EFFECT OF TIME OF PLANTING AND GROWTH REGULATORS ON FLOWERING AND VASE LIFE OF *Gerbera jamesonii*

By

P. SUMA

THESIS

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DECLARATION

I hereby declare that this thesis entitled "**Effect of time of planting and growth regulators on flowering and vase life of** Gerbera jamesonii" 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, associateship, fellowship or other similar title of any other University or Society.

Vellanikkara

P. SUMA

CERTIFICATE

Certified that this thesis entitled "**Effect of time of planting and growth regulators on flowering and vase life of** Gerbera jamesonii" is a record of research work done independently by **Ms.P.SUMA** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

DR.LILA MATHEW, K.
Major Advisor
Advisory Committee
Associate Professor
Department of Pomology & Floriculture

Vellanikkara

CERTIFICATE

We, the undersigned Members of the Advisory Committee of **Ms.P.Suma**, a candidate for the degree of Master of Science in Agriculture with major in Horticulture, agree that the thesis entitled **"Effect of time of planting and growth regulators on flowering and vase life of Gerbera jamesonii"** may be submitted by **Ms.P.Suma** in partial fulfilment of the requirement for the degree.

Major Advisor:

Dr.Lila Mathew, K.
Associate Professor
Dept. of Pomology &
Floriculture

Members :

1. Dr.P.K.Rajeevan
   Professor & Head i/c
   Dept. of Pomology &
   Floriculture

Dr. N.K. Parameswaran
Asso. Prof
in lieu of 2. Dr.Sarah T. George
Assistant Professor
College of Horticulture
Vellanikkara

3. Smt.K.A.Mercy
   Assistant Professor (Ag.Stat.)
   College of Horticulture
   Vellanikkara

K.A.Mercy

External Examiner

Y N Reddy
16.4.94.

(Dr. Y. NARAYANA REDDY)
Professor and Head
Dept. of Horticulture, C.A., R.Nagar
APAU, Hyderabad-30.

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Introduction

INTRODUCTION

Gerbera jamesonii, commonly known as Transvaal Daisy, Barberton Daisy or African Daisy, produces very attractive flowers. It is an important commercial flower grown throughout the world in a wide range of climatic conditions. The cut blooms, when placed in water, last for a long time. Gerbera is also ideal for growing in beds, borders, pots and in rock gardens.

Gerbera occupies the sixth position in international trade. In India it is gaining popularity as a cut flower. In Kerala, this elegant flower is grown in home gardens and under our conditions, the plants are coming up well producing attractive blooms.

Gerbera belongs to the family compositae. The genus Gerbera which was named after a German naturalist, Trangott Gerber, consists of about forty species of half hardy and perennial flowering plants (Bailey, 1963). Out of all the recorded species, only Gerbera jamesonii is under cultivation.

The plants are stemless and tender perennial herbs. Leaves radical, petioled, lanceolate, deeply lobed, sometimes leathery, narrower at the base and wider at top and are arranged in a rosette at the base. Flower heads are solitary, many flowered, the conspicuous rays in one or two rows, those of the inner row when present, very short, sub tubular and two lipped. Based on flower heads, they may be grouped into single, semi-double and double cultivars

(Loeser, 1986a). The cultivars are available in various self coloured flowers as well as in bicolours.

Gerbera can be propagated by both sexual and asexual methods. Seed propagation, however, is not always satisfactory, since impurity of strain produces a great deal of variation (Schiva, 1975). It also requires longer time to produce flowers. Vegetative propagation, on the other hand, overcomes the problem of unpredictable characters, and plan tained by this method perform better than those from seeds. A comparison of clonal plants with seedlings showed that in the first cropping year the seedling plants gave higher winter yield, but in the second year the clonal plants flowered more profusely. Flower quality was better in the clonal plants (Peper et al., 1971) throughout the period. Among the vegetative means, multiplication through division of clumps is the most common method used for several decades. Micropropagation is also successful for rapid and large scale multiplication.

The factors which attract the cultivation of gerbera as a cut flower are the large size of flowers, long and stout flower stalk, long vase life and above all, the ability to withstand rigorous transport because of hardy stem. Though flowers are having long vase life, bending and folding of stalks are the major problems of cut gerbera flowers in vase.

