show in exhibitions and floral arrangements, because of its numerous colours and forms. The flower has good field life as well as vase life. It has already gained momentum as cut flower in international market and is getting popularized in domestic markets. The flower is a boon to florists as well as consumers. An added advantage of gerbera is that it grows well in soil less culture and hydroponics. Gerbera is also suitable for pot culture. Nanjan (1994) reported good flower production in gerberas grown in pots. A maximum of 52 flowers per plant were harvested in containers of 14 litres capacity and the best pot mixture reported was equal quantities of FYM, sand and red earth.

Though getting popularized in domestic markets, commercial cultivation of gerbera is still in infancy with regard to our state. Now-a-days it is seen as a garden flower in very few home gardens. But the possibilities of commercial cut flower production has not been explored yet. An evaluation study of four varieties was done by Suma (1993). The study was conducted under open conditions. Among the

varieties tried, Presley had maximum height, spread, number of leaves and petiole length and flowering was earlier than other three varieties.

Cultivation of gerbera under open condition is very much limited by fluctuating environmental conditions. Traditional cultivation practices do not provide any opportunity for crop environment control. The practices like water management, fertilizer application and tillage only modify the nature of root medium. Consequently the productivity of the crop is not fully realised. Under these circumstances, protected cultivation is having great relevance. Green houses are structures suitable for protected cultivation, which protects the plants from wind, precipitation, excessive radiation, temperature extremes, insects and diseases (Attavar, 1993). Protected cultivation facilitates quality improvement and multifold productivity enhancement, which help to compete in the global market.

Intense rainfall and high relative humidity during monsoon and slightly high temperature during summer hinder the commercial production of gerbera under open conditions in the state. Hi-tech structures with fully automatic control systems cannot be recommended to farmers of Kerala, under the prevailing economic situations. So low cost greenhouses with ample natural ventilation are only advisable here and hence the present study was undertaken under low cost greenhouse with the following objectives.

- \* To evaluate performance of gerbera varieties.
- \* To compare ground planting of gerbera with pot culture under low cost green house.



# *Review of Literature*

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## 2. REVIEW OF LITERATURE

Gerbera is an important commercial flower grown through out the world under a wide range of climatic conditions. It is one of the cut flowers having good vase life. Generally flowers remain in vase for 10 to 15 days. The flowers are having great export potential.

Though gerbera grows under a wide range of climate, there are varieties best suited to particular regions. For commercial purpose gerbera is raised under protected conditions. The type of structures suitable for different climatic conditions also varies accordingly. Cited here are the literature on gerbera and some other crops, with respect to varietal evaluation, influence of weather parameters on growth and yield, cost effective structures and protected cultivation.

### 2.1 VARIETAL EVALUATION

There are innumerable varieties in gerbera which differ significantly with respect to vegetative and floral characters and which were found to be performing exceedingly well under different climatic conditions. Several attempts have been made to evaluate the performance of different varieties under greenhouse and open conditions.

In a comparative study with five gerbera clones, planted in mid-July Zalmrosa gave the highest yield of cut flowers and Sympathie was slowest to flower. Productivity was lowest in January except in the case of cultivar Mandarin, which produced flowers uniformly each month after a slow start (Steen, 1975).

The double pink cultivar Fredaisy was compared with single red and pink Richon selections. The cultivar Fredaisy was found to be producing more flowers per plant and flowers were of greater diameter with longer stalks. Homogeneity, stability of colour and general quality were reported to be excellent (Bailot, 1976).

Varietal trial conducted by Battacharjee (1981) showed that varieties such as Agnihotri, Debendra's glory, Indukumari, Red beauty and White perfection were performing well under Bangalore condition.

Fourteen gerbera cultivars were compared for cut flower production with the three standards, Clementine, Appelblosem and Marleen. The white cultivar Alp proved best followed by Terramor (light red) and Gracia (violet-red). Flower quality was highest in Clementine and Appelblosem and lowest in Atlas. Vase life in chrysal solution was longest for white cultivar Alp (30 days) and shortest was pink cv. Terraflorida (9 days) (Brundert and Schmidt, 1983).

Thirty two cultivars of *Gerbera jamesonii* grown in 12 litre containers were assessed for cut flower quality and production. Traditional cultivar Appelblosem was most prolific with 29 flowers per plant but only 46 per cent of the flowers were in first grade. Eventhough cultivar Anita produced less numbers of flowers, 88 per cent were in the first grade. Flower diameter was highest in varieties Amaranta and Rosaquarz (Gotz, 1983).

Eight French gerbera cultivars and six Dutch cultivars were planted in an unheated plastic greenhouse between mid June and early July (Aragon, *et al.*, 1985). It was observed that total flower production (September to August) and winter flower production (November to March) were highest in the French cultivar Caprice with total flower production of 53.8 flowers per plant and 20.26 flowers per plant during winter months.

An evaluation of gerbera cultivars indicated that productivity was highest with Appelblosem and Amber and keeping quality was best with Romilda. Among the varieties evaluated, Romilda, Appelblosem and Rozamunde were considered the best (Gelder and Reijnders, 1985).

Twentyfour gerbera cultivars planted in containers limed and manured with high moor peat were grown in a triple layer plastic house. Among the most prolific

high quality cultivars, the Pink Fleur and the White Maria had the longest vase life (over 16 days). The most vigorous cultivars were Clivia and Red clore 15/79, where as some what less vigorous cultivars were Rufina and Teravisia. (Fischer *et al.*, 1985)

Loeser (1985) reported that cultivars Alexis, Fredeking, Salmrosa, Bilitis and Anke which produced over 30 flowers (in 9 months) were proved to be productive and had a vase life of 15 days in a comparison trial with 108 cultivars.

Among the 44 gerbera cultivars grown under glass, the best winter flowering cultivar was Fredigor with 29 per cent of total yield between November and February. Cultivars Opaal, Irmgard, Hariekin had 26 per cent flower production during winter followed by Rouge Double and Hannyweiss which produced 15 per cent flowers during winter (Loeser, 1986a).

In another experiment Loeser (1986b) reported that among 55 cultivars grown in greenhouse trials, the highest cut stem yield per plant was recorded in cultivar Alexis (36), Bilitis (33), Salmrosa (33), Anke (31) and Labaiga (30). Cultivars with high proportion of class I stems (>85%) were found to have relatively poor vase life (<11 days) except for Alexis which had a vase life of 18 days.

Some cultivars were recommended by Reimherr *et al.* (1986) for greenhouse cultivation in ErstWhile German Federal Republic. They included cultivars Frediking with an average of 28 flowers per plant and 19 days vase life. Cultivar Nadja with 23 flowers and vase life of 12.5 days, cultivar Terraqueen (22 flowers, 19 days), Dusty (22 stems, 17.5 days) and Labaiga (30 stems, 14 days)

Forty seven gerbera cultivars were evaluated by Loeser (1989). The cultivars with best overall performance with high yields, high proportion of class I flowers and long vase life were Roma, Monaco, Gelbchloe and Julia. Cultivars Terra Mexico, Terra Estelle, TH-170, TH-167, TH-168, Molina, Monika and Marijke produced higher yield in a commercial substrate.

In an experiment with three gerbera cultivars, Clementine, Robijin and Saskia planted at different spacing (30 x 25 cm, 30 x 20 cm and 30 x 15 cm) in an unheated plastic tunnel, cultivar Saskia produced more number of flowers. Flower quality was the best in Saskia and Clementine. It was suggested that for gerberas grown in unheated tunnels, the spacing should be 30 x 15 cm and Saskia was the recommended cultivar for unheated tunnels (Lisiecka, 1991).

An evaluation of four varieties of gerbera, viz., Presley, Eoliet, Pritty and Sunbird was done by Suma (1993). Among the varieties tried, Presley had maximum height, spread, number of leaves and petole length and early flowering than other three varieties.

Yield and cutflower quality of four greenhouse gerbera cultivars, Party, Rejina, Fame and Chimena growing in perlite, sand, zeolite and rock wool were measured. In all cases cultivar, Party showed the highest yield. For most cultivars, perlite produced better quality flowers (Spanomitsios *et al.*, 1995).

Lisiecka (1996) reported that among three gerbera cultivars, planted in a cold tunnel, cultivars Roulette and Tamara gave more flowers (94 and 90 per m<sup>2</sup>). Tamara started flowering earlier than Roulette. Flower yield of Terracerise was low. Yield of flowers and dynamics of flowering were mainly cultivar dependent, eventhough quality was influenced by date of planting.

Varietal evaluations of gerbera was done under low cost greenhouse (Khan *et al.*, 1997). Some of the exotic varieties like Ibiza, Rosabella and Gold spot were found to be performing well under low cost greenhouse.

Fourty nine gerbera accessions were evaluated at Yercaud. Among them, GJ-10, GJ-11, GJ-23, GJ-32 and GJ-39 produced flowers with a stalk length of more than 40 cm. GJ 14, GJ 23, GJ 24 and GJ 46 recorded a flower stalk girth of more than 1.5 cm while flower diameter was greatest in GJ-23. The yield of more than 90

flowers per clump per year was observed in GJ-23, GJ-27, GJ-29, GJ-35, GJ-45 and GJ-47. Vase life ranged from 3.95 days to 8.55 days (Jawaharlal *et al.*, 1998)

The effect of soil heating to 16°C was studied in six gerbera cultivars growing in a sand : peat substrate in a heated greenhouse. Yields were higher in cultivar Fame (4.23 flowers per plant per month) and lowest in Impala (1.84 flowers per plant per month). Soil heating increased cut flower yield by 10 to 40 per cent in cultivar Impala and Cerise (Benavente *et al.*, 1998).

In a greenhouse study to investigate the effects of supplementary light on cultivar Tiffany (small flowers) and cultivar Optima (large flowers) there was an increase in the number of flowers per m<sup>2</sup> of cultivar Optima with longer stems and heavier flowers. In the case of cultivar Tiffany, there was only a slight increase in flower production eventhough significant increase was measured for flower diameter, stem length and stem weight (Vanlabeke and Dambre, 1999).

Thirteen cultivars of *Gerbera jamesonii* were compared in an open soil less system to evaluate cut flower yield. Highest cut flower yield was from Orange flowered cultivars (11.0 flower stems per plant). No significant difference between red and white flowered cultivars were observed (9.2 and 9.1 flowers per plant respectively). Flowering was earlier in cultivars with red and pink flowers (Fiorenza and Paradiso, 2000).

Gerbera cultivars Lily, Blorosa, Rosabella, Goldspot and Lilabella were studied for flower production under open conditions of Ludhiana. The best cultivar was Goldspot, producing a monthly mean of 23.56 flowers per unit area and the best season was April (Kumar and Kumar, 2000).

Performance of nine exotic cultivars of gerbera viz., Diablo, Lyonella, Ornella, Sunset, Tara, Thalassa, Tiramisu, Twiggy and Whitsun was studied under low cost naturally ventilated greenhouse environment. Cultivar Lyonella recorded

maximum plant height (53.49 cm), spread of plant (72.71 cm) and number of suckers (4.55) and leaves (46.66 per plant). The earliest and latest flowering was observed in cultivars Whitsun and Tiramisu respectively. The maximum flower diameter, stalk length, stalk thickness and fresh weight of stalk were recorded in cultivars Thalassa, Lyonella, Tiramisu and Ornella respectively. Higher yield of flowers per plot per plant per year was obtained in Diablo followed by Lyonella, Ornella and Thalassa and minimum in cultivar Tara (Singh and Mandhar, 2001).

## 2.2 INFLUENCE OF WEATHER PARAMETERS ON GROWTH AND YIELD

The development and productivity of a crop is controlled by its surrounding environment, viz., light, temperature, air composition and biotic factors. But natural environment is not always optimum and crop suffers from stresses so that the productivity is significantly reduced. If we know the effect of various weather parameters, on crop growth, we can manipulate such conditions in a greenhouse so that crop productivity is optimised.

### 2.2.1 Gerbera

The light and temperature have been found to influence the growth and flower production in gerbera. The beneficial effect of supplementary lighting during winter season had been reported in various trials. Leffring (1981) observed more flower production when plants were grown under long day with a high irradiance level for eight hours with  $67\mu \text{ mol S}^{-1} \text{ m}^{-2}$ . Increased irradiance was found to stimulate floral development in cultivars Orange Nasau and Fabiolo by Lin and French (1985).

A number of experiments had revealed a positive correlation of yield with both light intensity and day length. Van *et al.* (1989) reported increased flower yield per  $\text{m}^2$  with long stemmed heavier flowers at high light intensity. The same effect was also observed by Garala *et al.* (1989).

Leffring (1975) reported that low temperature (17°C day and 13°C night) and short days (8 hrs day light) had a positive influence on the number of lateral shoots and on flower production in two gerbera clones. It was also observed that the degree to which the clones related to these factors differed. Increased production with good quality flowers at low temperature was also observed by Bulthuis (1979) in cooler greenhouse with 16°C day and 12°C night. Plants produced more flowers when the difference between air and soil temperature was less. Berninger (1975) further stressed that in gerbera air temperature affects the maturation rate of flowers while the interval between the appearance of successive inflorescence was influenced by soil temperature. Warming of soil from 13°C - 15°C to 18°C - 21°C during winter season increased the productivity (Tesi, 1977). Garala *et al.* (1989) also reported that increasing substrate temperature from 15 to 19°C enhanced flower yield in gerbera. Soil warming from 16 - 20°C to 23°C also increased peduncle length in pot grown gerbera (Lin and French, 1985). Increased flower stem length with high temperature was also reported by Shin *et al.* (1994).

Varying day/night temperature regimes with different treatments like split night temperature regime, pulsing night temperature regime and constant night temperature regime were also found to influence the flower production in gerbera. In trials with varied night temperatures of 9, 13, 17 and 20°C, Dansereau and Senecal (1983) observed that at 9 and 13 °C night temperature, vegetative development was reduced but plant appearance and rooting were improved. Cold day treatment with a day/night temperature of 14/21°C was found to increase flower weight in gerbera by Van *et al.* (1989). They also observed that flower colour was more intense and there was less number of damaged flowers per m<sup>2</sup> under cold day temperature treatment except for a slight decrease in flower diameter. Higher day temperature caused more flower bud abortion. In several cultivars during winter seasons split and pulsing night temperature regimes increased not only flower yields but also reduced heating time of greenhouse by 30 to 40 per cent (Farina *et al.*, 1993).

Kim *et al.* (1990) observed the effect of age and season on flower production in gerbera. Flower characters were found to be changing with season and



age of the plant. Seasonal fluctuations in yield and quality of cut flowers were also reported by Shin *et al.* (1994). They observed maximum flower production between March and May.

Mean daily production data from four greenhouse gerbera cultivars (Part, Regina, Fame and Chimena) growing in perlite, sand, zeolite and rock wool substrates were correlated with net radiation, mean diurnal air temperatures, day-night temperature difference and mean saturated vapour pressure deficit. Significant correlations between crop production and all these climatic variables were found. Decreased net radiation values seemed to negatively affect crop production (Spanomitsios *et al.*, 1995).

### 2.2.2 Other crops

Effect of photoperiod and soil temperature in geranium has been reported by Merrit and Kohl (1985). Seedlings grown under 13 hrs photoperiod had larger leaves and high crop productivity efficiency when compared to seedlings grown under 9 hrs photoperiod. Widely varying response to relative humidity has been reported in different plant species by Mortensen (1986). In some species dry weight of plants increased with increase in relative humidity whereas in some other species, the response was negative. In another experiment, Mortensen and Fjeld (1998) observed an increase in shoot length of rose cultivars at higher relative humidity, while there was a reduction in vase life. They also found out that the time until flowering was reduced by increasing lighting period. With increasing temperature the average time to flower and plant weight increased in chrysanthemum but flower diameter decreased with increasing temperature (Willits and Bailey, 1994). In the same trial the authors observed an increase in number of blooms in heat tolerant cultivars. Effect of light intensity and CO<sub>2</sub> supplement on growth and flowering of gladiolus was reported by Xiaoping (1995). He observed beneficial effects of improved plant growth and enhanced flowering under supplementary lighting and CO<sub>2</sub> enrichment in gladiolus. Vanlabeke and Dambre (1998) also reported that a combination of supplementary lighting and CO<sub>2</sub> enrichment increased the flower production and flower stem quality in *Alstroemeria* cultivars. Increasing assimilate availability level with higher light intensity, high CO<sub>2</sub> concentration or lower plant density showed a positive effect on

external quality in chrysanthemum in terms of stem and leaf morphology and flowering aspects (Carvalhos and Heuvelink, 2001). They also observed that temperature and daily night integral are the main factors that determine stem elongation and time to flowering.

### 2.3 COST EFFECTIVE STRUCTURES

Products of excellent quality is an essential criteria for the success of commercial production units. Greenhouse technology can be adopted to get a regular supply of high quality products. But hi-tech structures which ensure quality products may not be always profitable. Location specific designs of green houses, which are cost effective, should be emphasised to make this technology popular among farmers.

Nelson (1978) reported that film plastic greenhouse offer an inexpensive means for flower growing. They can be built on permanent, metal ridge and furrow frames. Polyethylene is most common film plastic in use and is applied as an air inflated double layer. The insulating property decreases fuel consumption by 40 per cent.

A low cost greenhouse with plastic roofing and natural ventilation was designed with provision for installing environmental control equipment. The frame was made from steel pipes and the sides were covered with coirmats for protection from rain and wind. Light intensity, RH, maximum and minimum temperatures were recorded at 15 points and indicated that RH and temperature profiles do not change significantly (Varghese *et al.*, 1989).

Jimenezfumero (1991) reported about low cost shelter nets which were used for cultivation of tomatoes in winter. It consists of a rigid frame and translucent net covering. The advantages of this structure include wind resistance, climatic control, savings in irrigation water and improved pollination.

Two new unheated prototype greenhouses were evaluated as possible alternative to conventional flat roofed greenhouse (a N-S oriented multispan of

symmetrical 17° roof slope and E-W oriented single span of assymetrical roof angles 18° and 8°). The higher light transmission in the assymetrical single span significantly increased the crop yield, where as additional light reducing materials of the multispan structure generated lower radiation which decreased crop yield. The assymetrical greenhouse was found to be more profitable than conventional one as it's building costs do not exceed 24 per cent of building costs of a conventional plastic house (Castilla and Lopezgalvez, 1994).

Nimmermark (1995) reported about a simple low cost plastic greenhouse for large areas suitable for use with machinery. The greenhouse consisted of a galvanized steel frame work covered with EVA film with a moveable film roof which could be wound on to two steel pipes. The greenhouse roof can be fully opened when the air temperature inside the greenhouse was 79 per cent of that of outside.

Plasticulture development centre has developed a simple low cost wooden frame polyhouse for growing gerbera. Low cost polyhouse of 15.0 m x 8.0 m x 3.9 m size was built out of locally available materials. Casuarina posts were used as frame and was covered with UV stabilized film 200  $\mu$  (800 gauge). Natural side and ridge ventilation were provided. The benefit cost ratio was Rs.3.49 which indicate high returns with low investment (Khan *et al.*, 1995).

Rajeevan (1997) designed an ecocompatible structure for growing orchids in Kerala. The design consisted of a double layer roofing of which the top layer was a permanently fixed one providing 25 per cent shade and a lower layer which can be changed according to seasons. The structure was provided with overhead microsprinkler units and with raised platforms with a shallow water channel at the centre to maintain humidity.

An economic analysis of gerbera cultivation was done in two types of polyhouses namely naturally ventilated polyhouse (NVPH) and polyhouse having fan and pad system (EPPH). Both were having same size, 12 x 30 m. The cost of polyhouse construction was found to be Rs.612.50 per m<sup>2</sup> for NVPH and Rs.1215.28

per m<sup>2</sup> for EPPH. It was observed that NVPH recorded higher yield of 103 flowers per m<sup>2</sup> as compared to only 94 flowers per m<sup>2</sup> in EPPH. NVPH gave net return to the tune of Rs.136.48 per m<sup>2</sup> where as EPPH registered losses to the extend of Rs.160.02 per m<sup>2</sup>. Hence it is desirable to select naturally, ventilated low cost polyhouse for gerbera cultivation (Gajanana *et al.*, 2000).

A low cost greenhouse suitable for Kerala condition has been designed at KCAET, Thavanur (Thomas *et al.*, 1997). Arecanut palm was used for vertical support, longitudinal and transverse beams. Split arecanut palms were used as roof truss, bent in the form of an arch. For greenhouse cladding, 200 micron UV stabilised LDPE film was used with shade nets on the sides. The cost was estimated to be Rs.175 per m<sup>2</sup>.