Growth regulators are used in floriculture to induce dwarfeness and earlyness in flowering, to increase the size and number of flowers and to improve the vase life of cut flowers.

The present studies were undertaken mainly to test the suitability of growing gerbera under Vellanikkara conditions for cut flower production and to evaluate the effect of growth regulators on flower qualities. The main objectives of the study were

(a) to determine the best time of planting

(b) to evaluate the effect of growth regulators on flower qualities

(c) to evaluate vase life and to study the effect of various treatments to prevent bending of stalks and to increase vase life.

Review of Literature

REVIEW OF LITERATURE

Gerbera is an elegant flower of immense value both as a garden flower and cut flower. A number of commercially important gerbera varieties are cultivated throughout the world. Several trials have been conducted to study the performance of different cultivars and select the suitable ones for different locations, high yield, homogenity, stability of colour and general quality of flowers.

In recent years the plant growth regulators are being increasingly used to manipulate the growth, flowering and vase life of cut flowers like gerbera.

Literature pertaining to these aspects are reviewed in this chapter. Reports on the hormonal response of gerberas are meagre, hence some related crops has also been included in the review.

2.1. Varietal evaluation

In an experiment with five gerbera clones, planted in mid July in Netherlands, Sympathie was the slowest to flower and Salmrosa gave the highest yield of flowers. Productivity was lowest in January except in the case of cv. Mandarin which produced uniformly each month after a slow start (Steen, 1975).

Eight French cultivars and six Dutch cultivars were planted in an unheated plastic greenhouse between mid June and early July. Total flower production (September to August) and winter flower

production (November to March) were highest in the French cv. Caprice (53.8 and 20.26 flowers per plant, respectively), which produced good quality flowers (Aragon et al., 1985).

A comparison of 24 cultivars, planted in winter in Federal Republic of Germany, was made by Fischer et al. (1985). The most prolific flower producing cultivars were Pink Fleur and White Maria. The most vigorous cultivars were Clivia and the red clone 15/79. Somewhat less vigorous were the cultivars Rufina and Terravisa. Fredigor was also recommended.

Trial on the performance of 20 cultivars indicated that productivity was the highest with Appelbloesem and Amber and keeping quality was best with Romilda. Appelbloesem, Rosamunde and Romilda were considered the best (Geldera and Reijinders, 1985).

The double pink cv. Fredaisy was compared with single red and pink Richon selections in France. During the eight months of the trial Fredaisy produced more flowers per plant and the flowers were of greater diameter with longer stalks. Homogenity, stability of colour and general quality were reported to be excellent (Bailot, 1976). Vidalie et al. (1985) reported that cultivars Clementine and Valentine yielded well quantitatively and qualitatively.

Forty four cultivars grown under glass were compared by Loesser (1986a) in German Federal Republic. These cultivars yielded from 20 (cv. Suzan) to 50 (cv. Joyce) cut flowers per plant annually.

The best winter flowering cultivars were Fredigor (29% of total yield between November and February), Opaal, Irmgard, Harlekin (26%) and Rouge Double and Hanny-Weiss (both 15%). Cultivar Cabandha Mufeta produced the highest proportion (88%) of Class I flowers and cv. Adamant the lowest (22%).

Loeser (1986b) reported that among 55 cultivars grown in green house trials, the highest cut-stem yield per plant was recorded in cultivars Alexis (36), Bilitis (33), Salmrosa (33), Anke (31) and Labalga (30). It was also observed that cultivars with a high proportion (greater than 85%) of class I stems had relatively poor vase life (less than 11 days), except for Alexis (18 days) and Terrafame (14 days). Other high yielding cultivars (greater than 25 stem/plant) with good vase life were Hildegard (17 days), Anke (15 days), Nadja (15 days) and Pascal (16 days). Some cultivars were recommended by Reimherr et al. (1986) for green house cultivation in erstwhile German Federal Republic. They included cvs. Fredeking (average 28 cut-stem per plant and 19 days vase life)). Nadja (23 stems, 20.5 days), the Terraqueen (22 stems, 19 days), Dusty (22 stems, 17.5 days) and Labalga (30 stems, 14 days).