An experiment was laid out inside an LDPE film covered bamboo structured low cost polyhouse, in which different cultivars of cucumbers were grown during winter season. It was found that, the inside temperature in the polyhouse was considerably higher during winter season in which summer season crops could be grown profitably during winter as off season crops (Saikia *et al.*, 2001).

## 2.4 PROTECTED CULTIVATION

The production and year round availability of high value ornamental crops are very much limited by climatic fluctuations. So it is necessary to grow these plants in conditions where growing environments can be altered to suit the specific requirement of the plants. It is in this context that the proposition of protected cultivation becomes relevant.

### 2.4.1 Gerbera

Positive effects of shading especially during summer was reported in gerbera. Vidalie *et al.* (1985) observed a more number of leaves and flowers under shade. In summer, under shading (30%) flower diameter and plant quality were improved eventhough number of flowers were less (Ter *et al.*, 1992).

Kaur *et al.* (1996) observed increased number of leaves and more long stemmed flowers of larger size when plants were grown under plastic nets with 25 per cent shade. Moreover the chlorophyll content of leaves was maximum for the plants grown under 25 per cent shade. Tér (1996) reported better performance for gerbera under 30 per cent shade than those under unshaded condition. More number of leaves with large sized flowers with better quality was recorded under 50 per cent shade than under natural sunlight (Kumar and Kumar, 2001).

Several studies were also conducted on the performance of gerbera under different types of protected structures like shadehouses, naturally ventilated greenhouses and polyhouses. Growing conditions like structures which were partially and fully covered were also tried under many trials. Kaur *et al.* (1996) reported highest number of flowers under completely covered plastic houses than under structures with overhead covers and without cover.

Naturally ventilated greenhouses were found to provide a favourable environment for gerbera by Biradar *et al.* (1997) and ICAR (1999). Very high yield of 200 to 250 flowers per m<sup>2</sup> per year was observed under greenhouse in comparison to a low yield of 120 to 150 flowers per m<sup>2</sup> per year under open (Das and Singh, 1999). More than 85 per cent of flowers produced under greenhouse was of best quality.

Better vegetative and floral performances in terms of plant height, plant spread, number of flowers with best quality and longer stalk were registered in naturally ventilated polyhouses when compared to growth in a polyhouse with fan and pad cooling system (Singh *et al.*, 2000). Improved vegetative growth as well as good flower yield was observed under rainshelter than under open conditions by KAU (2000).

#### 2.4.2 Other crops

Gill and Atawal (1979) obtained high yield of rose flowers from plants grown under polyethylene tent than those grown under open during December and

January when temperature was low. Chadha *et al.* (1992) observed that gladiolus spikes were free from cold injury and of good quality, when grown under 100 micron polyethylene, whereas those grown under open were highly susceptible to cold injury.

In an experiment conducted by Kadmanzahavi and Yahil (1986) it was observed that 40 days for flower bud initiation in aster under field condition was reduced to 21 days when it was grown under greenhouse condition. Neelofar (1992) reported that in carnation flowering can be made earlier by manipulating extra light for four hours under polyhouse conditions.

An experiment was conducted to study the performance of china aster under rainshelter and open conditions. Plants under rainshelter condition showed better vegetative growth, more number of flowers and increased flower size in terms of diameter (KAU, 2000).

Investigation on the performance of exotic rose cultivars under naturally ventilated low cost polyhouse in comparison with open conditions were carried out by Gowda (2000). Low cost polyhouse produced the highest flower yield (80.59 per m<sup>2</sup>) as compared to open conditions (41.7 per m<sup>2</sup>). Flowers produced under open conditions were of poor quality and unmarketable to a large extent.

An experiment conducted by Rana *et al.* (2000) to study the performance of gladiolus under open and shade nets of different intensities (50% and 75%) showed that the plants under 75 per cent shade net attained maximum height as well as maximum spike length with more number of florets in both varieties in comparison to 50 per cent shade and plants grown under open conditions.

# *Materials and Methods*

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### 3. MATERIALS AND METHODS

The study was conducted at the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara, Thrissur during the year 2000-2002. The aim of the study was to evaluate the performance of gerbera varieties and to compare ground planting of gerbera with pot culture under low cost green house.

Tissue cultured plants of five gerbera varieties were evaluated. They were Essandre, Juvena, Lindessa, Tamara and Yanara. The flower colour of these varieties were yellow for Essandre, red for Juvena and Yanara, peach colour for Lindessa and orange yellow for Tamara (Plate 1 to 5).

The experiment was laid out inside a low cost greenhouse with gable type roof and vent having length x width x central height 21.0 x 6.0 x 3.6 m. Roof cladding was done with UV stabilized film of 120 gsm thickness and 50 per cent shade net. Sides were protected by 25 per cent shade net (Plate 6).

#### 3.1 LAND PREPARATION AND PLANTING

Before planting, the land was cleared. Shallow basins of 2.0 m length and 0.4 m width were taken and filled with media (sand, cowdung and rice husk) and kept as such for weathering for 10 days. Planting was done at a spacing of 30 cm x 30 cm. A plot consisted of a single row of six plants. Each treatment was replicated four times and four plants per treatment were taken for observation. Experimental design was in CRD. Twelve inch sized pots were used for pot culture and filled with same media. Uniform cultural practices were followed in all treatments. A general view of the experimental plot is illustrated in Plate 7.

#### 3.2 CULTURAL MANAGEMENT

NPK was applied at the rate of 30:15:30 g per m<sup>2</sup> per month in two equal splits at 15 days interval around the plant during the first three months. From fourth month onwards, application of 15:10:30 g NPK per m<sup>2</sup> per month in two equal splits at





**Plate 1. Variety - Essandre**



Plate 2. Variety - Juvena

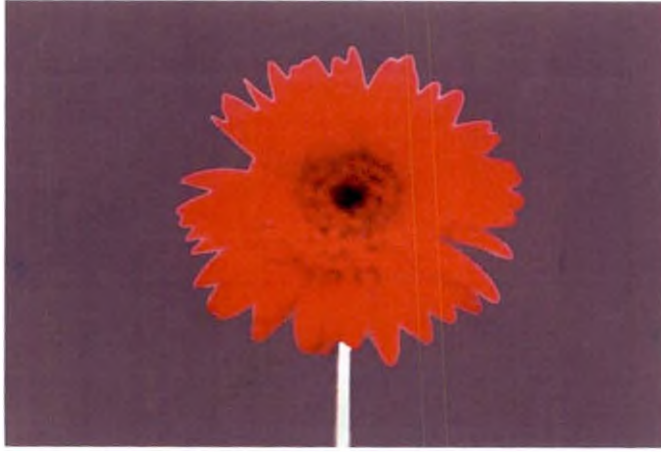


**Plate 3. Variety - Lindessa**





**Plate 4. Variety - Tamara**



**Plate 5. Variety - Yanara**



**Plate 6. General view of the structure**



**Plate 7. General view of the experimental plot**

15 days interval was done. Fortnightly spray of green care was also done (30:27:27 NPK). The plants were irrigated regularly. Regular weeding and raking of soil were followed. Plant protection measures were undertaken whenever necessary.

### 3.3 HARVESTING

Flowers for field observations were allowed to remain on the plant till starting of wilting and those for vase life studies were harvested at the commercial stage of harvest, i.e. when outer row of disc florets became perpendicular to the stalk.

### 3.4 OBSERVATIONS

The parameters on which observations recorded were

#### 3.4.1 Vegetative characters

Initial observation was recorded at the time of planting. There after monthly observations were taken on the following parameters.

##### 3.4.1.1 *Plant height*

Standing height of the plant in centimeters was taken as height of the plant.

##### 3.4.1.2 *Plant spread*

Circumference of the plant was measured and expressed in centimeters.

##### 3.4.1.3 *Number of leaves*

Total number of leaves at the time of each observation was taken as number of leaves.

##### 3.4.1.4 *Petiole length*

Length of petiole was taken in centimeters.

##### 3.4.1.5 *Leaf area*

Leaf area =  $0.43 \times \text{Length} \times \text{Breadth}$



Where 0.43 is a constant. The constant was calculated using statistical package of non linear regression method. Leaf area was expressed in  $\text{cm}^2$ .

**3.4.1.6**    *Number of lobes*

Number of lobes on each leaf was counted per observation.

**3.4.2**        **Floral characters**

**3.4.2.1**    *Days taken for first flower bud appearance*

Number of days from planting to first flower bud emergence was recorded.

**3.4.2.2**    *Days taken from flower bud emergence to opening of the flower*

Days taken from flower bud emergence to flower opening of flower was noted.

**3.4.2.3**    *Total number of flowers per plant*

Total number of flowers in each observational plant was counted.

**3.4.2.4**    *Flower size*

Diameter of the flower was measured and recorded in centimeter..

**3.4.2.5**    *Stalk length*

Length of the stalk from base to flower head was taken in centimeter.

**3.4.2.6**    *Stalk girth*

Girth of stalk at 15 cm from the base was measured and expressed in centimeter.

**3.4.2.7**    *Nature of flower stalk*

Whether the flower stalk is erect or bending.

**3.4.2.8**    *Flower life in the field*

Flower life in the field is expressed as number of days from opening of flower to starting of wilting.



#### **3.4.2.9 Flower life in vase**

Vase life was tested in water. Flowers were harvested at the commercial stage of harvest, i.e. when outer one or two rows of disc florets became perpendicular to the stalk and kept in tap water. Vase life is expressed as the number of days taken for fresh flower to show signs of wilting.

#### **3.4.3 Incidence of pests and diseases**

Treatment plants were observed for incidence of pests and diseases.

#### **3.4.4 Weather parameters**

Weather parameters, like minimum and maximum temperature (inside the green house), relative humidity (inside and outside the green house), light intensity (both inside and outside) were recorded daily.

Minimum and maximum temperature were measured using minimum-maximum thermometer. Relative humidity inside the green house was measured by a wet and dry bulb thermometer. Whirling Psychrometer was used to measure outside Relative humidity. Sunlight intensity was recorded in Lux using a Lux meter.

#### **3.4.5 Statistical analysis**

M STAT-C package was used for the statistical analysis. Data relating to different characters were analysed by applying the technique of Analysis of Variance. For obtaining the relationship between various weather parameters, vegetative and floral characters, correlation studies were conducted.

# Results

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## 4. RESULTS

Studies were conducted at the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara, during 2000-2002 to examine the performance of five gerbera varieties, viz., Essandre, Juvena, Lindessa, Yanara and Tamara under two methods of planting: ground planting and pot culture under low cost green house. The varieties were planted in November, 2001. To study the differential performance of the varieties during the steady period of growth, with respect to various morphological characters like plant height, number of leaves, petiole length, lobes of leaves, plant, leaf area and floral characters, observations were recorded monthwise starting from November 2001 to September 2002. The results of the experiments are as follows.

### 4.1 VEGETATIVE CHARACTERS

#### 4.1.1 Plant height

Data pertaining to the monthly variation in height are presented in Table 1(a). Monthly variation in height was significant throughout the growth period. During the initial growth period, up to February, variety Yanara was found to have maximum height. Minimum height was recorded in variety Tamara. From March onwards variety Essandre registered maximum height. Varieties attained maximum height in April. Average performance of the varieties throughout the growth period is given in the Table 1(b). In general it could be observed that varieties Essandre and Yanara were performing on par with maximum height of 21.43 cm and 21.11 cm, respectively. Minimum height was recorded in variety Tamara (15.7 cm).

It is also revealed from Table 1(b) that planting method had significant influence on plant height. Plants recorded better height (19.71 cm) in ground than in pots (18.76 cm).

Table 1a. Plant height (cm) of gerbera varieties over the months November 2001-September 2002

Varieties	November			December			January			February		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	4.36 <sup>b</sup>	2.80 <sup>b</sup>	3.57 <sup>B</sup>	8.66 <sup>bc</sup>	9.43 <sup>bc</sup>	9.04 <sup>BC</sup>	16.44 <sup>cd</sup>	19.00 <sup>b</sup>	17.72 <sup>B</sup>	20.62 <sup>bc</sup>	17.88 <sup>d</sup>	19.25 <sup>B</sup>
Juvena	5.94 <sup>a</sup>	3.48 <sup>b</sup>	4.71 <sup>A</sup>	9.28 <sup>bc</sup>	9.65 <sup>bc</sup>	9.47 <sup>B</sup>	15.37 <sup>de</sup>	20.38 <sup>b</sup>	17.87 <sup>B</sup>	17.39 <sup>d</sup>	22.63 <sup>ab</sup>	20.01 <sup>AB</sup>
Lindessa	3.69 <sup>b</sup>	3.95 <sup>b</sup>	3.82 <sup>AB</sup>	7.03 <sup>bc</sup>	8.13 <sup>bc</sup>	7.58 <sup>C</sup>	14.59 <sup>def</sup>	13.00 <sup>ef</sup>	13.79 <sup>C</sup>	15.87 <sup>d</sup>	16.25 <sup>d</sup>	16.06 <sup>C</sup>
Tamara	4.34 <sup>b</sup>	3.52 <sup>b</sup>	3.48 <sup>B</sup>	7.63 <sup>bc</sup>	10.50 <sup>b</sup>	9.07 <sup>BC</sup>	13.12 <sup>ef</sup>	12.50 <sup>f</sup>	12.80 <sup>C</sup>	16.42 <sup>d</sup>	15.50 <sup>d</sup>	15.96 <sup>C</sup>
Yanara	4.17 <sup>b</sup>	4.25 <sup>b</sup>	4.21 <sup>AB</sup>	9.69 <sup>bc</sup>	13.15 <sup>a</sup>	11.42 <sup>A</sup>	18.02 <sup>bc</sup>	22.0 <sup>a</sup>	20.39 <sup>A</sup>	18.22 <sup>cd</sup>	24.75 <sup>a</sup>	21.49 <sup>A</sup>
Mean	4.32	3.60	3.96	8.46	10.17	9.28	15.51	17.53	16.51	17.70	19.40	18.55

Varieties	March			April			May			June		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	26.86 <sup>ab</sup>	30.13 <sup>a</sup>	28.49 <sup>A</sup>	28.84 <sup>abc</sup>	31.75 <sup>a</sup>	30.29 <sup>A</sup>	24.81 <sup>b</sup>	29.63 <sup>a</sup>	27.22 <sup>A</sup>	25.60 <sup>ab</sup>	26.25 <sup>a</sup>	25.93 <sup>A</sup>
Juvena	23.00 <sup>abc</sup>	22.83 <sup>abc</sup>	22.91 <sup>BC</sup>	25.96 <sup>bcd</sup>	25.63 <sup>cd</sup>	25.79 <sup>BC</sup>	18.66 <sup>ef</sup>	23.25 <sup>bc</sup>	20.95 <sup>C</sup>	19.78 <sup>e</sup>	24.75 <sup>abc</sup>	22.26 <sup>B</sup>
Lindessa	19.94 <sup>bc</sup>	17.13 <sup>c</sup>	18.53 <sup>D</sup>	23.87 <sup>d</sup>	23.85 <sup>d</sup>	23.86 <sup>CD</sup>	17.83 <sup>f</sup>	21.88 <sup>cd</sup>	19.85 <sup>C</sup>	19.26 <sup>e</sup>	23.38 <sup>bc</sup>	21.32 <sup>B</sup>
Tamara	19.82 <sup>bc</sup>	20.63 <sup>bc</sup>	20.22 <sup>CD</sup>	22.50 <sup>d</sup>	23.00 <sup>d</sup>	22.76 <sup>D</sup>	19.92 <sup>def</sup>	20.75 <sup>cde</sup>	20.33 <sup>C</sup>	16.82 <sup>f</sup>	20.63 <sup>de</sup>	18.70 <sup>C</sup>
Yanara	23.93 <sup>abc</sup>	27.13 <sup>ab</sup>	25.53 <sup>B</sup>	25.89 <sup>bcd</sup>	29.38 <sup>ab</sup>	27.64 <sup>B</sup>	19.26 <sup>def</sup>	27.63 <sup>a</sup>	23.44 <sup>B</sup>	22.37 <sup>cd</sup>	22.75 <sup>cd</sup>	22.56 <sup>B</sup>
Mean	22.70	22.70	23.14	25.40	26.72	26.07	20.09	24.63	22.36	20.77	23.55	22.15

Varieties	July			August			September		
	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	23.00 <sup>a</sup>	21.75 <sup>ab</sup>	22.38 <sup>A</sup>	27.48 <sup>ab</sup>	23.38 <sup>ab</sup>	24.43 <sup>A</sup>	28.63 <sup>a</sup>	26.38 <sup>a</sup>	27.50 <sup>A</sup>
Juvena	18.77 <sup>ab</sup>	19.00 <sup>ab</sup>	13.89 <sup>B</sup>	25.98 <sup>ab</sup>	25.98 <sup>c</sup>	18.49 <sup>C</sup>	26.94 <sup>a</sup>	12.75 <sup>b</sup>	19.84 <sup>A</sup>
Lindessa	22.88 <sup>a</sup>	19.75 <sup>c</sup>	21.31 <sup>A</sup>	24.21 <sup>ab</sup>	24.21 <sup>ab</sup>	24.04 <sup>AB</sup>	25.83 <sup>a</sup>	26.13 <sup>a</sup>	25.98 <sup>A</sup>
Tamara	18.23 <sup>ab</sup>	15.69 <sup>b</sup>	16.96 <sup>B</sup>	21.95 <sup>ab</sup>	21.95 <sup>b</sup>	20.35 <sup>BC</sup>	22.75 <sup>a</sup>	23.63 <sup>a</sup>	23.19 <sup>A</sup>
Yanara	23.27 <sup>a</sup>	20.13 <sup>ab</sup>	21.69 <sup>A</sup>	26.88 <sup>a</sup>	26.88 <sup>ab</sup>	24.75 <sup>AB</sup>	29.75 <sup>a</sup>	27.25 <sup>a</sup>	28.50 <sup>A</sup>
Mean	21.23	17.26	19.25	25.29	25.29	22.41	26.78	23.23	25.01

Treatment means having similar alphabets in superscript, do not differ significantly.

G - Ground planting

P - Pot planting

Table 1b. Plant height (cm) of gerbera varieties under different methods of planting

Varieties	Method of planting		Mean
	Ground	Pot	
Essandre	21.21 <sup>ab</sup>	21.66 <sup>ab</sup>	21.43 <sup>A</sup>
Juvena	18.73 <sup>c</sup>	18.73 <sup>c</sup>	18.73 <sup>B</sup>
Lindessa	21.70 <sup>ab</sup>	17.72 <sup>cd</sup>	19.70 <sup>B</sup>
Tamara	16.66 <sup>d</sup>	14.74 <sup>e</sup>	15.70 <sup>C</sup>
Yanara	20.27 <sup>b</sup>	21.95 <sup>a</sup>	21.11 <sup>A</sup>
Mean	19.71 <sup>a</sup>	18.76 <sup>b</sup>	19.24

Treatment means having similar alphabets in superscript, do not differ significantly

#### 4.1.2 Plant spread

Variety Yanara recorded maximum plant spread up to April (Table 2a). From May onwards, spread was maximum for the variety Essandre, whereas minimum plant spread was noticed in variety Juvena. It was observed that for all the varieties there was a decrease in plant spread during June and July.

When average performance is considered, variety Yanara recorded maximum plant spread (156.36 cm) with varieties Essandre and Lindessa performing on par (Table 2b). Variety Juvena showed minimum plant spread of 129.20 cm. More plant spread was observed in pot when compared to plants in ground.

#### 4.1.3 Number of leaves

In the case of number of leaves, varieties differ significantly from January onwards. Variety Essandre had maximum number of leaves up to September (Table 3a). Minimum number of leaves was noticed in variety Tamara. When average performance of the varieties were compared, it was found that variety Essandre had maximum number of leaves (16.87) followed by variety Lindessa (11.83). Variety Tamara registered the minimum number of leaves of 9.57 (Table 3b).

With respect to method of planting, for all the varieties plants had more number of leaves when planted in ground, than in pots.

#### 4.1.4 Petiole length

There was significant variation in petiole length throughout the growing season (Table 4a). From January, up to September, variety Essandre registered maximum petiole length. Petiole length was minimum in variety Lindessa up to May, whereas from June up to September, variety Juvena recorded minimum petiole length. On an average, variety Essandre exhibited maximum petiole length of 9.35 cm whereas minimum petiole length was recorded in variety Lindessa (7.10 cm). As far as method of planting is concerned, there was no significant difference in petiole length of gerbera varieties between pot planting and ground planting (Table 4b).

Table 2a. Plant spread (cm) of gerbera varieties over the months December 2001-September 2002

Varieties	December			January			February			March		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	53.39 <sup>e</sup>	62.38 <sup>cde</sup>	57.88 <sup>B</sup>	109.29 <sup>cd</sup>	89.00 <sup>e</sup>	99.15 <sup>C</sup>	148.75 <sup>a</sup>	130.50 <sup>bcd</sup>	139.62 <sup>B</sup>	163.90 <sup>bc</sup>	161.13 <sup>bc</sup>	162.56 <sup>AB</sup>
Juvena	57.48 <sup>de</sup>	70.63 <sup>abc</sup>	64.05 <sup>AB</sup>	91.40 <sup>e</sup>	112.50 <sup>bcd</sup>	101.95 <sup>C</sup>	114.44 <sup>d</sup>	123.00 <sup>cd</sup>	118.72 <sup>C</sup>	127.50 <sup>d</sup>	147.23 <sup>c</sup>	137.37 <sup>C</sup>
Lindessa	57.98 <sup>de</sup>	69.78 <sup>abc</sup>	63.88 <sup>AB</sup>	116.39 <sup>bcd</sup>	118.63 <sup>bcd</sup>	117.51 <sup>B</sup>	143.17 <sup>ab</sup>	149.88 <sup>a</sup>	146.52 <sup>AB</sup>	152.48 <sup>bc</sup>	158.38 <sup>bc</sup>	155.43 <sup>B</sup>
Tamara	63.03 <sup>cde</sup>	78.63 <sup>a</sup>	70.83 <sup>A</sup>	107.54 <sup>d</sup>	124.38 <sup>ab</sup>	115.96 <sup>B</sup>	135.26 <sup>abc</sup>	137.00 <sup>abc</sup>	136.13 <sup>B</sup>	154.90 <sup>bc</sup>	167.50 <sup>b</sup>	161.20 <sup>AB</sup>
Yanara	65.50 <sup>bcd</sup>	76.58 <sup>ab</sup>	71.04 <sup>A</sup>	122.56 <sup>abc</sup>	132.50 <sup>a</sup>	127.53 <sup>A</sup>	150.76 <sup>a</sup>	151.00 <sup>a</sup>	150.98 <sup>A</sup>	160.42 <sup>bc</sup>	186.38 <sup>a</sup>	173.39 <sup>A</sup>
Mean	59.48	71.59	65.54	109.44	115.40	112.42	138.52	138.28	138.40	151.86	164.12	157.99

Varieties	April			May			June			July		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	173.35 <sup>bc</sup>	188.50 <sup>ab</sup>	180.93 <sup>A</sup>	169.44 <sup>ab</sup>	182.25 <sup>a</sup>	175.84 <sup>A</sup>	172.50 <sup>ab</sup>	178.13 <sup>ab</sup>	175.36 <sup>A</sup>	128.04 <sup>abc</sup>	161.00 <sup>a</sup>	144.52 <sup>A</sup>
Juvena	136.95 <sup>d</sup>	155.88 <sup>c</sup>	146.41 <sup>C</sup>	135.45 <sup>d</sup>	153.12 <sup>bcd</sup>	144.29 <sup>C</sup>	141.63 <sup>c</sup>	163.13 <sup>ab</sup>	152.38 <sup>C</sup>	100.02 <sup>cd</sup>	75.13 <sup>d</sup>	87.57 <sup>B</sup>
Lindessa	161.85 <sup>c</sup>	167.50 <sup>c</sup>	164.68 <sup>B</sup>	157.43 <sup>bc</sup>	171.63 <sup>ab</sup>	164.53 <sup>AB</sup>	165.13 <sup>ab</sup>	180.63 <sup>a</sup>	173.13 <sup>A</sup>	152.29 <sup>ab</sup>	162.62 <sup>a</sup>	157.46 <sup>A</sup>
Tamara	161.59 <sup>c</sup>	173.75 <sup>bc</sup>	167.67 <sup>AB</sup>	158.69 <sup>bc</sup>	162.75 <sup>bc</sup>	160.72 <sup>B</sup>	159.13 <sup>bc</sup>	160.25 <sup>b</sup>	159.69 <sup>BC</sup>	112.65 <sup>bcd</sup>	148.63 <sup>ab</sup>	130.64 <sup>A</sup>
Yanara	168.07 <sup>c</sup>	194.13 <sup>a</sup>	181.10 <sup>A</sup>	150.15 <sup>cd</sup>	184.50 <sup>a</sup>	167.33 <sup>AB</sup>	158.88 <sup>bc</sup>	173.13 <sup>ab</sup>	166.00 <sup>AB</sup>	161.58 <sup>a</sup>	163.87 <sup>a</sup>	162.73 <sup>A</sup>
Mean	160.36	175.95	168.16	154.23	170.85	162.54	159.55	171.05	165.30	130.92	142.25	136.59

Varieties	August			September		
	G	P	Mean	G	P	Mean
Essandre	190.56 <sup>a</sup>	174.25 <sup>ab</sup>	182.16 <sup>A</sup>	177.13 <sup>a</sup>	176.00 <sup>a</sup>	176.56 <sup>A</sup>
Juvena	138.95 <sup>b</sup>	79.50 <sup>c</sup>	109.23 <sup>B</sup>	144.13 <sup>a</sup>	81.13 <sup>b</sup>	112.53 <sup>B</sup>
Lindessa	177.44 <sup>ab</sup>	170.13 <sup>ab</sup>	173.78 <sup>A</sup>	173.81 <sup>a</sup>	174.25 <sup>a</sup>	174.03 <sup>A</sup>
Tamara	164.19 <sup>ab</sup>	137.38 <sup>b</sup>	150.78 <sup>B</sup>	153.63 <sup>a</sup>	179.31 <sup>a</sup>	166.47 <sup>A</sup>
Yanara	184.52 <sup>ab</sup>	178.88 <sup>ab</sup>	181.69 <sup>A</sup>	189.63 <sup>a</sup>	186.50 <sup>a</sup>	188.06 <sup>A</sup>
Mean	21.23	17.26	19.25	25.29	25.29	22.41

Treatment means having similar alphabets in superscript, do not differ significantly

G - Ground planting

P - Pot planting

Table 2b. Plant spread (cm) of gerbera varieties under different methods of planting

Varieties	Method of planting		Mean
	Ground	Pot	
Essandre	150.18 <sup>bc</sup>	152.81 <sup>b</sup>	151.49 <sup>A</sup>
Juvena	123.82 <sup>f</sup>	134.59 <sup>e</sup>	129.20 <sup>C</sup>
Lindessa	146.75 <sup>bcd</sup>	154.83 <sup>ab</sup>	150.79 <sup>A</sup>
Tamara	142.55 <sup>cde</sup>	140.30 <sup>de</sup>	141.43 <sup>B</sup>
Yanara	150.31 <sup>bc</sup>	162.41 <sup>a</sup>	156.36 <sup>A</sup>
Mean	142.72 <sup>b</sup>	148.99 <sup>a</sup>	145.85

Treatment means having similar alphabets in superscript, do not differ significantly



Table 3a. Number of leaves of gerbera varieties over the months November 2001-September 2002

Varieties	November			December			January			February		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	4.63 <sup>ab</sup>	5.00 <sup>ab</sup>	4.81 <sup>AB</sup>	7.12 <sup>ab</sup>	8.25 <sup>a</sup>	7.68 <sup>A</sup>	9.52 <sup>ab</sup>	11.75 <sup>a</sup>	10.63 <sup>A</sup>	13.90 <sup>ab</sup>	15.75 <sup>a</sup>	14.83 <sup>A</sup>
Juvena	5.05 <sup>ab</sup>	4.25 <sup>ab</sup>	4.65 <sup>AB</sup>	6.77 <sup>ab</sup>	7.00 <sup>ab</sup>	6.89 <sup>A</sup>	7.53 <sup>bc</sup>	7.25 <sup>bc</sup>	7.39 <sup>B</sup>	9.77 <sup>bc</sup>	8.75 <sup>c</sup>	9.26 <sup>B</sup>
Lindessa	4.66 <sup>ab</sup>	4.25 <sup>ab</sup>	4.46 <sup>AB</sup>	6.22 <sup>ab</sup>	7.50 <sup>ab</sup>	6.86 <sup>A</sup>	6.98 <sup>c</sup>	6.75 <sup>c</sup>	6.87 <sup>B</sup>	10.42 <sup>bc</sup>	8.50 <sup>c</sup>	9.46 <sup>B</sup>
Tamara	5.25 <sup>ab</sup>	5.50 <sup>a</sup>	5.38 <sup>A</sup>	6.60 <sup>ab</sup>	7.50 <sup>ab</sup>	7.05 <sup>A</sup>	7.19 <sup>bc</sup>	8.50 <sup>bc</sup>	7.85 <sup>B</sup>	10.28 <sup>bc</sup>	10.75 <sup>bc</sup>	10.51 <sup>B</sup>
Yanara	3.67 <sup>b</sup>	4.25 <sup>ab</sup>	3.96 <sup>B</sup>	5.53 <sup>b</sup>	6.75 <sup>ab</sup>	6.14 <sup>A</sup>	6.07 <sup>c</sup>	8.50 <sup>bc</sup>	7.29 <sup>B</sup>	8.19 <sup>c</sup>	11.25 <sup>bc</sup>	9.72 <sup>B</sup>
Mean	4.65	4.65	4.65	6.45	7.40	6.92	7.46	8.55	8.005	10.51	11.00	10.76

Varieties	March			April			May			June		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	20.43 <sup>a</sup>	20.75 <sup>a</sup>	20.59 <sup>A</sup>	22.53 <sup>a</sup>	19.25 <sup>a</sup>	20.89 <sup>A</sup>	30.10 <sup>a</sup>	18.00 <sup>b</sup>	24.05 <sup>A</sup>	23.92 <sup>b</sup>	17.29 <sup>ba</sup>	20.51 <sup>A</sup>
Juvena	12.41 <sup>b</sup>	11.25 <sup>b</sup>	11.83 <sup>B</sup>	14.18 <sup>b</sup>	13.25 <sup>b</sup>	13.72 <sup>B</sup>	16.35 <sup>b</sup>	11.25 <sup>cd</sup>	13.80 <sup>B</sup>	14.44 <sup>cde</sup>	11.50 <sup>ef</sup>	12.97 <sup>CD</sup>
Lindessa	12.35 <sup>b</sup>	10.75 <sup>b</sup>	11.55 <sup>B</sup>	14.07 <sup>b</sup>	13.75 <sup>b</sup>	13.91 <sup>B</sup>	17.83 <sup>b</sup>	14.25 <sup>bcd</sup>	16.04 <sup>B</sup>	19.29 <sup>b</sup>	14.25 <sup>cdf</sup>	16.77 <sup>B</sup>
Tamara	13.00 <sup>b</sup>	13.75 <sup>b</sup>	13.38 <sup>B</sup>	14.80 <sup>b</sup>	14.75 <sup>b</sup>	14.78 <sup>B</sup>	14.54 <sup>bc</sup>	10.50 <sup>d</sup>	12.52 <sup>B</sup>	12.20 <sup>ef</sup>	11.00 <sup>f</sup>	11.60 <sup>D</sup>
Yanara	10.93 <sup>b</sup>	13.50 <sup>b</sup>	12.22 <sup>B</sup>	12.90 <sup>b</sup>	14.75 <sup>b</sup>	13.83 <sup>B</sup>	14.37 <sup>bc</sup>	14.25 <sup>bcd</sup>	14.31 <sup>B</sup>	15.61 <sup>cd</sup>	14.00 <sup>def</sup>	14.80 <sup>BC</sup>
Mean	13.82	14.00	13.91	15.69	15.15	15.42	18.64	13.65	16.14	17.09	13.60	15.35

Varieties	July			August			September		
	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	9.00 <sup>bc</sup>	10.50 <sup>ab</sup>	9.75 <sup>A</sup>	15.25 <sup>ab</sup>	17.00 <sup>a</sup>	16.13 <sup>A</sup>	16.88 <sup>ab</sup>	19.75 <sup>a</sup>	18.32 <sup>A</sup>
Juvena	9.87 <sup>ab</sup>	4.25 <sup>d</sup>	7.06 <sup>B</sup>	8.48 <sup>bc</sup>	6.50 <sup>c</sup>	7.49 <sup>B</sup>	10.13 <sup>cd</sup>	7.25 <sup>d</sup>	8.69 <sup>B</sup>
Lindessa	13.16 <sup>a</sup>	8.50 <sup>bc</sup>	10.83 <sup>A</sup>	10.00 <sup>bc</sup>	12.75 <sup>abc</sup>	11.38 <sup>B</sup>	11.25 <sup>bcd</sup>	14.25 <sup>abc</sup>	12.75 <sup>AB</sup>
Tamara	7.03 <sup>bcd</sup>	5.25 <sup>cd</sup>	6.13 <sup>B</sup>	9.53 <sup>bc</sup>	7.25 <sup>c</sup>	8.38 <sup>B</sup>	11.00 <sup>bcd</sup>	10.13 <sup>cd</sup>	10.56 <sup>B</sup>
Yanara	11.04 <sup>ab</sup>	10.00 <sup>ab</sup>	10.52 <sup>A</sup>	12.73 <sup>abc</sup>	11.50 <sup>abc</sup>	12.11 <sup>AB</sup>	18.00 <sup>a</sup>	15.00 <sup>abc</sup>	16.50 <sup>A</sup>
Mean	10.21	7.70	8.96	11.19	11.00	11.09	13.45	13.27	13.36

Treatment means having similar alphabets in superscript, do not differ significantly

G - Ground planting

P - Pot planting

Table 3b. Number of leaves of gerbera varieties under different methods of planting

Varieties	Method of planting		Mean
	Ground	Pot	
Essandre	17.18 <sup>a</sup>	16.57 <sup>a</sup>	16.87 <sup>A</sup>
Juvena	10.91 <sup>c</sup>	9.80 <sup>cd</sup>	10.35 <sup>C</sup>
Lindessa	13.33 <sup>b</sup>	10.32 <sup>cd</sup>	11.83 <sup>B</sup>
Tamara	10.03 <sup>cd</sup>	9.10 <sup>d</sup>	9.57 <sup>C</sup>
Yanara	10.35 <sup>cd</sup>	10.24 <sup>cd</sup>	10.30 <sup>C</sup>
Mean	12.36 <sup>a</sup>	11.21 <sup>b</sup>	11.79

Treatment means having similar alphabets in superscript, do not differ significantly

Table 4a. Petiole length (cm) of gerbera varieties over the months December 2001-September 2002

Varieties	December			January			February			March		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	4.45 <sup>bc</sup>	5.60 <sup>ab</sup>	5.03 <sup>A</sup>	6.29 <sup>b</sup>	9.05 <sup>a</sup>	7.67 <sup>A</sup>	7.76 <sup>b</sup>	9.19 <sup>a</sup>	8.47 <sup>A</sup>	10.01 <sup>b</sup>	11.13 <sup>a</sup>	10.57 <sup>A</sup>
Juvena	3.72 <sup>c</sup>	5.20 <sup>ab</sup>	4.46 <sup>A</sup>	4.84 <sup>d</sup>	8.38 <sup>a</sup>	6.60 <sup>BC</sup>	5.30 <sup>d</sup>	8.50 <sup>ab</sup>	6.90 <sup>B</sup>	6.26 <sup>d</sup>	8.38 <sup>c</sup>	7.32 <sup>C</sup>
Lindessa	4.62 <sup>abc</sup>	5.15 <sup>ab</sup>	4.88 <sup>A</sup>	5.19 <sup>cd</sup>	6.88 <sup>b</sup>	6.03 <sup>C</sup>	5.43 <sup>d</sup>	6.06 <sup>cd</sup>	5.75 <sup>C</sup>	6.04 <sup>d</sup>	5.79 <sup>d</sup>	5.92 <sup>D</sup>
Tamara	4.34 <sup>bc</sup>	5.25 <sup>ab</sup>	4.79 <sup>A</sup>	6.00 <sup>bc</sup>	8.13 <sup>a</sup>	7.06 <sup>AB</sup>	6.46 <sup>c</sup>	8.13 <sup>b</sup>	7.29 <sup>B</sup>	8.36 <sup>c</sup>	9.00 <sup>bc</sup>	8.68 <sup>B</sup>
Yanara	4.36 <sup>bc</sup>	5.93 <sup>a</sup>	5.14 <sup>A</sup>	5.22 <sup>cd</sup>	8.21 <sup>a</sup>	6.71 <sup>BC</sup>	6.39 <sup>c</sup>	8.38 <sup>ab</sup>	7.38 <sup>B</sup>	6.77 <sup>d</sup>	8.81 <sup>c</sup>	7.79 <sup>C</sup>
Mean	4.29	5.43	4.86	5.51	8.12	6.82	6.27	8.05	7.16	7.49	8.62	8.06

Varieties	April			May			June			July		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	10.92 <sup>a</sup>	11.69 <sup>a</sup>	11.30 <sup>A</sup>	10.48 <sup>ab</sup>	10.88 <sup>a</sup>	10.48 <sup>A</sup>	10.43 <sup>a</sup>	9.63 <sup>b</sup>	10.04 <sup>A</sup>	9.45 <sup>a</sup>	9.18 <sup>a</sup>	9.32 <sup>A</sup>
Juvena	8.13 <sup>bc</sup>	8.25 <sup>bc</sup>	8.19 <sup>C</sup>	6.85 <sup>e</sup>	8.007 <sup>cd</sup>	7.43 <sup>C</sup>	7.04 <sup>ef</sup>	8.44 <sup>cd</sup>	7.92 <sup>C</sup>	7.63 <sup>a</sup>	4.06 <sup>b</sup>	5.85 <sup>B</sup>
Lindessa	6.81 <sup>d</sup>	8.68 <sup>bc</sup>	7.75 <sup>C</sup>	6.57 <sup>e</sup>	6.76 <sup>e</sup>	6.67 <sup>D</sup>	7.51 <sup>ef</sup>	7.28 <sup>J</sup>	7.39 <sup>D</sup>	8.46 <sup>a</sup>	7.18 <sup>a</sup>	7.83 <sup>A</sup>
Tamara	9.18 <sup>b</sup>	9.38 <sup>b</sup>	9.28 <sup>B</sup>	7.99 <sup>cd</sup>	8.50 <sup>e</sup>	8.25 <sup>B</sup>	9.23 <sup>b</sup>	8.13 <sup>cd</sup>	8.77 <sup>B</sup>	9.26 <sup>a</sup>	8.43 <sup>a</sup>	8.85 <sup>A</sup>
Yanara	7.69 <sup>cd</sup>	8.94 <sup>bc</sup>	8.39 <sup>C</sup>	7.01 <sup>de</sup>	9.06 <sup>bc</sup>	8.03 <sup>BC</sup>	8.06 <sup>de</sup>	9.00 <sup>bc</sup>	8.53 <sup>B</sup>	9.62 <sup>a</sup>	8.31 <sup>a</sup>	8.97 <sup>A</sup>
Mean	8.54	9.38	8.96	7.70	8.64	8.17	8.53	8.53	8.53	8.89	7.43	8.16

Varieties	August			September		
	G	P	Mean	G	P	Mean
Essandre	10.61 <sup>ab</sup>	11.88 <sup>a</sup>	11.24 <sup>A</sup>	10.78 <sup>ab</sup>	12.19 <sup>a</sup>	11.48 <sup>A</sup>
Juvena	10.39 <sup>abc</sup>	4.31 <sup>d</sup>	7.35 <sup>C</sup>	9.75 <sup>ab</sup>	4.44 <sup>c</sup>	7.09 <sup>B</sup>
Lindessa	10.11 <sup>abc</sup>	7.88 <sup>c</sup>	8.99 <sup>BC</sup>	9.69 <sup>ab</sup>	8.56 <sup>b</sup>	9.13 <sup>AB</sup>
Tamara	9.63 <sup>abc</sup>	7.93 <sup>c</sup>	8.78 <sup>BC</sup>	8.19 <sup>b</sup>	9.97 <sup>ab</sup>	9.08 <sup>AB</sup>
Yanara	9.78 <sup>abc</sup>	8.81 <sup>bc</sup>	9.29 <sup>B</sup>	10.56 <sup>ab</sup>	9.31 <sup>b</sup>	9.94 <sup>A</sup>
Mean	10.10	8.16	9.13	9.79	8.89	9.34

Treatment means having similar alphabets in superscript, do not differ significantly

G - Ground planting

P - Pot planting

Table 4b. Petiole length (cm) of gerbera varieties under different methods of planting

Varieties	Method of planting		Mean
	Ground	Pot	
Essandre	8.67 <sup>b</sup>	10.03 <sup>a</sup>	9.35 <sup>A</sup>
Juvena	6.87 <sup>ef</sup>	7.93 <sup>cd</sup>	7.39 <sup>BC</sup>
Lindessa	7.70 <sup>d</sup>	6.51 <sup>f</sup>	7.10 <sup>C</sup>
Tamara	8.12 <sup>c</sup>	6.99 <sup>e</sup>	7.57 <sup>B</sup>
Yanara	6.59 <sup>ef</sup>	7.68 <sup>d</sup>	7.13 <sup>C</sup>
Mean	7.59 <sup>a</sup>	7.83 <sup>a</sup>	7.71

Treatment means having similar alphabets in superscript, do not differ significantly

#### 4.1.5 Leaf area

Varieties exhibited significant variation in leaf area throughout the growth period. During the months of study, variety Essandre was found to have maximum leaf area (Table 5a) whereas minimum leaf area was recorded in variety Juvena.