Some of the work done in India are as follows:

At University of Agricultural Science, Bangalore, a total number of 19 accessions were maintained and screened for commercial characters like vase life (Nalawadi et al., 1975). In Tamil Nadu, a total number of 49 accessions including open pollinated clones

are maintained at Horticultural Research Station, Yercaud of Tamil Nadu Agricultural University (Thangaraj et al., 1990). The accessions have been screened for flower yield, vase life, length and girth of stalk, flower colour, flower diameter and resistance to pest and diseases. Studies were conducted in ICAR Complex, Meghalaya with 21 varieties of gerbera for 11 economically important traits by Aswath and Parthasarathy (1992) to ascertain the contribution of various factors for dependent traits, viz., number of flowers and vase life.

2.2. Effect of hormones on growth promotion

The effect of auxins and GA_3 on the intercalary growth in the scape of gerbera was studied by Sachs (1968). Inflorescence was removed in some cases together with the receptacle and involucral bracts, and the cut surfaces were treated with GA_3, IAA, 2,4-D, NAA or kinetin at various concentrations either as a paste or in a solution. Intercalary growth was maintained by applying GA_3 or IAA. IAA normally caused more rapid and greater elongation than GA_3. When both substances were applied simultaneously the effect was greater regardless of the concentration used. In decapitated scapes, GA_3 and/or IAA promoted cell elongation, but there was little or no cell division. In scapes from which only the inflorescence was removed, application of GA_3 and/or IAA promoted cell division as well as cell elongation. Deflowered and decapitated scapes elongated at almost the same rate initially but the ultimate length of the scape was dependent upon the number of cells present.

The response of Chrysanthemum frutescence to GA was investigated in order to improve its cultivation for cut flowers by Dabab et al. (1987). The plants were sprayed with GA_3 at 250, 500 and 1000 ppm, three times in the early growth stages. The treatments especially 500 and 1000 ppm, increased plant height and diameter, number of shoots per plant and length of shoots.

The effect of two cytokinins N^6-benzyl adenine (bzl) and N^6 - m-hydroxy benzyl adenosine for increasing shoot formation and cutting production in the Gerbera cv. Helias were studied by Kaminek et al. (1987). For initiation of bud regeneration and shoot growth, stems of the stock plants were cut off and the plants were submerged with two cm long stem stumps upside down in cytokinin solution before planting. Supplementary spraying with cytokinin was done at each time cuttings were taken. Both cytokinins tested enhanced the production of cuttings.

Fu Kunda et al. (1987) observed that Chrysanthemum plants kept at 2-3°C grew taller than those kept under low natural temperatures and the height differences increased with the length of time the plants were kept chilled. Spraying plants with GA (3 x 50 ppm or 2 x 75 ppm) after exposure to natural temperatures for 4-5 weeks resulted in the production of shoots as tall as those from plants which had been chilled for 5 weeks.

Zieslin et al. (1988) reported that application of cytokinin solution (PBA or BA at 100-400 ppm) to defoliated Gerbera jamesonii

mother plants in which the crowns were exposed to the light, increased the production of cuttings, compared with the untreated defoliated plants. An additional stimulative application of cytokinin resulted in an additional flush of cuttings produced by the treated plants.

Application of GA_3 (100 ppm) as spray, cycocel (chlormequat 5000 ppm) as spray or soil drench and nucleic acids (NAS) extracted from Zinnia plants as spray were compared for their effects on the growth of Chrysanthemum (cv. Forester) by Koriesh et al. (1989a). Each treatment was applied twice (in early August and 20 days later). The tallest plants were those sprayed with GA_3.

2.3. Effect on growth inhibition

Pot grown chrysanthemums must be short and of uniform height, and for some cultivars these requirements cannot be achieved by cultural means. Growth retardants can be used to reduce the length of the internodes. Alar is most commonly used, being simple to apply and reliable, and the doses 1000 and 2000 ppm in one or two applications is recommended by Pergola (1976). Fourth week after the start of short day treatment is the best time to apply it or as soon as the apical bud is well differentiated and clearly visible.

Zvirblis (1976) observed that internodes were shortened in chrysanthemum by chlormequat applied when the plants reached 5-8 cm height. Final plant height was 20-40 cm.