The maximum leaf area was observed in variety Essandre (1276.28 cm<sup>2</sup>) followed by variety Lindessa (1060.20 cm<sup>2</sup>). Minimum leaf area (788.75 cm<sup>2</sup>) was recorded in variety Juvena (Table 5b).

When planting methods were compared, it was found that the varieties exhibited better leaf area in ground (1058.97 cm<sup>2</sup>) than in pots (944.19 cm<sup>2</sup>).

#### 4.1.6 Number of lobes on leaves

There was significant variation in number of lobes on leaves from the month of February (Table 6a). Variety Lindessa was found to have maximum number of lobes, followed by varieties Tamara, Yanara and Essandre. Number of lobes was minimum in variety Juvena. In general it was noticed that variety Lindessa recorded maximum number of lobes (14.75) whereas variety Juvena had the minimum value of 9.26 (Table 6b).

No specific effect of planting method was observed on number of lobes in gerbera.

### 4.2 FLORAL CHARACTERS

#### 4.2.1 Days taken for first flower bud appearance

Table 7 shows that emergence of first flower bud was observed in variety Juvena, which took minimum number of days for the first flower bud emergence (48.88 days) followed by varieties Yanara and Essandre that took 55.53 and 56.66 days respectively. The maximum number of days for the emergence of first flower bud was recorded in variety Tamara which took 70.81 days. It is also clear from the table that method of planting had no significant influence on the first flower bud emergence of gerbera varieties.

Table 5a. Leaf area (cm<sup>2</sup>) of gerbera varieties over the months December 2001-September 2002

Varieties	December			January			February			March		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	106.20 <sup>e</sup>	140.80 <sup>de</sup>	123.51 <sup>B</sup>	412.14 <sup>cd</sup>	579.69 <sup>bc</sup>	495.92 <sup>AB</sup>	1076.95 <sup>a</sup>	1021.19 <sup>a</sup>	1049.07 <sup>A</sup>	1438.94 <sup>ab</sup>	1311.97 <sup>ab</sup>	1375.45 <sup>A</sup>
Juvena	176.03 <sup>bcde</sup>	207.66 <sup>abcd</sup>	171.85 <sup>A</sup>	280.12 <sup>d</sup>	515.01 <sup>c</sup>	397.56 <sup>B</sup>	660.20 <sup>a</sup>	769.79 <sup>a</sup>	714.99 <sup>B</sup>	1136.95 <sup>ab</sup>	858.25 <sup>b</sup>	997.60 <sup>A</sup>
Lindessa	171.44 <sup>cde</sup>	261.62 <sup>ab</sup>	216.53 <sup>A</sup>	442.81 <sup>cd</sup>	468.08 <sup>cd</sup>	455.45 <sup>AB</sup>	946.58 <sup>a</sup>	761.79 <sup>a</sup>	854.33 <sup>AB</sup>	965.15 <sup>ab</sup>	1119.34 <sup>ab</sup>	1042.24 <sup>A</sup>
Tamara	198.11 <sup>abcd</sup>	253.28 <sup>abc</sup>	225.69 <sup>A</sup>	421.63 <sup>cd</sup>	722.05 <sup>ab</sup>	571.84 <sup>A</sup>	774.05 <sup>a</sup>	1123.81 <sup>a</sup>	948.93 <sup>AB</sup>	1024.56 <sup>ab</sup>	1212.09 <sup>ab</sup>	1118.33 <sup>A</sup>
Yanara	133.39 <sup>de</sup>	283.48 <sup>a</sup>	208.43 <sup>A</sup>	283.53 <sup>d</sup>	839.32 <sup>a</sup>	561.42 <sup>A</sup>	701.51 <sup>a</sup>	1226.28 <sup>a</sup>	963.89 <sup>AB</sup>	864.43 <sup>b</sup>	1545.82 <sup>a</sup>	1205.12 <sup>A</sup>
Mean	157.04	229.37	193.21	368.04	624.83	496.44	831.92	980.58	906.25	1086.01	1209.49	1147.75

Varieties	April			May			June			July		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	1962.43 <sup>c</sup>	1573.27 <sup>ab</sup>	1767.85 <sup>A</sup>	2080.26 <sup>a</sup>	1488.96 <sup>b</sup>	1784.61 <sup>A</sup>	1893.98 <sup>a</sup>	1351.43 <sup>bc</sup>	1622.70 <sup>A</sup>	789.79 <sup>a</sup>	840.88 <sup>a</sup>	784.84 <sup>BC</sup>
Juvena	1140.43 <sup>bc</sup>	1095.04 <sup>c</sup>	1117.73 <sup>B</sup>	2080.26 <sup>a</sup>	897.68 <sup>c</sup>	1488.97 <sup>B</sup>	1083.07 <sup>bcd</sup>	930.47 <sup>cd</sup>	1006.77 <sup>B</sup>	711.81 <sup>a</sup>	314.04 <sup>a</sup>	512.93 <sup>D</sup>
Lindessa	1375.25 <sup>bc</sup>	1173.67 <sup>bc</sup>	1274.46 <sup>B</sup>	1576.53 <sup>b</sup>	1186.85 <sup>bc</sup>	1381.69 <sup>BC</sup>	1833.49 <sup>a</sup>	1431.13 <sup>b</sup>	1632.30 <sup>A</sup>	1457.41 <sup>a</sup>	894.59 <sup>a</sup>	1176.01 <sup>A</sup>
Tamara	1222.55 <sup>bc</sup>	1545.63 <sup>abc</sup>	1384.09 <sup>B</sup>	1211.31 <sup>bc</sup>	1161.00 <sup>bc</sup>	1186.16 <sup>C</sup>	842.85 <sup>d</sup>	1183.88 <sup>bcd</sup>	1013.36 <sup>B</sup>	539.31 <sup>a</sup>	663.25 <sup>a</sup>	601.28 <sup>CD</sup>
Yanara	1312.97 <sup>bc</sup>	1249.33 <sup>bc</sup>	1281.15 <sup>B</sup>	1036.57 <sup>c</sup>	1177.00 <sup>bc</sup>	1106.78 <sup>C</sup>	1314.34 <sup>bc</sup>	962.08 <sup>cd</sup>	1138.21 <sup>B</sup>	1096.67 <sup>a</sup>	818.09 <sup>a</sup>	957.38 <sup>AB</sup>
Mean	1402.72	1327.39	1365.06	1596.99	1182.29	1389.64	1393.55	1171.79	1282.67	906.80	706.17	806.49

Varieties	August			September		
	G	P	Mean	G	P	Mean
Essandre	1593.98 <sup>a</sup>	1464.07 <sup>a</sup>	1529.03 <sup>A</sup>	1950.34 <sup>ab</sup>	1779.30 <sup>abc</sup>	1864.82 <sup>A</sup>
Juvena	692.89 <sup>bc</sup>	489.45 <sup>c</sup>	591.17 <sup>B</sup>	928.23 <sup>de</sup>	641.89 <sup>a</sup>	785.05 <sup>B</sup>
Lindessa	1225.59 <sup>ab</sup>	1340.51 <sup>ab</sup>	1283.05 <sup>A</sup>	1318.05 <sup>bcd</sup>	1604.84 <sup>abcd</sup>	1461.44 <sup>A</sup>
Tamara	920.50 <sup>abc</sup>	1280.38 <sup>ab</sup>	1100.04 <sup>A</sup>	1541.51 <sup>bcd</sup>	1109.78 <sup>cde</sup>	1325.65 <sup>AB</sup>
Yanara	1464.96 <sup>a</sup>	1109.09 <sup>abc</sup>	1287.02 <sup>A</sup>	2264.96 <sup>a</sup>	1187.44 <sup>cde</sup>	1726.19 <sup>A</sup>
Mean	1179.59	1136.69	1158.14	1600.62	1264.65	1432.64

Treatment means having similar alphabets in superscript, do not differ significantly

G - Ground planting

P - Pot planting

Table 5b. Leaf area (cm<sup>2</sup>) of gerbera varieties under different methods of planting

Varieties	Method of planting		Mean
	Ground	Pot	
Essandre	1401.43 <sup>a</sup>	1151.14 <sup>b</sup>	1276.28 <sup>A</sup>
Juvena	812.33 <sup>de</sup>	765.18 <sup>e</sup>	788.75 <sup>C</sup>
Lindessa	1122.30 <sup>b</sup>	998.10 <sup>bcd</sup>	1060.20 <sup>B</sup>
Tamara	1077.65 <sup>bc</sup>	856.79 <sup>de</sup>	967.22 <sup>B</sup>
Yanara	881.15 <sup>cde</sup>	949.75 <sup>bcde</sup>	915.45 <sup>BC</sup>
Mean	1058.97 <sup>a</sup>	944.19 <sup>b</sup>	1001.58

Treatment means having similar alphabets in superscript, do not differ significantly

Table 6a. Number of lobes on leaves of gerbera varieties over the months February 2002-September 2002

Varieties	February			March			April			May		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	9.05 <sup>cd</sup>	7.25 <sup>d</sup>	8.15 <sup>C</sup>	9.32 <sup>d</sup>	8.37 <sup>d</sup>	8.85 <sup>D</sup>	10.71 <sup>bcd</sup>	10.50 <sup>cd</sup>	10.60 <sup>D</sup>	10.65 <sup>bc</sup>	10.44 <sup>bc</sup>	10.55 <sup>C</sup>
Juvena	9.04 <sup>cd</sup>	9.00 <sup>cd</sup>	9.02 <sup>C</sup>	9.76 <sup>cd</sup>	8.75 <sup>d</sup>	9.26 <sup>D</sup>	9.70 <sup>de</sup>	8.75 <sup>e</sup>	9.23 <sup>E</sup>	9.51 <sup>cd</sup>	8.63 <sup>d</sup>	9.07 <sup>D</sup>
Lindessa	14.29 <sup>a</sup>	7.88 <sup>d</sup>	11.08 <sup>AB</sup>	15.16 <sup>a</sup>	14.00 <sup>a</sup>	14.58 <sup>A</sup>	15.16 <sup>a</sup>	14.75 <sup>a</sup>	14.96 <sup>A</sup>	14.57 <sup>a</sup>	15.00 <sup>a</sup>	14.78 <sup>A</sup>
Tamara	13.29 <sup>a</sup>	11.08 <sup>b</sup>	12.19 <sup>A</sup>	14.28 <sup>a</sup>	11.88 <sup>b</sup>	13.08 <sup>B</sup>	14.29 <sup>a</sup>	12.12 <sup>b</sup>	13.20 <sup>B</sup>	13.82 <sup>a</sup>	11.50 <sup>b</sup>	12.66 <sup>B</sup>
Yanara	10.53 <sup>bc</sup>	10.13 <sup>bc</sup>	10.33 <sup>B</sup>	11.86 <sup>b</sup>	10.88 <sup>bc</sup>	11.37 <sup>C</sup>	11.86 <sup>bc</sup>	11.95 <sup>bc</sup>	11.90 <sup>C</sup>	13.62 <sup>a</sup>	10.06 <sup>bcd</sup>	11.84 <sup>B</sup>
Mean	9.07	9.07	10.16	12.08	10.70	11.43	12.34	11.62	11.98	12.14	11.13	11.64

Varieties	June			July			August			September		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	9.46 <sup>cde</sup>	11.00 <sup>bc</sup>	10.23 <sup>B</sup>	7.76 <sup>d</sup>	10.38 <sup>bc</sup>	9.08 <sup>B</sup>	11.46 <sup>b</sup>	11.13 <sup>b</sup>	11.29 <sup>C</sup>	12.25 <sup>b</sup>	11.38 <sup>b</sup>	11.81 <sup>B</sup>
Juvena	9.24 <sup>de</sup>	8.94 <sup>e</sup>	9.08 <sup>C</sup>	7.19 <sup>d</sup>	3.50 <sup>e</sup>	5.34 <sup>C</sup>	11.79 <sup>b</sup>	3.56 <sup>c</sup>	7.68 <sup>D</sup>	10.56 <sup>b</sup>	3.94 <sup>c</sup>	7.25 <sup>C</sup>
Lindessa	14.19 <sup>a</sup>	14.88 <sup>a</sup>	14.53 <sup>A</sup>	13.85 <sup>a</sup>	15.31 <sup>a</sup>	14.58 <sup>A</sup>	16.13 <sup>a</sup>	15.75 <sup>a</sup>	15.94 <sup>A</sup>	16.81 <sup>a</sup>	16.25 <sup>a</sup>	16.53 <sup>A</sup>
Tamara	10.80 <sup>bcd</sup>	11.63 <sup>b</sup>	11.21 <sup>B</sup>	9.50 <sup>bcd</sup>	11.38 <sup>b</sup>	10.44 <sup>B</sup>	13.63 <sup>ab</sup>	11.75 <sup>b</sup>	12.68 <sup>BC</sup>	13.25 <sup>b</sup>	16.25 <sup>a</sup>	14.75 <sup>A</sup>
Yanara	11.29 <sup>b</sup>	10.25 <sup>bcde</sup>	10.77 <sup>B</sup>	8.97 <sup>cd</sup>	9.06 <sup>cd</sup>	9.01 <sup>B</sup>	16.02 <sup>a</sup>	11.13 <sup>b</sup>	13.58 <sup>B</sup>	16.38 <sup>a</sup>	11.88 <sup>b</sup>	14.13 <sup>AB</sup>
Mean	10.99	11.34	11.17	9.46	9.93	9.69	13.80	10.66	12.23	13.85	11.94	12.89

Treatment means having similar alphabets in superscript, do not differ significantly

G - Ground planting

P - Pot planting



Table 6b. Number of lobes on leaves of gerbera varieties under different methods of planting

Varieties	Method of planting		Mean
	Ground	Pot	
Essandre	10.64 <sup>c</sup>	10.08 <sup>cd</sup>	10.35 <sup>D</sup>
Juvena	9.71 <sup>d</sup>	8.79 <sup>e</sup>	9.26 <sup>E</sup>
Lindessa	14.77 <sup>a</sup>	14.73 <sup>a</sup>	14.75 <sup>A</sup>
Tamara	11.79 <sup>b</sup>	12.14 <sup>b</sup>	11.96 <sup>C</sup>
Yanara	12.08 <sup>b</sup>	10.63 <sup>c</sup>	11.35 <sup>B</sup>
Mean	11.79 <sup>a</sup>	11.27 <sup>a</sup>	11.53

Treatment means having similar alphabets in superscript, do not differ significantly

Table 7. Days taken for first flower bud emergence of gerbera varieties under different methods of planting

Varieties	Method of planting		Mean
	Ground	Pot	
Essandre	55.31 <sup>e</sup>	58.00 <sup>de</sup>	56.66 <sup>C</sup>
Juvena	48.50 <sup>g</sup>	49.25 <sup>fg</sup>	48.88 <sup>D</sup>
Lindessa	65.01 <sup>bc</sup>	60.75 <sup>cd</sup>	62.88 <sup>B</sup>
Tamara	72.63 <sup>a</sup>	69.00 <sup>ab</sup>	70.81 <sup>A</sup>
Yanara	57.56 <sup>de</sup>	53.50 <sup>ef</sup>	55.53 <sup>C</sup>
Mean	59.80 <sup>a</sup>	58.10 <sup>a</sup>	58.95

Treatment means having similar alphabets in superscript, do not differ significantly

#### 4.2.2 Days taken from flower bud emergence to opening

Data relating to monthly variation in days taken from flower bud emergence to flower opening is given in the Table 8a. Variety Tamara had maximum number of days from flower bud initiation to flower opening, whereas variety Juvena took minimum number of days for flower opening, throughout the growth period. All the varieties took less number of days from flower bud emergence to flower opening in months of June and July compared to other months. It was observed that (Table 8b) maximum number of days from flower bud initiation flower opening in variety Tamara was 16.4 days and variety Juvena recorded minimum number of days of 14.28 from bud emergence to flower opening. Method of planting is not found to be significantly influencing days taken from flower bud initiation to flower opening of gerbera varieties.

#### 4.2.3 Total number of flowers per plant

Significant variation in flower production was noticed among the varieties throughout the growth period (Table 9a). It was observed that in all the varieties, there was an increase in flower production up to June, whereas in July all the varieties showed a decline in flower production. The maximum number of flowers per plant was observed in variety Essandre in the month of September 2002. The variety produced 3.81 flowers per plant when planted in ground, followed by variety Lindessa with a flower number of 3.56 when planted in ground.

With regard to general performance, variety Essandre was superior in flower production, which produced maximum number of flowers (17.69). Variety Tamara had a minimum value of 8.00 (Table 9b).

When planting methods were compared it was found that flower production was better in ground planting than in pot planting.

#### 4.2.4 Flower diameter

Table 10a shows the difference in flower diameter among the varieties. For all the varieties, monthly variation in flower diameter was not significant except for

Table 8a. Days taken from flower bud initiation to flower opening of gerbera varieties over the months March 2002-September 2002

Varieties	March			April			May			June		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	15.46 <sup>a</sup>	14.31 <sup>a</sup>	14.89 <sup>A</sup>	15.60 <sup>a</sup>	14.25 <sup>a</sup>	14.93 <sup>A</sup>	16.38 <sup>a</sup>	14.25 <sup>a</sup>	15.31 <sup>A</sup>	15.64 <sup>a</sup>	13.88 <sup>a</sup>	14.76 <sup>A</sup>
Juvena	13.24 <sup>a</sup>	14.50 <sup>a</sup>	13.87 <sup>A</sup>	14.52 <sup>a</sup>	15.25 <sup>a</sup>	14.88 <sup>A</sup>	13.92 <sup>a</sup>	14.25 <sup>a</sup>	14.08 <sup>AB</sup>	13.68 <sup>a</sup>	14.31 <sup>a</sup>	13.99 <sup>A</sup>
Lindessa	14.63 <sup>a</sup>	15.38 <sup>a</sup>	15.00 <sup>A</sup>	14.89 <sup>a</sup>	15.25 <sup>a</sup>	15.07 <sup>A</sup>	14.46 <sup>a</sup>	14.37 <sup>a</sup>	14.42 <sup>AB</sup>	14.88 <sup>a</sup>	15.00 <sup>a</sup>	14.94 <sup>A</sup>
Tamara	16.00 <sup>a</sup>	15.38 <sup>a</sup>	15.69 <sup>A</sup>	15.50 <sup>a</sup>	16.00 <sup>a</sup>	15.75 <sup>A</sup>	15.13 <sup>a</sup>	17.88 <sup>a</sup>	16.50 <sup>A</sup>	15.38 <sup>a</sup>	15.00 <sup>a</sup>	15.19 <sup>A</sup>
Yanara	16.09 <sup>a</sup>	15.35 <sup>a</sup>	15.72 <sup>A</sup>	15.05 <sup>a</sup>	14.63 <sup>a</sup>	14.84 <sup>A</sup>	15.41 <sup>a</sup>	15.08 <sup>a</sup>	15.24 <sup>A</sup>	15.47 <sup>a</sup>	15.38 <sup>a</sup>	15.42 <sup>A</sup>
Mean	15.09	14.98	15.04	15.11	15.08	15.09	15.06	15.17	15.12	15.01	14.31	14.66

Varieties	July			August			September		
	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	15.40 <sup>a</sup>	15.31 <sup>a</sup>	15.36 <sup>A</sup>	15.24 <sup>a</sup>	14.50 <sup>a</sup>	14.87 <sup>A</sup>	15.58 <sup>b</sup>	15.56 <sup>b</sup>	15.57 <sup>A</sup>
Juvena	15.06 <sup>a</sup>	15.00 <sup>a</sup>	15.03 <sup>A</sup>	14.02 <sup>a</sup>	13.75 <sup>a</sup>	13.89 <sup>A</sup>	14.58 <sup>b</sup>	14.38 <sup>b</sup>	14.48 <sup>A</sup>
Lindessa	15.68 <sup>a</sup>	14.38 <sup>a</sup>	15.03 <sup>A</sup>	14.41 <sup>a</sup>	13.75 <sup>a</sup>	14.08 <sup>A</sup>	14.38 <sup>b</sup>	15.00 <sup>b</sup>	14.69 <sup>A</sup>
Tamara	13.75 <sup>a</sup>	16.00 <sup>a</sup>	14.87 <sup>A</sup>	18.50 <sup>a</sup>	13.52 <sup>a</sup>	16.01 <sup>A</sup>	18.37 <sup>b</sup>	15.50 <sup>b</sup>	16.94 <sup>A</sup>
Yanara	15.46 <sup>a</sup>	15.13 <sup>a</sup>	15.29 <sup>A</sup>	16.00 <sup>a</sup>	15.00 <sup>a</sup>	15.50 <sup>A</sup>	14.63 <sup>b</sup>	14.65 <sup>b</sup>	14.64 <sup>A</sup>
Mean	15.07	13.17	14.12	15.64	14.10	14.87	15.50	15.01	15.25

Treatment means having similar alphabets in superscript, do not differ significantly

G - Ground planting

P - Pot planting

Table 8b. Days taken from flower bud initiation to flower opening of gerbera varieties under different methods of planting

Varieties	Method of planting		Mean
	Ground	Pot	
Essandre	15.61 <sup>bc</sup>	14.55 <sup>de</sup>	15.08 <sup>BC</sup>
Juvena	14.08 <sup>e</sup>	14.48 <sup>de</sup>	14.28 <sup>D</sup>
Lindessa	14.76 <sup>d</sup>	14.78 <sup>d</sup>	14.77 <sup>C</sup>
Tamara	16.89 <sup>a</sup>	15.91 <sup>b</sup>	16.40 <sup>A</sup>
Yanara	15.44 <sup>bc</sup>	15.03 <sup>cd</sup>	15.23 <sup>B</sup>
Mean	15.36 <sup>a</sup>	14.95 <sup>a</sup>	15.16

Treatment means having similar alphabets in superscript, do not differ significantly

Table 9a. Number of flowers per plant of gerbera varieties over the months January 2002-September 2002

Varieties	January			February			March			April		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	1.19 <sup>ab</sup>	1.00 <sup>ab</sup>	1.09 <sup>A</sup>	1.94 <sup>abc</sup>	2.25 <sup>a</sup>	2.09 <sup>A</sup>	3.13 <sup>a</sup>	1.50 <sup>cd</sup>	2.41 <sup>A</sup>	3.50 <sup>a</sup>	2.00 <sup>bc</sup>	2.75 <sup>A</sup>
Juvena	1.38 <sup>a</sup>	1.00 <sup>ab</sup>	1.19 <sup>A</sup>	2.06 <sup>ab</sup>	1.25 <sup>cd</sup>	1.66 <sup>AB</sup>	2.75 <sup>ab</sup>	1.75 <sup>cd</sup>	2.25 <sup>A</sup>	2.12 <sup>bc</sup>	2.00 <sup>bc</sup>	2.06 <sup>B</sup>
Lindessa	0.25 <sup>c</sup>	0.75 <sup>b</sup>	0.50 <sup>B</sup>	1.50 <sup>bcd</sup>	1.00 <sup>de</sup>	1.25 <sup>BC</sup>	2.56 <sup>ab</sup>	2.00 <sup>bc</sup>	2.28 <sup>A</sup>	2.50 <sup>bc</sup>	1.75 <sup>c</sup>	2.13 <sup>B</sup>
Tamara	0.00 <sup>c</sup>	0.00 <sup>c</sup>	0.00 <sup>C</sup>	0.50 <sup>e</sup>	1.25 <sup>cd</sup>	0.87 <sup>C</sup>	0.50 <sup>e</sup>	1.00 <sup>de</sup>	0.75 <sup>B</sup>	0.50 <sup>d</sup>	0.75 <sup>d</sup>	0.63 <sup>C</sup>
Yanara	0.00 <sup>c</sup>	1.00 <sup>ab</sup>	0.50 <sup>B</sup>	1.25 <sup>cd</sup>	1.50 <sup>bcd</sup>	1.38 <sup>B</sup>	2.63 <sup>ab</sup>	1.75 <sup>cd</sup>	2.19 <sup>A</sup>	2.69 <sup>b</sup>	2.25 <sup>bc</sup>	2.47 <sup>AB</sup>
Mean	0.56	0.75	0.94	1.45	1.45	1.45	2.35	1.60	1.98	2.26	1.75	2.005

Varieties	May			June			July			August		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	2.75 <sup>a</sup>	1.00 <sup>cd</sup>	1.88 <sup>A</sup>	3.19 <sup>a</sup>	1.75 <sup>c</sup>	2.47 <sup>A</sup>	1.63 <sup>a</sup>	0.75 <sup>c</sup>	1.18 <sup>A</sup>	2.75 <sup>a</sup>	1.00 <sup>c</sup>	1.88 <sup>AB</sup>
Juvena	2.25 <sup>ab</sup>	1.50 <sup>bcd</sup>	1.88 <sup>A</sup>	2.25 <sup>ab</sup>	1.25 <sup>bc</sup>	1.75 <sup>AB</sup>	1.00 <sup>bc</sup>	0.00 <sup>e</sup>	1.00 <sup>A</sup>	2.00 <sup>bc</sup>	1.25 <sup>de</sup>	1.63 <sup>B</sup>
Lindessa	2.63 <sup>a</sup>	1.75 <sup>abcd</sup>	2.19 <sup>A</sup>	2.50 <sup>ab</sup>	1.75 <sup>bc</sup>	2.13 <sup>A</sup>	1.50 <sup>ab</sup>	0.50 <sup>cde</sup>	1.00 <sup>A</sup>	2.50 <sup>ab</sup>	1.75 <sup>cd</sup>	2.13 <sup>A</sup>
Tamara	1.38 <sup>bcd</sup>	0.75 <sup>d</sup>	1.06 <sup>B</sup>	1.13 <sup>c</sup>	1.25 <sup>bc</sup>	1.19 <sup>B</sup>	0.25 <sup>de</sup>	0.25 <sup>de</sup>	0.25 <sup>B</sup>	1.86 <sup>abc</sup>	1.00 <sup>e</sup>	0.93 <sup>C</sup>
Yanara	2.00 <sup>abc</sup>	1.50 <sup>bcd</sup>	1.75 <sup>A</sup>	2.00 <sup>abc</sup>	1.25 <sup>bc</sup>	1.63 <sup>AB</sup>	1.00 <sup>bc</sup>	1.00 <sup>bc</sup>	1.00 <sup>A</sup>	2.25 <sup>ab</sup>	1.00 <sup>e</sup>	1.63 <sup>B</sup>
Mean	2.20	1.30	1.75	2.21	1.45	1.83	1.08	0.50	0.79	2.27	1.00	1.64

Varieties	September		
	G	P	Mean
Essandre	3.81 <sup>a</sup>	1.75 <sup>de</sup>	2.78 <sup>A</sup>
Juvena	2.50 <sup>bcd</sup>	1.25 <sup>e</sup>	1.88 <sup>BC</sup>
Lindessa	3.56 <sup>cde</sup>	1.50 <sup>de</sup>	2.53 <sup>AB</sup>
Tamara	2.88 <sup>abc</sup>	1.25 <sup>c</sup>	2.06 <sup>ABC</sup>
Yanara	2.00 <sup>ab</sup>	1.00 <sup>e</sup>	1.50 <sup>C</sup>
Mean	2.95	1.35	2.15

Treatment means having similar alphabets in superscript, do not differ significantly

G - Ground planting

P - Pot planting

Table 9b. Total number of flowers per plant of different gerbera varieties under different methods of planting

Varieties	Method of planting		Mean
	Ground	Pot	
Essandre	22.38 <sup>a</sup>	13.00 <sup>cd</sup>	17.69 <sup>A</sup>
Juvena	15.75 <sup>bc</sup>	11.75 <sup>de</sup>	13.75 <sup>C</sup>
Lindessa	17.69 <sup>b</sup>	12.75 <sup>d</sup>	15.21 <sup>B</sup>
Tamara	9.50 <sup>e</sup>	6.50 <sup>f</sup>	8.00 <sup>D</sup>
Yanara	14.12 <sup>cd</sup>	12.25 <sup>de</sup>	13.19 <sup>C</sup>
Mean	15.89 <sup>a</sup>	11.25 <sup>b</sup>	13.57

Treatment means having similar alphabets in superscript, do not differ significantly

Table 10a. Flower diameter (cm) of gerbera varieties over the months March 2002-September 2002

Varieties	March			April			May			June		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	7.78 <sup>a</sup>	7.63 <sup>a</sup>	7.70 <sup>^</sup>	7.98 <sup>a</sup>	7.66 <sup>a</sup>	7.82 <sup>AB</sup>	8.15 <sup>a</sup>	7.50 <sup>a</sup>	7.82 <sup>AB</sup>	8.60 <sup>ab</sup>	7.93 <sup>ab</sup>	8.26 <sup>^</sup>
Juvena	7.52 <sup>a</sup>	8.01 <sup>a</sup>	7.77 <sup>^</sup>	7.44 <sup>a</sup>	7.16 <sup>a</sup>	7.30 <sup>AB</sup>	8.01 <sup>a</sup>	7.45 <sup>ab</sup>	7.73 <sup>AB</sup>	8.19 <sup>ab</sup>	7.90 <sup>ab</sup>	8.04 <sup>^</sup>
Lindessa	8.51 <sup>a</sup>	8.36 <sup>a</sup>	8.44 <sup>^</sup>	8.00 <sup>a</sup>	8.20 <sup>a</sup>	8.10 <sup>AB</sup>	8.29 <sup>a</sup>	8.06 <sup>a</sup>	8.17 <sup>^</sup>	8.55 <sup>ab</sup>	8.63 <sup>ab</sup>	8.59 <sup>^</sup>
Tamara	7.00 <sup>a</sup>	7.00 <sup>a</sup>	7.00 <sup>^</sup>	8.73 <sup>a</sup>	8.75 <sup>a</sup>	8.74 <sup>^</sup>	7.75 <sup>a</sup>	8.53 <sup>a</sup>	8.14 <sup>^</sup>	9.58 <sup>a</sup>	8.25 <sup>ab</sup>	8.92 <sup>^</sup>
Yanara	9.32 <sup>a</sup>	9.95 <sup>a</sup>	9.64 <sup>^</sup>	9.01 <sup>a</sup>	8.25 <sup>a</sup>	8.63 <sup>^</sup>	8.90 <sup>a</sup>	9.23 <sup>a</sup>	9.06 <sup>^</sup>	9.61 <sup>a</sup>	9.43 <sup>a</sup>	9.52 <sup>^</sup>
Mean	8.03	8.19	8.11	8.23	8.12	8.18	8.21	8.15	8.18	8.91	8.42	8.67

Varieties	July			August			September		
	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	8.31 <sup>a</sup>	8.21 <sup>a</sup>	8.26 <sup>^</sup>	8.47 <sup>ab</sup>	8.65 <sup>ab</sup>	8.56 <sup>^</sup>	9.17 <sup>a</sup>	8.81 <sup>a</sup>	8.99 <sup>^</sup>
Juvena	8.47 <sup>a</sup>	8.35 <sup>a</sup>	8.41 <sup>^</sup>	8.87 <sup>ab</sup>	8.62 <sup>ab</sup>	8.75 <sup>^</sup>	9.35 <sup>a</sup>	9.67 <sup>a</sup>	9.52 <sup>^</sup>
Lindessa	8.99 <sup>a</sup>	8.50 <sup>a</sup>	8.75 <sup>^</sup>	8.77 <sup>ab</sup>	8.65 <sup>ab</sup>	8.71 <sup>^</sup>	9.21 <sup>a</sup>	9.36 <sup>a</sup>	9.28 <sup>^</sup>
Tamara	8.37 <sup>a</sup>	8.80 <sup>a</sup>	8.59 <sup>^</sup>	8.15 <sup>ab</sup>	9.07 <sup>a</sup>	8.61 <sup>^</sup>	9.35 <sup>a</sup>	9.90 <sup>a</sup>	9.62 <sup>^</sup>
Yanara	9.53 <sup>a</sup>	8.95 <sup>a</sup>	9.24 <sup>^</sup>	10.01 <sup>a</sup>	10.80 <sup>a</sup>	10.41 <sup>^</sup>	9.66 <sup>a</sup>	10.17 <sup>a</sup>	9.91 <sup>^</sup>
Mean	8.73	8.56	8.64	8.85	9.41	9.13	9.35	9.58	9.47

Treatment means having similar alphabets in superscript, do not differ significantly

G - Ground planting

P - Pot planting



Table 10b. Flower diameter of gerbera varieties under different methods of planting

Varieties	Method of planting		Mean
	Ground	Pot	
Essandre	8.35 <sup>cde</sup>	8.08 <sup>e</sup>	8.22 <sup>D</sup>
Juvena	8.26 <sup>de</sup>	8.22 <sup>e</sup>	8.24 <sup>D</sup>
Lindessa	8.61 <sup>c</sup>	8.56 <sup>cd</sup>	8.59 <sup>C</sup>
Tamara	9.15 <sup>b</sup>	8.65 <sup>c</sup>	8.89 <sup>B</sup>
Yanara	9.42 <sup>b</sup>	9.75 <sup>a</sup>	9.59 <sup>A</sup>
Mean	8.76 <sup>a</sup>	8.65 <sup>a</sup>	8.71

Treatment means having similar alphabets in superscript, do not differ significantly

the months of April and May. In April and May, varieties Essandre and Juvena had smaller flowers when compared to other varieties.

Data presented in Table 10b shows that flower diameter was maximum in variety Yanara (9.59 cm) followed by varieties Tamara (8.89 cm) and Lindessa (8.56 cm). Minimum flower diameter was recorded in varieties Essandre (8.22 cm) and Juvena (8.24 cm).

When method of planting was compared, it was noticed that planting method had no influence on flower size of gerbera varieties.

#### **4.2.5 Stalk length**

Stalk length of flowers was less during initial months of March and April (Table 11a). All the varieties had exhibited an increasing trend in stalk length from July to September. Variety Yanara had the maximum stalk length and variety Lindessa showed minimum stalk length throughout the growth period.

Table 11b shows that varieties Yanara and Tamara were performing on par with maximum stalk length of 56.77 cm and 56.15cm, respectively. Variety Lindessa recorded minimum stalk length of 51.01 cm. It is also relevant from the table that stalk length is not influenced by method of planting in gerbera.

#### **4.2.6 Stalk girth**

Data relating to the monthly variation in stalk girth of different gerbera varieties are given in Table 12a. Varieties Juvena and Lindessa exhibited almost uniform stalk girth throughout the study period. The parameter was highly varying in variety Tamara. Variety Lindessa registered a maximum stalk girth of 2.29 cm which was on par with variety Tamara (2.28 cm). Variety Essandre had the minimum value of 1.99 cm (Table 12b). It is also revealed from the table that planting method had no significant influence on stalk girth of gerbera varieties.

Table 11a. Stalk length (cm) of gerbera varieties over the months March 2002-September 2002

Varieties	March			April			May			June		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	55.26 <sup>ab</sup>	47.88 <sup>ab</sup>	51.57 <sup>AB</sup>	57.72 <sup>ab</sup>	48.40 <sup>ab</sup>	53.06 <sup>A</sup>	52.10 <sup>a</sup>	52.37 <sup>a</sup>	52.24 <sup>A</sup>	53.73 <sup>ab</sup>	51.10 <sup>ab</sup>	52.41 <sup>A</sup>
Juvena	47.32 <sup>ab</sup>	47.25 <sup>ab</sup>	47.29 <sup>AB</sup>	52.33 <sup>ab</sup>	46.40 <sup>ab</sup>	49.38 <sup>AB</sup>	52.14 <sup>a</sup>	51.00 <sup>a</sup>	51.58 <sup>A</sup>	51.27 <sup>ab</sup>	53.25 <sup>ab</sup>	52.26 <sup>A</sup>
Lindessa	44.07 <sup>ab</sup>	47.15 <sup>ab</sup>	45.61 <sup>AB</sup>	45.32 <sup>ab</sup>	49.30 <sup>ab</sup>	47.29 <sup>AB</sup>	48.21 <sup>a</sup>	50.12 <sup>a</sup>	49.16 <sup>A</sup>	49.86 <sup>ab</sup>	51.27 <sup>ab</sup>	50.57 <sup>A</sup>
Tamara	42.00 <sup>ab</sup>	46.50 <sup>a</sup>	44.25 <sup>AB</sup>	41.25 <sup>b</sup>	52.38 <sup>a</sup>	46.80 <sup>AB</sup>	50.25 <sup>a</sup>	55.75 <sup>a</sup>	53.00 <sup>B</sup>	58.00 <sup>a</sup>	40.78 <sup>a</sup>	49.39 <sup>A</sup>
Yanara	53.81 <sup>ab</sup>	57.13 <sup>ab</sup>	55.47 <sup>A</sup>	56.49 <sup>a</sup>	57.88 <sup>a</sup>	57.18 <sup>A</sup>	53.26 <sup>a</sup>	54.26 <sup>a</sup>	53.94 <sup>A</sup>	52.53 <sup>ab</sup>	53.38 <sup>ab</sup>	52.96 <sup>A</sup>
Mean	48.48	49.18	48.83	50.62	50.87	50.75	51.19	52.78	51.98	53.08	49.96	51.52

Varieties	July			August			September		
	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	52.34 <sup>a</sup>	50.63 <sup>a</sup>	51.48 <sup>A</sup>	55.03 <sup>a</sup>	54.28 <sup>a</sup>	54.65 <sup>A</sup>	59.08 <sup>ab</sup>	59.63 <sup>ab</sup>	59.35 <sup>A</sup>
Juvena	54.47 <sup>a</sup>	56.87 <sup>a</sup>	55.67 <sup>A</sup>	58.66 <sup>a</sup>	59.50 <sup>a</sup>	59.07 <sup>A</sup>	59.75 <sup>ab</sup>	59.38 <sup>ab</sup>	59.56 <sup>A</sup>
Lindessa	53.20 <sup>a</sup>	55.13 <sup>a</sup>	54.16 <sup>A</sup>	53.58 <sup>a</sup>	55.63 <sup>a</sup>	54.60 <sup>A</sup>	54.94 <sup>b</sup>	56.63 <sup>ab</sup>	55.78 <sup>A</sup>
Tamara	48.63 <sup>a</sup>	55.30 <sup>a</sup>	51.88 <sup>A</sup>	58.75 <sup>a</sup>	53.00 <sup>a</sup>	55.75 <sup>A</sup>	59.59 <sup>ab</sup>	65.13 <sup>a</sup>	62.36 <sup>A</sup>
Yanara	52.27 <sup>a</sup>	54.38 <sup>a</sup>	53.32 <sup>A</sup>	55.88 <sup>a</sup>	64.13 <sup>a</sup>	60.00 <sup>A</sup>	56.67 <sup>ab</sup>	56.50 <sup>ab</sup>	56.58 <sup>A</sup>
Mean	46.46	54.46	50.46	56.38	57.31	56.85	58.006	59.45	58.73

Treatment means having similar alphabets in superscript, do not differ significantly

G - Ground planting

P - Pot planting

Table 11b. Stalk length of gerbera varieties under different methods of planting

Varieties	Method of planting		Mean
	Ground	Pot	
Essandre	54.82 <sup>bc</sup>	52.36 <sup>c</sup>	53.59 <sup>B</sup>
Juvena	53.70 <sup>c</sup>	53.61 <sup>c</sup>	53.66 <sup>B</sup>
Lindessa	49.86 <sup>d</sup>	52.16 <sup>cd</sup>	51.01 <sup>C</sup>
Tamara	57.46 <sup>a</sup>	54.84 <sup>bc</sup>	56.15 <sup>A</sup>
Yanara	54.39 <sup>c</sup>	57.16 <sup>ab</sup>	56.77 <sup>A</sup>
Mean	54.05 <sup>a</sup>	54.03 <sup>a</sup>	54.04