In a green house trial on potted Zinnia seedlings and Chrysanthemum rooted cuttings, Arzee et al. (1977) studied the effect of dikegulac sodium at 100-750 ppm. Concentrations upto 500 ppm caused temporary arrest of apical development. Leaves expanding directly after treatment were convoluted and chlorotic but later greened. Later, developing leaves were irregularly shaped and green. There were some outgrowth of axillary buds. DNA synthesis was inhibited throughout the apical meristem, and normal cytohistological zonation was no longer apparent. Dikegulac applied to a leaf was translocated to the apex. It is suggested that dikegulac acts selectively on meristamatic cells in the apex and developing leaf primordia and that minute amounts of the agent are sufficient to effect changes in apical development.

McDaniel and Fuber (1977) reported that height of potted Chrysanthemum was effectively controlled by soaking entire rooted cuttings in daminozide at 2500-5000 mg/l for 60 seconds before planting. Response to the pre-planting application of daminozide depends upon the normal flowering height of each cultivars as does foliar application. Soaking rooted cuttings in ancymidol at 50 or 88 ppm resulted in excessive growth reduction.

In another experiment, Sen and Naik (1977) observed that pinched rooted cuttings of Chrysanthemum cv. Early White when 60 days old or not pinched when sprayed after six days of planting with B9 (daminozide) or cycocel (chlormequat) each at 5000 or

10,000 ppm or MH at 1000 or 2000 ppm, resulted in reduced plant height and node, branch, leaf and flower numbers, but leaf and flower size were increased. All growth substances suppressed plant height. MH at 2000 ppm was having the greatest effect followed by cycocel at 10,000 ppm.

Morioka et al. (1978) reported that the growth of glass house Chrysanthemum was retarded by ancymidol and flowering was delayed by 4-5 days. Soil drench was more effective than foliar spray. The best rates of application were 0.25 mg/15 cm pot as soil drench and 100 ppm as foliar spray. Alden (Piproctanyl - brown) also retarded the growth when applied once or twice during the growing period as foliar spray of 100 ppm.

Application of BAS 106 (5,4 - chlorophenyl - 3, 4, 5, 9, 10 pentazatetracyclo 4, 5, 10, 26, 0, 8, 11 - dodeca - 3 - 9 - diene) as granules (1 G) to the substrate surface or 50 per cent W.P. as soil drench as compared with standard methods of application for chlormequat, daminozide or ancymidol, for their retardation of growth in chrysanthemum was studied by Holcomb et al. (1983). BAS 106 (50 W.P.) at 32 g/12 cm pot caused temporary vein chlorosis of the leaves, BAS 106 (1 G) at 6 mg/plot, BAS 106 (50 W.P.) at 8 mg/pot and daminozide spray at 2500 ppm retarded growth of Chrysanthemum cv. Always pink. The same treatments were more effective on Chrysanthemum cv. Ritz than either a 2500 mg/l spray or 0.25 mg/pot ancymidol drench.

Reed and Nightingale (1983) in their studies on chrysanthemum found that daminozide (2500 mg/l) is most effective in limiting plant height increase. Ancymidol (66 mg/l) was slightly less effective and chlormequat (1500 mg/l) had no effect when compared on the plants of the cv. Early Golden Hill. There was no significant effect of spray solution (pH 4.0 - 9.0) on controlling height.

Studies on chrysanthemum cultivars Mardi Gras and Jongenelen showed that the applications of daminozide (4000 ppm) or ancymidol (200 ppm) restricted plant height but no response occurred with chlormequat (1500 ppm). Ancymidol was more effective than daminozide, especially when applied 6 or 7 weeks after transplanting (Armitage et al., 1984). The time taken for bud emergence and leaf number were not affected by the treatments. Plants were more responsive to daminozide when applied 8 weeks after transplanting compared with 5, 6 or 7 weeks.

Pre plant dip of shoot or root portion or of entire rooted cuttings in ancymidol (10-15 mg/l) or daminozide (1000-1500 mg/l) has been reported to reduce the height of the chrysanthemum cv. Garland regardless of the plant part treated (Reiss - Bubenheim and Lewis, 1984). Shoot or entire cutting dips were generally more effective than root dips. Height and dry weight decreased with increasing concentrations of both chemicals and flowering was slightly delayed by ancymidol. Exposure time (1-60 minutes) had no effect on subsequent height reduction. No phytotoxicity resulted from any

treatments, although in one experiment, daminozide foliar sprays induced a change in flower colour.