Treatment means having similar alphabets in superscript, do not differ significantly

Table 12a. Stalk girth (cm) of gerbera varieties over the months March 2002-September 2002

Varieties	March			April			May			June		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	1.99 <sup>a</sup>	1.84 <sup>a</sup>	1.91 <sup>AB</sup>	1.75 <sup>a</sup>	1.78 <sup>a</sup>	1.76 <sup>A</sup>	2.07 <sup>a</sup>	1.86 <sup>a</sup>	1.96 <sup>AB</sup>	1.94 <sup>a</sup>	1.83 <sup>a</sup>	1.88 <sup>A</sup>
Juvena	1.88 <sup>a</sup>	2.24 <sup>a</sup>	2.06 <sup>AB</sup>	1.94 <sup>a</sup>	2.23 <sup>a</sup>	2.08 <sup>A</sup>	1.97 <sup>a</sup>	2.05 <sup>a</sup>	2.01 <sup>AB</sup>	1.96 <sup>a</sup>	2.03 <sup>a</sup>	1.99 <sup>A</sup>
Lindessa	2.38 <sup>a</sup>	2.49 <sup>a</sup>	2.44 <sup>AB</sup>	2.38 <sup>a</sup>	2.38 <sup>a</sup>	2.38 <sup>A</sup>	2.27 <sup>a</sup>	2.34 <sup>a</sup>	2.30 <sup>A</sup>	2.29 <sup>a</sup>	2.33 <sup>a</sup>	2.31 <sup>A</sup>
Tamara	1.90 <sup>a</sup>	1.93 <sup>a</sup>	1.92 <sup>AB</sup>	2.03 <sup>a</sup>	1.98 <sup>a</sup>	2.00 <sup>A</sup>	2.33 <sup>a</sup>	2.13 <sup>a</sup>	2.23 <sup>B</sup>	2.20 <sup>a</sup>	1.70 <sup>a</sup>	1.95 <sup>A</sup>
Yanara	2.11 <sup>a</sup>	2.08 <sup>a</sup>	2.09 <sup>AB</sup>	2.17 <sup>a</sup>	1.90 <sup>a</sup>	2.03 <sup>A</sup>	2.06 <sup>a</sup>	2.03 <sup>a</sup>	2.04 <sup>AB</sup>	2.06 <sup>a</sup>	1.95 <sup>a</sup>	2.01 <sup>A</sup>
Mean	2.05	2.11	2.08	2.053	2.05	2.052	2.13	2.08	2.11	2.08	1.97	2.03

Varieties	July			August			September		
	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	2.09 <sup>a</sup>	2.03 <sup>ab</sup>	2.06 <sup>A</sup>	2.08 <sup>a</sup>	1.95 <sup>a</sup>	2.02 <sup>A</sup>	2.20 <sup>abc</sup>	1.90 <sup>c</sup>	2.09 <sup>BC</sup>
Juvena	1.99 <sup>ab</sup>	1.93 <sup>ab</sup>	1.96 <sup>A</sup>	1.95 <sup>a</sup>	1.88 <sup>a</sup>	1.91 <sup>A</sup>	2.13 <sup>abc</sup>	1.98 <sup>c</sup>	2.05 <sup>C</sup>
Lindessa	2.22 <sup>a</sup>	2.18 <sup>a</sup>	2.19 <sup>A</sup>	2.26 <sup>a</sup>	2.10 <sup>a</sup>	2.18 <sup>A</sup>	2.38 <sup>a</sup>	2.04 <sup>bc</sup>	2.20 <sup>ABC</sup>
Tamara	2.35 <sup>a</sup>	1.95 <sup>ab</sup>	2.15 <sup>A</sup>	1.90 <sup>a</sup>	1.98 <sup>a</sup>	1.94 <sup>A</sup>	2.30 <sup>ab</sup>	2.23 <sup>abc</sup>	2.61 <sup>AB</sup>
Yanara	1.92 <sup>ab</sup>	1.83 <sup>ab</sup>	1.87 <sup>A</sup>	2.19 <sup>a</sup>	2.18 <sup>a</sup>	2.19 <sup>A</sup>	2.30 <sup>ab</sup>	2.35 <sup>a</sup>	2.33 <sup>A</sup>
Mean	2.10	1.98	2.04	2.08	2.02	2.05	2.26	2.12	2.19

Treatment means having similar alphabets in superscript, do not differ significantly

G - Ground planting

P - Pot planting

Table 12b. Stalk girth of gerbera varieties under different methods of planting

Varieties	Method of planting		Mean
	Ground	Pot	
Essandre	2.05 <sup>a</sup>	1.93 <sup>a</sup>	1.99 <sup>C</sup>
Juvena	1.97 <sup>a</sup>	2.05 <sup>a</sup>	2.01 <sup>BC</sup>
Lindessa	2.31 <sup>a</sup>	2.27 <sup>a</sup>	2.29 <sup>A</sup>
Tamara	2.31 <sup>a</sup>	2.25 <sup>a</sup>	2.28 <sup>A</sup>
Yanara	2.09 <sup>a</sup>	2.03 <sup>a</sup>	2.06 <sup>B</sup>
Mean	2.15 <sup>a</sup>	2.11 <sup>a</sup>	2.13

Treatment means having similar alphabets in superscript, do not differ significantly

#### 4.2.7 Nature of flower stalk

Varieties exhibited variation in the case of nature of flower stalk. In the case of variety Lindessa erect flower stalk was observed, whereas slight bending of flower stalk was shown by varieties Essandre and Juvena. Bending nature of flower stalk was expressed in varieties Yanara and Tamara.

#### 4.2.8 Flower life in the field

Eventhough the monthly variation in field life was not significant, for all the varieties, an increase in field life was observed from the month of June onwards (Table 13a). Variety Tamara was showing maximum field life followed by variety Yanara. The maximum field life shown by Tamara was 16.75 days in the months of May and July.

In the case of average performance, variety Tamara was found to have a maximum field life of 14.3 days followed by varieties Yanara, Juvena and Lindessa, which were performing on par. Variety Essandre had the minimum field life of 13.72 days (Table 13b).

Table 13b also indicates that method of planting was not influencing field life of gerbera varieties throughout the growth period.

#### 4.2.9 Flower life in vase

Vase life of gerbera varieties is given in Table 14. No significant difference was observed in the case of vase life of gerbera varieties in water. All the varieties exhibited almost same longevity in tap water.

#### 4.2.10 Incidence of pest and disease

During the initial growth period, plants were comparatively free from the attack of pest and diseases. Attack of flower thrips was a major problem during the

Table 13a. Field life of gerbera varieties over the months March 2002-September 2002

Varieties	March			April			May			June		
	G	P	Mean	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	13.43 <sup>bc</sup>	13.25 <sup>c</sup>	13.34 <sup>AB</sup>	12.40 <sup>abc</sup>	12.50 <sup>abc</sup>	12.45 <sup>A</sup>	11.68 <sup>ab</sup>	11.50 <sup>b</sup>	11.59 <sup>A</sup>	14.10 <sup>ab</sup>	13.63 <sup>ab</sup>	13.86 <sup>A</sup>
Juvena	14.66 <sup>a</sup>	14.50 <sup>a</sup>	14.58 <sup>A</sup>	12.36 <sup>abc</sup>	14.50 <sup>ab</sup>	13.43 <sup>A</sup>	12.67 <sup>ab</sup>	13.75 <sup>a</sup>	13.21 <sup>A</sup>	13.35 <sup>ab</sup>	14.13 <sup>a</sup>	13.74 <sup>A</sup>
Lindessa	13.77 <sup>b</sup>	14.63 <sup>a</sup>	14.19 <sup>A</sup>	13.18 <sup>abc</sup>	15.00 <sup>a</sup>	14.09 <sup>A</sup>	13.49 <sup>ab</sup>	14.13 <sup>a</sup>	13.81 <sup>A</sup>	13.62 <sup>ab</sup>	15.75 <sup>a</sup>	14.68 <sup>A</sup>
Tamara	10.00 <sup>e</sup>	11.13 <sup>d</sup>	10.56 <sup>D</sup>	8.75 <sup>c</sup>	9.63 <sup>bc</sup>	9.18 <sup>A</sup>	16.25 <sup>c</sup>	17.25 <sup>a</sup>	16.75 <sup>A</sup>	15.00 <sup>ab</sup>	15.88 <sup>a</sup>	15.44 <sup>A</sup>
Yanara	14.75 <sup>a</sup>	14.43 <sup>a</sup>	14.59 <sup>A</sup>	14.07 <sup>ab</sup>	13.25 <sup>abc</sup>	13.66 <sup>A</sup>	14.94 <sup>ab</sup>	13.63 <sup>a</sup>	14.28 <sup>A</sup>	14.08 <sup>ab</sup>	11.63 <sup>a</sup>	12.85 <sup>A</sup>
Mean	13.32	13.59	13.46	12.15	12.98	12.57	13.80	14.05	13.92	14.03	14.20	14.12

Varieties	July			August			September		
	G	P	Mean	G	P	Mean	G	P	Mean
Essandre	14.40 <sup>a</sup>	14.69 <sup>a</sup>	14.54 <sup>A</sup>	14.75 <sup>a</sup>	15.16 <sup>a</sup>	14.96 <sup>A</sup>	15.25 <sup>a</sup>	14.68 <sup>ab</sup>	14.96 <sup>A</sup>
Juvena	14.40 <sup>a</sup>	15.13 <sup>a</sup>	14.76 <sup>A</sup>	14.00 <sup>a</sup>	13.63 <sup>a</sup>	13.81 <sup>A</sup>	14.10 <sup>bc</sup>	15.30 <sup>a</sup>	14.70 <sup>A</sup>
Lindessa	14.70 <sup>a</sup>	13.38 <sup>a</sup>	14.04 <sup>A</sup>	14.24 <sup>a</sup>	13.75 <sup>a</sup>	13.99 <sup>A</sup>	14.03 <sup>bc</sup>	13.63 <sup>bc</sup>	13.83 <sup>B</sup>
Tamara	16.75 <sup>a</sup>	16.75 <sup>a</sup>	16.75 <sup>A</sup>	14.12 <sup>a</sup>	13.00 <sup>a</sup>	13.56 <sup>A</sup>	14.00 <sup>bc</sup>	14.50 <sup>ab</sup>	14.25 <sup>AB</sup>
Yanara	16.29 <sup>a</sup>	14.68 <sup>a</sup>	15.48 <sup>A</sup>	15.50 <sup>a</sup>	15.37 <sup>a</sup>	15.44 <sup>A</sup>	13.73 <sup>bc</sup>	13.38 <sup>c</sup>	13.55 <sup>B</sup>
Mean	15.30	14.30	14.80	14.52	14.18	14.35	14.22	14.29	14.26

Treatment means having similar alphabets in superscript, do not differ significantly

G - Ground planting

P - Pot planting



Table 13b. Field life of gerbera varieties under different methods of planting

Varieties	Method of planting		Mean
	Ground	Pot	
Essandre	13.70 <sup>bcd</sup>	13.73 <sup>bcd</sup>	13.72 <sup>B</sup>
Juvena	13.64 <sup>cd</sup>	14.41 <sup>ab</sup>	14.03 <sup>AB</sup>
Lindessa	13.50 <sup>d</sup>	14.29 <sup>abc</sup>	13.89 <sup>AB</sup>
Tamara	14.49 <sup>a</sup>	14.11 <sup>abcd</sup>	14.30 <sup>A</sup>
Yanara	13.97 <sup>abcd</sup>	14.14 <sup>abcd</sup>	14.05 <sup>AB</sup>
Mean	13.86 <sup>a</sup>	14.14 <sup>a</sup>	14.00

Treatment means having similar alphabets in superscript, do not differ significantly



flowering season. Thrips attack was severe during the months of March-April when temperature was high. Varieties Juvena and Tamara were more prone to the attack of flower thrips.

Eventhough there was no severe incidence of pathogens, incidence of leaf blight was there during the months of May-June.

#### 4.3 CORRELATION STUDIES

Table 15 shows the correlation between weather parameters and vegetative characters and also among different vegetative characters. A significantly negative correlation was observed between relative humidity and number of leaves. No specific pattern of correlation could be observed among other weather parameters with other vegetative characters. Plant height had significant positive correlation with number of leaves, petiole length and leaf area. Number of leaves was found to be significantly and positively correlated with leaf area.

Correlation between weather parameters and floral characters and also among different floral characters are given in Table 16. There was no significant correlation between any weather parameters and floral characters. The period from flower bud initiation to flower opening was significantly and positively correlated with flower diameter, stalk length, stalk girth and field life of flowers. Number of flowers was significantly and negatively correlated with flower diameter. There was a significant positive correlation observed between flower diameter and stalk length. Flower stalk length had significant positive correlation with field life. A significant positive correlation was also observed between stalk girth and field life.

Table 17 shows correlation among vegetative and floral characters. Plant height was significantly and positively correlated with number of flowers and stalk length and was negatively correlated with flower diameter. Number of leaves was positively and significantly related to number of flowers and leaf area. Leaf area was also significantly and positively correlated with number of flowers.

Table 15. Correlation between various weather parameters and vegetative characters

	Plant height	No. of leaves	Petiole length	Lobes	Spread	Leaf area
Height	1.000					
No. of leaves	0.350*	1.000				
Petiole length	0.600**	0.280	1.000			
Lobes	0.133	0.028	-0.123	1.000		
Spread	0.245	0.161	0.188	0.082	1.000	
Leaf area	0.315*	0.650**	0.217	0.139	0.159	1.000
Temperature	-0.069	0.197	-0.304	-0.167	-0.035	-0.022
Relative humidity	0.014	-0.370**	0.228	0.067	0.056	-0.183
Light intensity	0.067	-0.099	-0.107	-0.120	0.004	-0.174

\* Significant at 1% level

\*\* Significant at 5% level

Table 16. Correlation between various weather parameters and floral characters

	Initiation to opening	Diameter	Stalk length	Stalk girth	Field life	Number of flowers
Initiation to opening	1.000					
Diameter	0.324*	1.000				
Stalk length	0.320*	0.8763**	1.000			
Stalk girth	0.832**	0.255	-0.0256	1.000		
Field life	0.826**	0.225	0.395*	0.793**	1.000	
Number of flowers	0.180	-0.466**	-0.81304	0.272	0.208	1.000
Temperature	0.037	0.038	-0.120	0.012	-0.121	-0.061
Relative humidity	-0.013	-0.061	-0.035	-0.035	0.164	-0.056
Light intensity	-0.001	-0.050	-0.004	-0.004	-0.055	-0.006

\* Significant at 1% level

\*\* Significant at 5% level

Table 17. Correlation between vegetative and floral characters

	Plant height	No. of leaves	Petiole length	Lobes	Spread	Leaf area	Initiation to opening	Diameter	Stalk length	Stalk girth	Field life	No. of flowers
Height	1.000											
No. of leaves	0.350*	1.000										
Petiole length	0.600**	0.280	1.000									
Lobes	0.133	0.028	-0.123	1.000								
Spread	0.245	0.161	0.188	0.082	1.000							
Leaf area	0.315*	0.650**	0.217	0.139	0.159	1.000						
Initiation to opening	0.133	0.104	0.070	0.011	0.037	0.071	1.000					
Diameter	-0.324**	-0.267	0.018	-0.037	-0.030	-0.149	0.324**	1.000				
Stalk length	0.474**	0.309	0.124	0.022	0.070	0.225	0.320**	0.8763**	1.000			
Stalk girth	0.136	0.109	-0.072	0.233	0.044	0.133	0.832**	0.255	-0.0256	1.000		
Field life	0.116	-0.066	-0.008	0.018	0.043	-0.015	0.826**	0.225	0.395*	0.793**	1.000	
No. of flowers	0.441**	0.400**	0.054	0.141	0.219	0.331**	0.180	-0.466**	0.08130	0.272	0.208	1.000

\* Significant at 1% level

\*\* Significant at 5% level

# *Discussion*

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## 5. DISCUSSION

Gerbera is an elegant cut flower of great export potential. Numerous commercially important gerbera varieties are grown throughout the world. It is one of the cut flowers having good vase life and it suits to different floral arrangements. Intense rainfall and high relative humidity during monsoon and slightly high temperature during summer hinder commercial production of gerbera under open condition in Kerala. So low cost greenhouses with ample natural ventilation are advisable in climatic situations of Kerala.

A study was conducted at the Département of Pomology and Floriculture, College of Horticulture, Vellanikkara, during 2000-2002 to evaluate the performance of five gerbera varieties viz., Essandre, Juvena, Lindessa, Tamara and Yanara under two methods of planting: ground planting and pot culture under low cost green house. The results are discussed here under.

### 5.1 VEGETATIVE CHARACTERS

From this experiment, it was found that varieties differed significantly with respect to vegetative characters. Among the varieties tried, variety Essandre exhibited maximum plant height, number of leaves, petiole length and leaf area. Correlation studies have revealed significant positive correlation between plant height and number of leaves, petiole length and leaf area. Plant spread was maximum in variety Yanara, whereas variety Lindessa had maximum number of lobes on leaves. Suma (1993) has reported significant difference among varieties with regard to vegetative characters like plant height, plant spread, number of leaves petiole length and number of lobes on leaves. The varietal difference can be attributed to the genetic make up of the varieties (Hemalatha *et al.*, 1992). From the studies it was observed that there was an increase in dimensions of vegetative parameters (Fig.1 to 5) like plant height, plant spread, number of leaves, petiole length and leaf area during the first four to six month after planting. After this period, there was a decline in vegetative growth which was



observed during the months of June, July and August, with a steep reduction in the month of July. The decrease in vegetative parameters during these months may be due to increase in relative humidity due to high rainfall. This is in accordance with the findings of Mortensen (1986) who reported a negative response in the dry weight of some plant species under increased relative humidity. In correlation studies also a significant negative correlation was observed between relative humidity and number of leaves. The decline in vegetative growth during rainy season might also be attributed to the death of older leaves which contribute to the height and spread of plants.

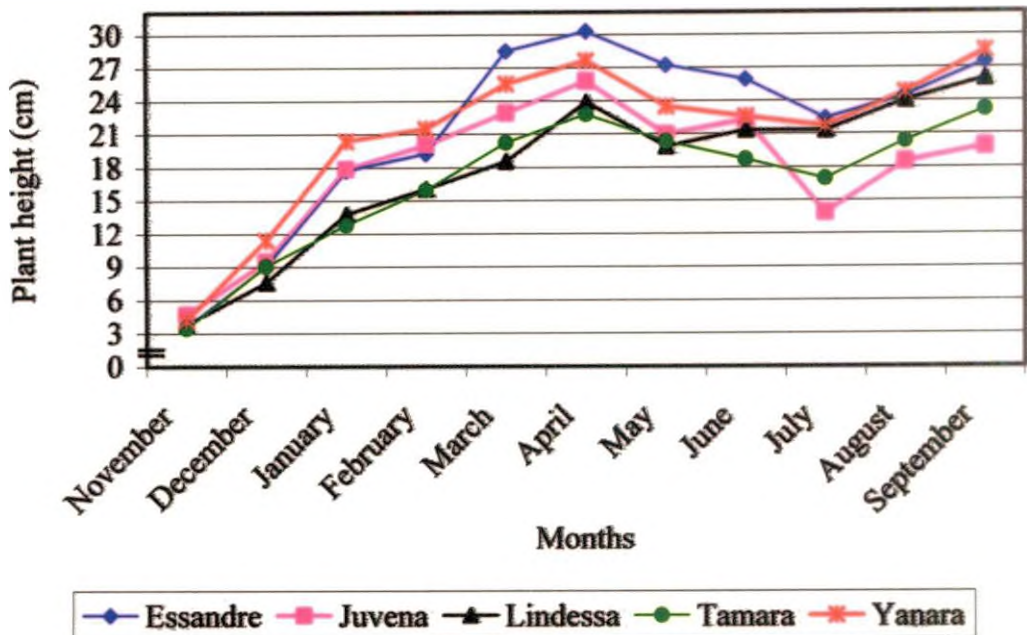
With regard to number of lobes on leaves, it was found that all the parameters showed almost uniform values for respective varieties through out the growth period (Fig.6). This might be due to the fact that this particular morphological trait was not influenced by external environment. Suma (1993) also observed that the number of lobes on leaves in gerbera was not influenced by any treatments.

## 5.2 FLORAL CHARACTERS

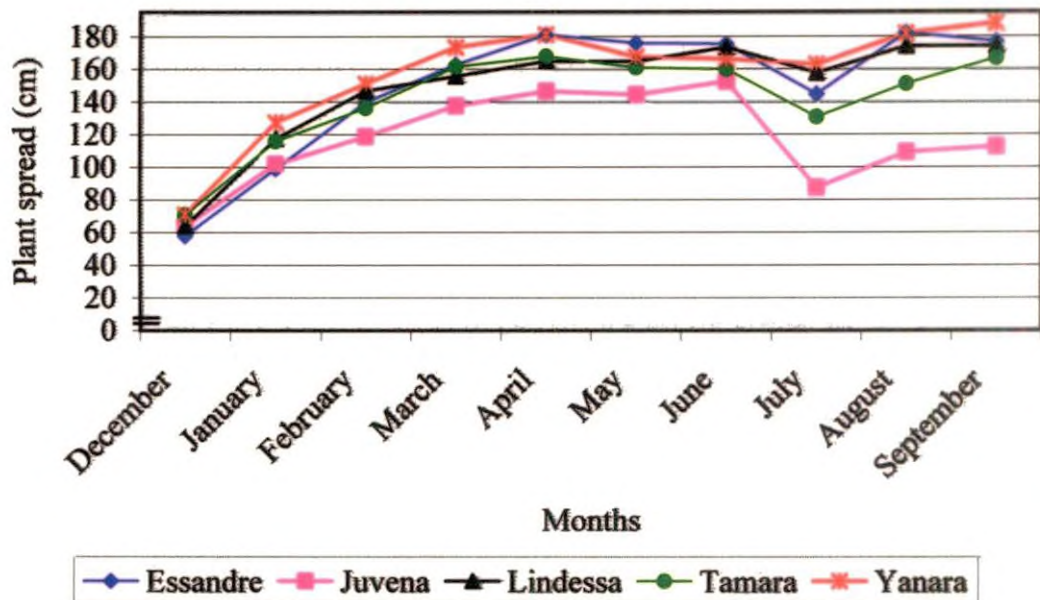
In a crop like gerbera where the cut flowers form the main consumable product, floral characters assume high importance. Significant difference was observed among the varieties with regard to various floral characters like days taken for first flower bud emergence, days taken from flower bud emergence to flower opening, number of flowers, flower diameter, stalk length, stalk girth and field life.

Number of days taken for the first flower bud emergence varied significantly among the varieties (Fig.7). Juvena was found to be the earliest flowering variety, which took 48.88 days to flowering. This was followed by varieties Yanara and Essandre, which took 55.53 and 56.66 days, respectively.

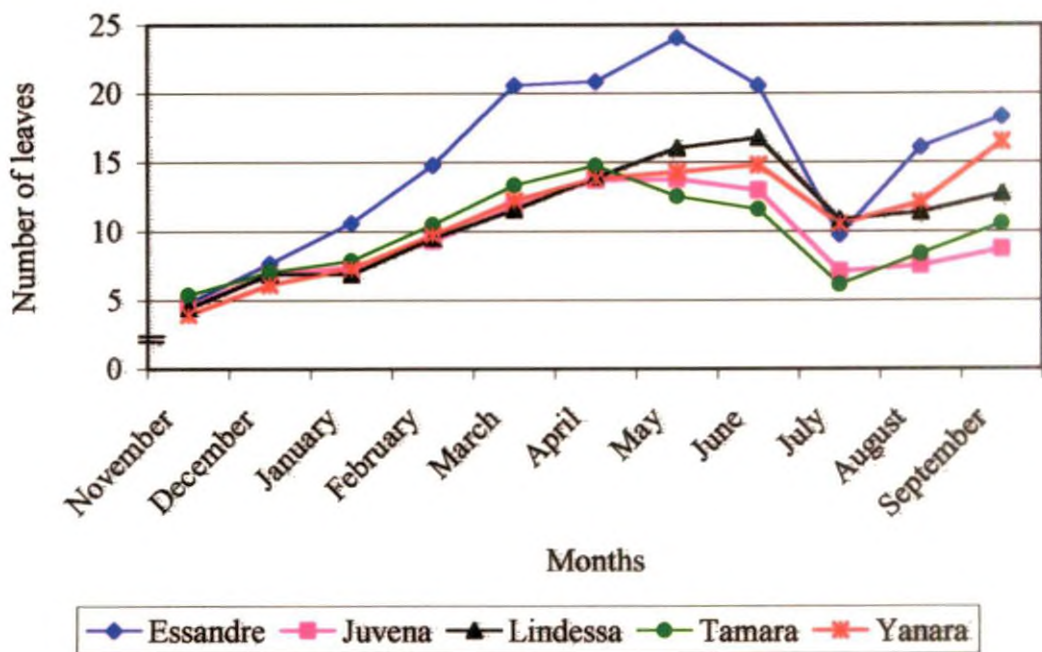
In the case of days taken from flower bud emergence to flower opening, maximum number of days was observed in variety Tamara (16.4 days) and minimum in variety Juvena (14.28 days).



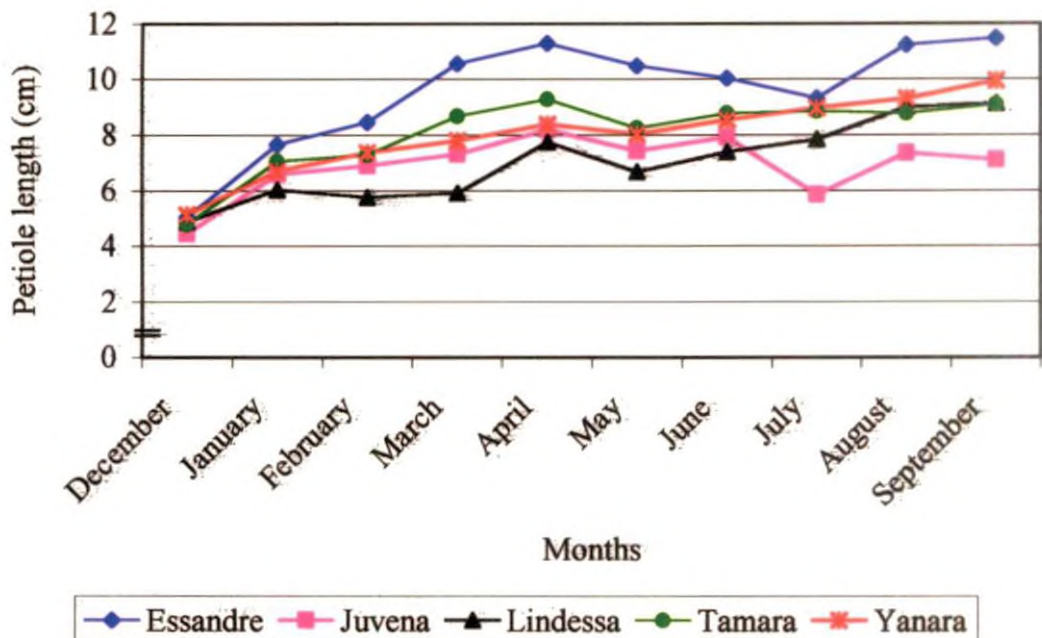
**Fig. 1. Plant height (cm) of gerbera varieties over the months November 2001 - September 2002**



**Fig. 2. Plant spread (cm) of gerbera varieties over the months December 2001 - September 2002**

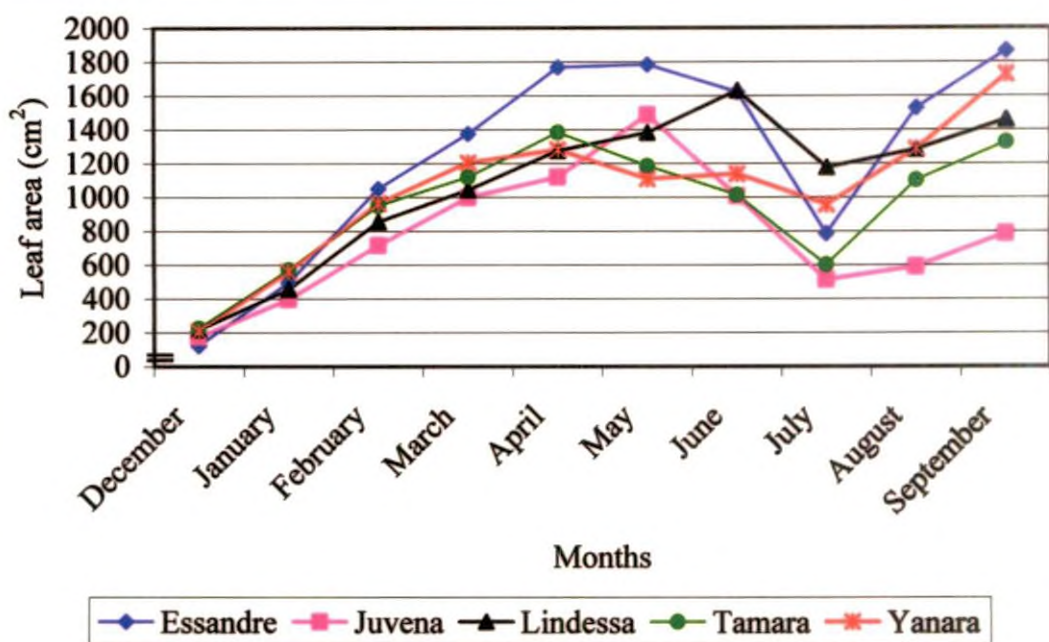


**Fig. 3. Number of leaves of gerbera varieties over the months November 2001 - September 2002**

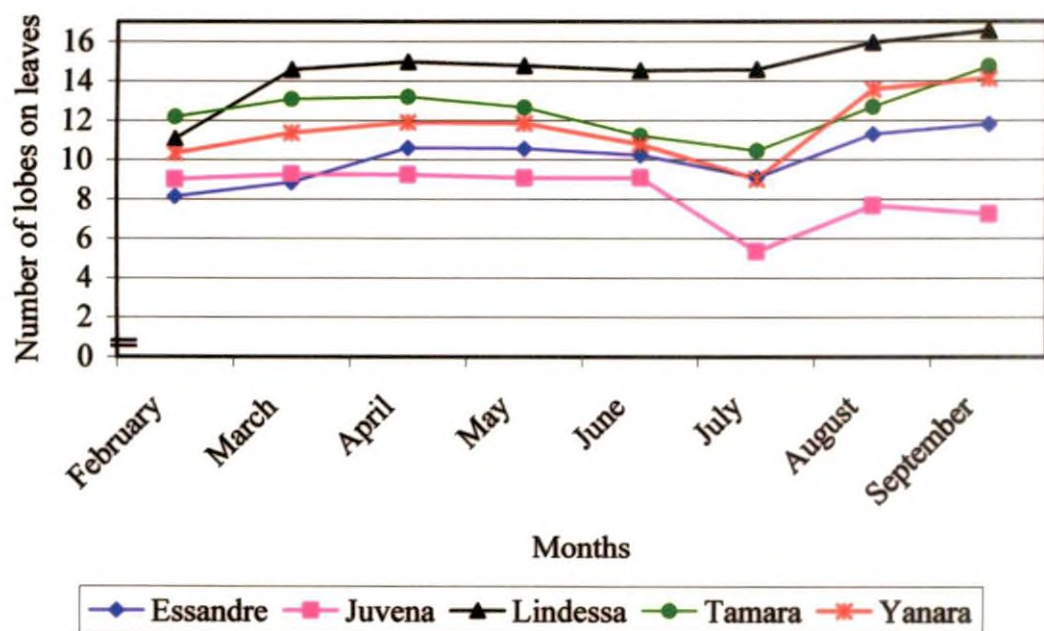


**Fig. 4. Petiole length (cm) of gerbera varieties over the months December 2001 - September 2002**

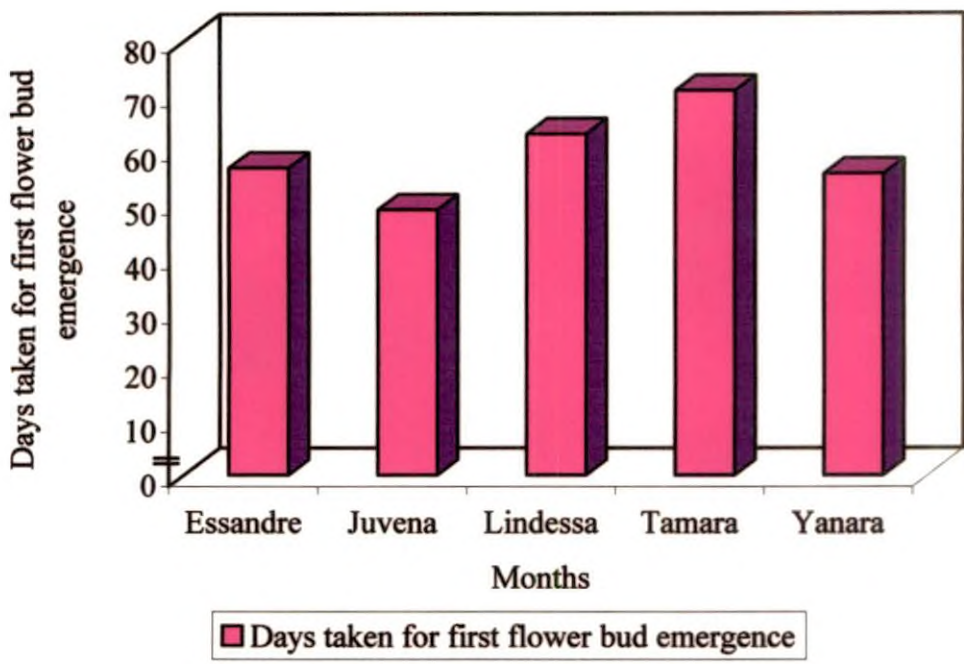




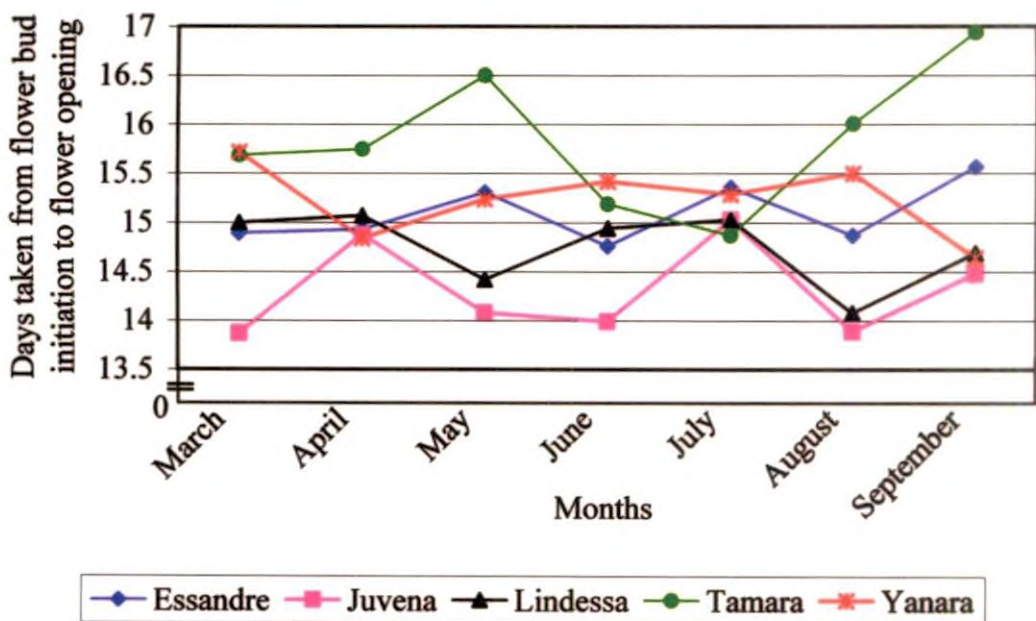
**Fig. 5. Leaf area (cm<sup>2</sup>) of gerbera varieties over the months December 2001 - September 2002**



**Fig. 6. Number of lobes on leaves of gerbera varieties over the months February 2002 - September 2002**



**Fig. 7. Days taken for first flower bud emergence**



**Fig. 8. Days taken from flower bud initiation to flower opening**



The total number of flowers per plant was maximum in variety Essandre (17.69) which also recorded minimum diameter. Minimum number of flowers per plant was observed in variety Tamara. Maximum flower diameter was observed in variety Yanara (9.59 cm) followed by varieties Tamara (8.89 cm) and Lindessa (8.56 cm). In gerbera number of flowers was significantly and negatively correlated with flower diameter (Suma, 1993). In the present study also a significant negative correlation was observed between number of flowers and flower diameter.

Stalk length is a factor that determines the attractiveness of the flower. Maximum stalk length was observed in varieties Yanara and Tamara (56.77 cm and 56.15 cm, respectively) and minimum stalk length was recorded in the variety Lindessa. Stalk length had a positive correlation with flower diameter. This was revealed with the result that varieties Tamara and Yanara which were having maximum stalk length had larger flowers, when compared to other varieties.

Stalk girth was maximum in varieties Lindessa (2.29 cm) and Tamara (2.28 cm) and minimum value of stalk girth was noticed in variety Essandre (1.99 cm). There was a positive correlation between stalk girth and field life. Variety Tamara with high stalk girth recorded maximum field life of 14.3 days.

Several scientists have conducted evaluation work on gerbera varieties and reported widely varied performance with regard to floral characters (Steen, 1975; Brundert and Schmidt, 1983; Gotz, 1983; Loeser, 1989; Suma, 1993; Spanomitsios *et al.*, 1995; Khan *et al.*, 1997; Jawaharlal *et al.*, 1998; Vanlabeke *et al.*, 1999; Kumar and Kumar, 2000). Ponnuswamy *et al.* (1985) reported that variation among the cultivars might be due to their genetic make up.

As far as flower production among different varieties is concerned, an increase in flower production from planting to a period of five to six months was observed for almost all varieties (Fig.8). There after there was a slight reduction in number of flowers produced with lowest value in July, for all the varieties. An

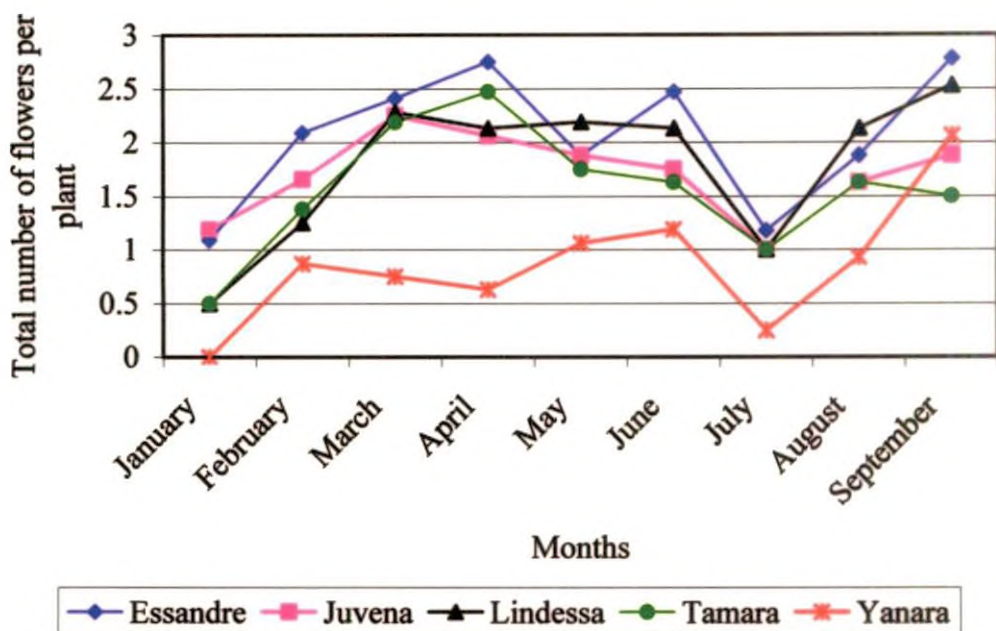


increasing trend in flower production was noticed after the decline in July. Earliest flowering was observed in the month of January, i.e., after two months of planting. This shows a minimum period for gerbera to induce flower buds. There is a juvenile phase reported in gerbera during which the plant is unable to synthesize sufficient floral stimulus or the apical meristem is incompetent to respond to it (Cockshull, 1985).

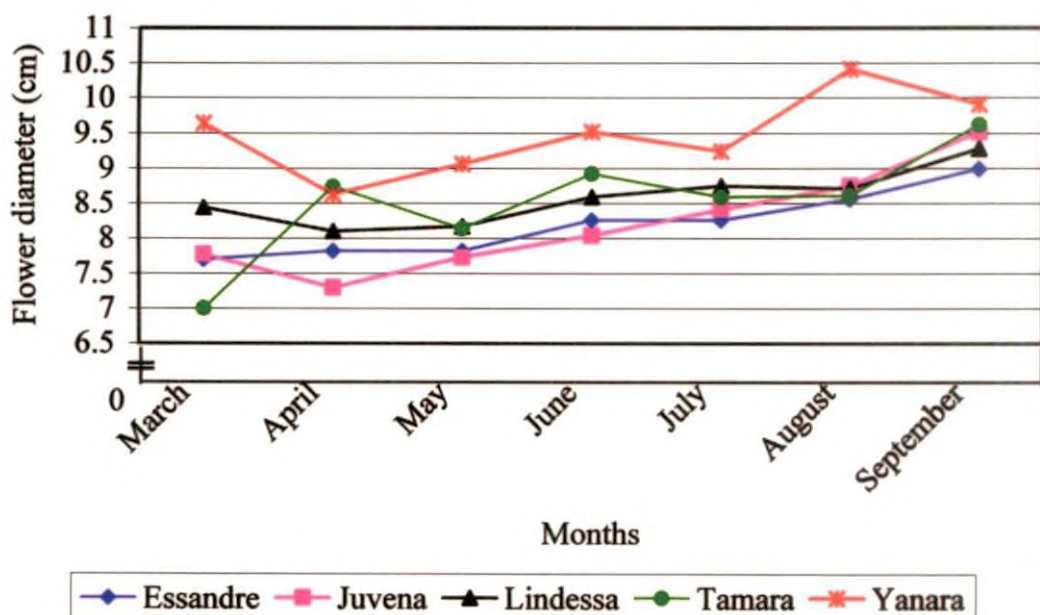
From Fig.9 it is revealed that there was a steep reduction in number of flowers in July. A peak reduction in number of leaves was also observed in the month. Correlation studies among vegetative and floral characters showed a highly significant positive correlation between number of leaves and number of flowers. So the lowest peak with regard to the number of flowers in July might be due to reduced number of leaves in this month. Leffring (1973) reported a positive correlation between number of flowers produced and number of lateral shoots. In gerbera, growth pattern is such that as the number of lateral shoots increases, the number of leaves also increases (Cockshull, 1985). Significant positive correlation between number of leaves and number of flowers was also reported by Suma (1993); Anuradha and Gowda (2000) and Kumar and Kumar (2001).

It was observed from the study that monthly variation in flower size was very much less during the flowering season (Fig.10). Das and Singh (1999) also observed very less variations in flower size in gerbera during different months from November to February. But there was variation in the performance of different varieties.

An increasing trend in stalk length with age of the varieties was observed during the growth period (Fig.11). Significant varietal difference was observed in the case of stalk girth also (Fig.12). Varieties exhibited no specific pattern in the variation of stalk girth in different months. Perhaps floral traits like stalk length and stalk girth are highly controlled by the genetic make up of the varieties.

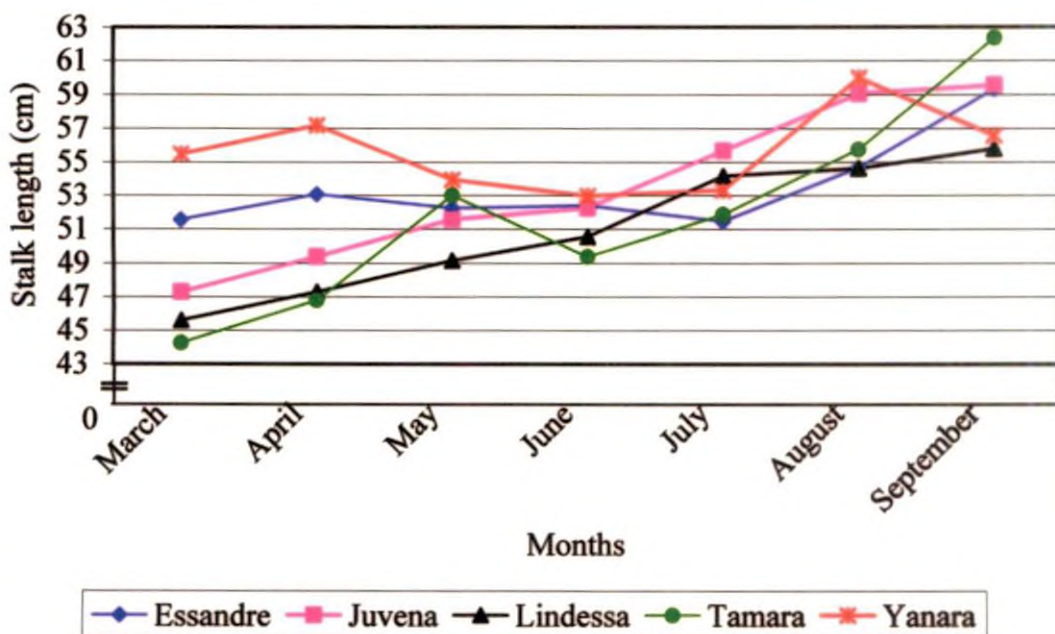


**Fig. 9. Total number of flowers per plant of gerbera varieties over the months January 2002 - September 2002**

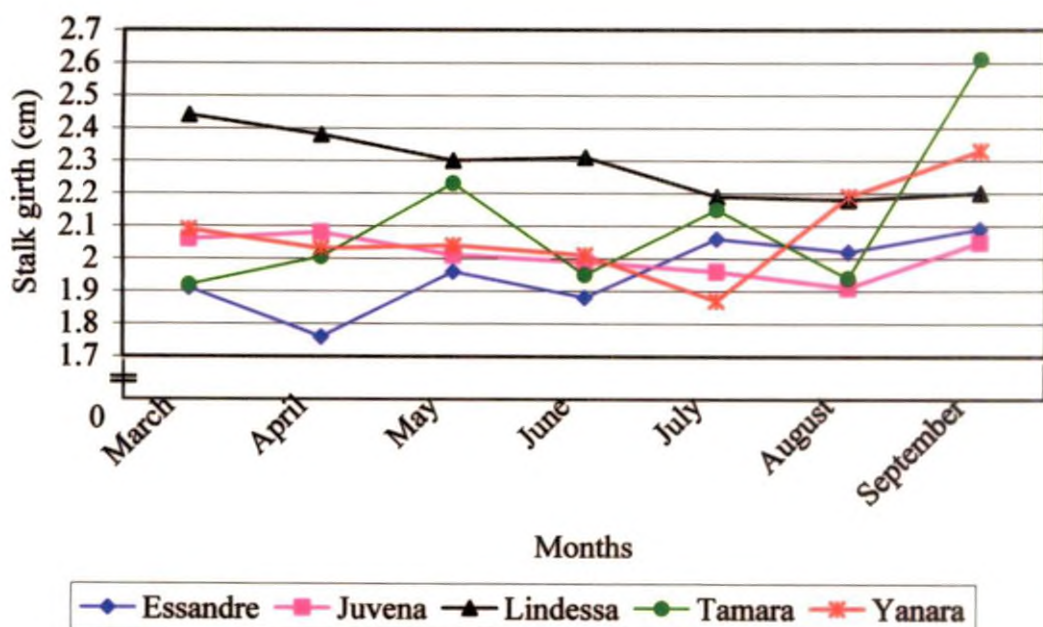


**Fig. 10. Flower diameter (cm) of gerbera varieties over the months March 2002 - September 2002**





**Fig. 11. Stalk length (cm) of gerbera varieties over the months March 2002 - September 2002**



**Fig. 12. Stalk girth (cm) of gerbera varieties over the months March 2002 - September 2002**

There was a significant variation in the field life of flowers of gerbera varieties (Fig.13). All the varieties showed a decreasing trend in field life of flowers during March and April. In correlation study, a negative correlation trend was observed between temperature and field life of flowers. Suma (1993) also reported a negative correlation of temperature with field life of flowers.

No significant difference was observed in vase life of gerbera varieties, when flowers were kept in tap water.

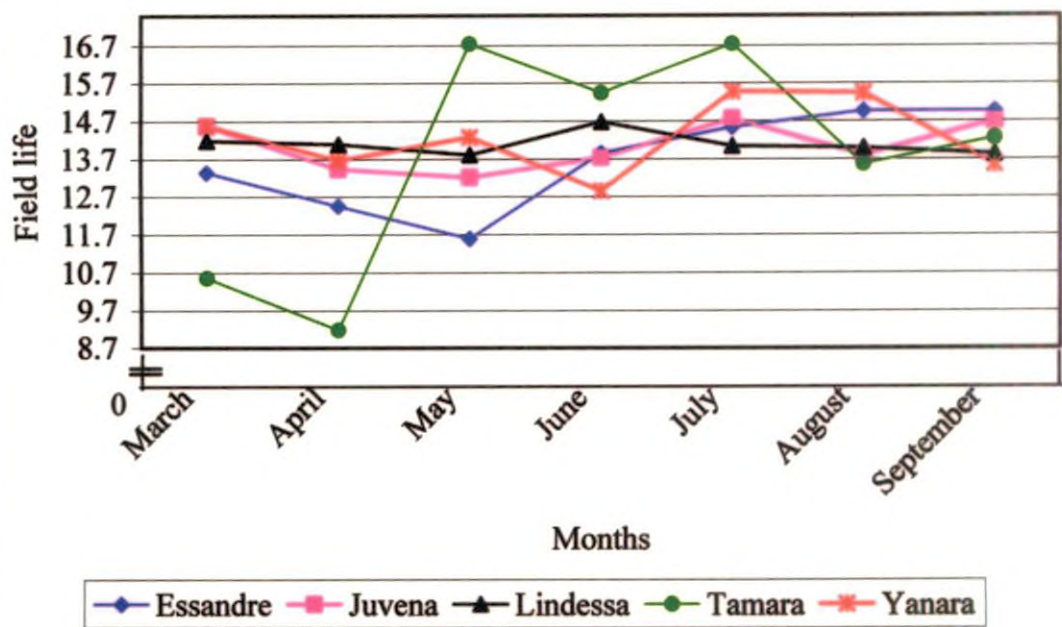
### 5.3 EFFECT OF VEGETATIVE GROWTH ON FLOWERING IN GERBERA

Plant height was significantly and positively correlated with number of flowers and stalk length and was negatively correlated with flower diameter. Number of leaves and leaf area were also positively and significantly related to number of flowers. The flowering and yield of any crop is a reflection of its growth during the pre flowering stage. Though the plant height is not having a direct correlation with the yield, its importance is that, the number of leaves produced by the plant is related to the stem length. In single stemmed plants internodal length also determines the stem length, but in the case of gerbera, since the stem is beneath the soil this does not make a detectable difference. In fact, the height of the plant is a net result of the number of leaves produced and the length of the leaves in the crop. So the factors which influence the number of leaves produced and length of leaves also influence the plant height.

### 5.4 EFFECT OF METHOD OF PLANTING ON VEGETATIVE GROWTH AND FLOWER YIELD IN GERBERA

When method of planting was concerned, it could be observed that all the varieties exhibited better plant height, number of leaves, leaf area and more number of flowers in ground planting, than in pot planting. Enhanced growth in ground may be due to increased nutrient uptake facilitated by better root spread in ground. Since





**Fig. 13. Field life of gerbera varieties over the months March 2002 - September 2002**

gerbera is a deep rooted plant, ground planting facilitates the roots to exploit nutrients from soil more deeply than when planted in pots. Better root growth and nutrient uptake may enhance vegetative growth which ultimately reflects in flower production.

In general it could be observed that the variety Essandre had maximum plant height, number of leaves, petiole length and leaf area. The variety was also superior in flower production with highest number of flowers per plant. But other floral characters like flower diameter and stalk length were highest for the variety Yanara which also had maximum plant spread. Variety Lindessa recorded maximum stalk girth and number of lobes on leaves. Earliest flowering was observed in Juvena which also took minimum number of days from flower bud emergence to flower opening. Maximum field life was observed in variety Tamara. When method of planting was compared, it was found that the varieties exhibited better plant height, number of leaves, leaf area and more number of flowers when planted in ground than in pots.

Performance of varieties under different agro-climatic regions of Kerala has to be assessed. Standardisation of growing conditions using different structures or cladding materials, media, fertigation etc. are also worth studying.

# Summary

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## 6. SUMMARY

An experiment was carried out at the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara, to evaluate the performance of five gerbera varieties (Essandre, Juvena, Lindessa, Tamara and Yanara) and to compare ground planting with pot culture under low cost greenhouse, during the year 2000-2002. The summary of the results are presented below:

The varieties differed significantly with respect to plant height. Varieties Essandre and Yanara were performing on par with maximum height of 21.43 cm and 21.11 cm respectively. Minimum height was recorded in variety Tamara (15.7 cm).

In the case of plant spread, variety Yanara recorded maximum plant spread (156.36 cm) with varieties Essandre and Lindessa performing on par. Plant spread was minimum in variety Juvena (129.20 cm).

Number of leaves was found to be maximum in variety Essandre (16.87) and variety Tamara registered minimum number of leaves (9.57).

There was significant variation in petiole length of the varieties. Maximum petiole length was observed in variety Essandre (9.35 cm) and minimum in variety Lindessa (7.10 cm).

Varieties exhibited significant variation in leaf area, throughout the growth period. Leaf area was maximum in variety Essandre (1276.28 cm<sup>2</sup>), where as minimum leaf area of 788.75 cm<sup>2</sup> was recorded in variety Juvena. For all the varieties, leaf area was found to be increasing up to the month of June, with a sharp decline in July.

Number of lobes on leaves was maximum in variety Lindessa (14.75) and variety Juvena was having minimum number of lobes on leaves (9.26).

For all the varieties studied, slight reduction in vegetative growth was observed in June and July. Studies on correlation between weather parameters and vegetative characters revealed that there was a significantly negative correlation between relative humidity and number of leaves resulting in death of older leaves and a subsequent decline in vegetative growth in terms of plant height, plant spread, petiole length and leaf area. No specific pattern of correlation was observed between other weather parameters and vegetative characters. In case of correlation among different vegetative characters, a significant positive correlation of plant height was observed with number of leaves, petiole length and leaf area. Number of leaves was found to be significantly and positively correlated with leaf area.

Number of days taken for the first flower bud emergence varied significantly among the varieties. Variety Juvena took minimum number of days for the first flower bud emergence (48.88 days) and maximum number of days for the emergence of first flower bud was recorded in variety Tamara (70.81 days).

Number of days from flower bud emergence to flower opening was maximum in variety Tamara (16.4 days) and minimum number of days from flower bud emergence to flower opening was observed in variety Juvena (14.28 days). It was observed that all the varieties took less number of days from flower bud emergence to flower opening, in the month of June and July, compared to other months.

There was significant variation in total number of flowers per plant of the varieties throughout the growth period. Variety Essandre was producing maximum number of flowers per plant (17.69) where as variety Tamara had a minimum value of 8.00. An increase in flower production upto the month of June was observed in all the varieties. In July a decline in flower production was noticed.

In the case of flower diameter, maximum flower diameter was observed in variety Yanara (9.59 cm) and minimum flower diameter was recorded in varieties Essandre (8.22 cm) and Juvena (8.24 cm).

With respect to the stalk length, varieties Yanara and Tamara were performing on par with maximum stalk length of 56.77 cm and 56.15 cm respectively, minimum stalk length was noticed in variety Lindessa (51.01 cm). An increasing trend in stalk length from July to September was observed in all the varieties.

Maximum stalk girth was recorded in variety Lindessa (2.29 cm) which was on par with variety Tamara (2.28 cm). Variety Essandre had a minimum stalk girth of 1.99 cm.

When field life was concerned, variety Tamara was found to have maximum longevity in field (14.3 days) and field life was minimum for the variety Essandre (13.72 days). For all the varieties, there was an increase in field life from May to July.

There was no significant correlation between any weather parameter and floral characters. Correlation among different floral characters showed that period from flower bud initiation to flower opening was significantly and positively correlated with flower diameter stalk length, stalk girth and field life of flowers. Number of flowers was significantly and negatively correlated with flower diameter. There was a significant positive correlation between flower diameter and stalk length. It was also observed that field life of flowers was highly correlated to stalk length and stalk girth. A significant positive correlation of field life was observed with stalk length and stalk girth.

Correlation between vegetative and floral characters showed that plant height was significantly and positively correlated with number of flowers and stalk length and negatively correlated with flower diameter. Number of flowers had a significant positive correlation with number of leaves and leaf area. With regard to vase life of flowers, there was no significant variation among the varieties when flowers were kept in tap water.



As far as method of planting was concerned, it could be observed that varieties recorded better plant height, number of leaves, leaf area and more number of flowers in ground planting than in pot planting.

Regarding the incidence of pests and diseases attack of flower thrips was a major problem during flowering season, especially during March-April when temperature was high. Varieties Juvena and Tamara were more prone to the attack. Even though there was no severe incidence of pathogens leaf blight was observed during May-June.

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\* Originals not seen



# Appendix

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## APPENDIX-I

Mean monthly weather data inside and outside the greenhouse for the period from December 2001 to September 2002

	Temperature (°C)		Relative humidity (%)		Light intensity (in lux)	
	Inside	Outside	Inside	Outside	Inside	Outside
December	27.9	25.1	60	59	160.92	644.55
January	28.84	27.5	63.31	62	178.9	752.26
February	29.7	28.7	70.95	50	168.97	632.85
March	31.34	30.15	70.72	63	219.16	775.4
April	32.12	29	72.21	71	189.94	789.28
May	30.71	30.15	73.91	87	147.99	621.56
June	28.54	26.45	76.95	86	117.97	400.8
July	29.64	26.2	77.96	84	147.6	576.12
August	27.44	25	77.92	86	135.57	433.27
September	28.75	27.3	77.49	77	159.3	666.4

**VARIETAL EVALUATION OF GERBERA**  
**(*Gerbera jamesonii* BOLUS)**  
**UNDER LOW COST GREEN HOUSE**

By  
**MINI SANKAR**

**ABSTRACT OF THE THESIS**

Submitted in partial fulfilment of the  
requirement for the degree of

**Master of Science in Horticulture**

Faculty of Agriculture  
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## ABSTRACT

Studies were conducted at the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara, to evaluate the performance of five gerbera varieties, viz., Essandre, Juvena, Lindessa, Tamara and Yanara and to compare ground planting with pot culture under low cost green house.

The varieties differed significantly with respect to vegetative and floral characters. Variety Essandre was found to have maximum plant height, number of leaves, petiole length and leaf area. Plant spread was maximum in variety Yanara and variety Lindessa had maximum number of lobes on leaves.

Variety Essandre produced maximum number of flowers per plant whereas variety Tamara was very poor in flower production. Flower diameter and stalk length were maximum in variety Yanara, while maximum stalk girth was recorded in variety Lindessa. Variety Juvena took minimum number of days for the emergence of first flower bud and from flower bud emergence to flower opening. Field life was maximum in variety Tamara. No significant variation was observed in the vase life of flowers of different gerbera varieties.

A significant negative correlation was observed between relative humidity and number of leaves. A significant positive correlation was observed between plant height and number of leaves, petiole length and leaf area. Correlation between number of leaves and leaf area was also positive.

No significant correlation was observed between weather parameters and floral characters. Period from flower bud initiation to flower opening was significantly and positively correlated with flower diameter, stalk length, stalk girth and field life of flowers. A significant negative correlation was observed between number of flowers and flower diameter, whereas flower diameter had a positive correlation with stalk length. Field life had a significant positive correlation with stalk length and stalk girth.

As far as method of planting was concerned, it could be observed that varieties recorded better plant height, number of leaves, leaf area and more number of flowers in ground planting than in pot planting.

Regarding the incidence of pests and diseases attack of flower thrips was a major problem during flowering season, especially during March-April when temperature was high. Varieties Juvena and Tamara were more prone to the attack. Even though there was no severe incidence of pathogens leaf blight was observed during May-June.