Ethephon was applied at 0-2000 ppm to chrysanthemum cultivar Otomezakura upto three times at seven days intervals by Konishi et al. (1985). At rates higher than 1000 ppm there was a strong inhibition of stem elongation and flower formation. When these concentrations were applied in the spring and summer, the inhibitory effect only lasted for about 15 days, after which stem elongation was noticed; but when less than 1000 ppm was applied in mid-September, the plants remained in rosette form until flowering.

Increasing concentrations of ancymidol (10-50 mg/l) or daminozide (1000-5000 mg/l) applied as pre plant dips to cuttings of chrysanthemum cv. Garland, has been reported to reduce the height of both pinched and unpinched plants (Reiss-Bubenheim and Lewis, 1986). Pinching also reduced height but lower concentrations of growth retardants were necessary to achieve the desired height control. Pinching reduced dry weight in most treatments as did most chemical treatments.

Furtani et al. (1987) sprayed leaves of chrysanthemum cv. Mountain Snow with 10 mM NAA or 10 mM NAA ethyl ester. The plants exhibited severe epinasty after 24 hours while leaves sprayed with 5 mM ethephon did not. Treatment with 100 μM AOA (Aminoxy acetic acid) 24 hours before NAA application reduced ethylene production rate of leaves, but not epinasty. Localised application of NAA to

adaxial, abaxial or both leaf surfaces resulted in similar amounts of leaf epinasty. Epinastic leaves had enlarged adaxial epidermal cells. Size of abaxial epidermal cells was unchanged. Evidence is provided that leaf epinasty of chrysanthemum following NAA application is not the result of auxin induced ethylene production.

Chrysanthemum cultivars White Popsie, Yellow Popsie, Red Popsie and Dark Deep Popsie growing in 15 cm pots were used for his studies by Shawreb (1987). When the mean lateral shoot length was 5 cm, cultar (Paclobutrazol) was applied as a soil drench at 2500, 4000 and 5000 ppm or as a foliar spray at 2500, 4000, 2 x 2500, 5000, 2 x 1250 and 2 x 2000 ppm concentrations. These treatments reduced lateral shoot growth and plant dry weight, delayed flowering, and increased shelf life and leaf chlorophyll content. Flower diameter and the number and diameter of lateral shoots were not affected. Both the 4000 and 5000 ppm treatments (single or double) caused abnormal plant appearance and leaf senescence. Alar (daminozide) applied to the soil or foliage at rate similar to that of cultar lessened primary and secondary lateral shoot growth, increased leaf chlorophyll content and reduced flower diameter but the number and diameter of the primary lateral shoots were unaffected. All the foliar treatments lowered plant dry weight and delayed flowering, and soil drenching at 4000 and 5000 ppm also lowered dry weight. The split foliar treatments of Alar reduced shoot growth more than equivalent single doses, and foliar spraying

was more effective than soil drenching in this respect. Foliar sprays also improved flower shelf life whereas soil drenches did not. When Alar and cultar were compared the latter proved more effective in reducing the growth of lateral shoots.

Stanley and Cockshull (1989) in their experiments on chrysanthemum cultivars Polaris and Bright Golden Anne, treated rooted cuttings with ethephon by applying a 10 µ drop containing 10 g l^{-1} ai to either a leaf or the apical bud or both or to different locations on the stem. Plants were grown under short days and the effects of treatments were assessed about 4 weeks later. Irrespective of the site of application a single drop of ethephon increased leaf number, delayed time of flower initiation, reduced stem elongation and apical dominance. The effect of ethephon was generally greater when the application site was closer to apical bud rather than to leaf. Application to stem, close to apex was more effective than application to the base. Defoliating plants to one leaf resulted in similar responses to those found for ethephon application. When ethephon was applied to a leaf and the leaf was then removed after 12, 24, 48 and 96 h, ethephon appeared to be translocated out of the leaf within 12 h as indicated by the higher leaf number and smaller apical diameter of the treated plants. If the leaf was removed, there was a further significant increase in leaf numbers and the apical diameter was smaller, indicating that there was continued production of endogenous ethylene after 96 h. Covering the leaf had little effect on the translocation of ethylene.

There was less effect of ethephon on Bright Golden Anne than on Polaris.

Ancymidol and Paclobutrazol were applied at rates of 0.25, 0.5 or 1.0 mg/pot as soil drench in experiments with Gerbera cv. Parade by Lee and Lee (1990). Both growth retardants significantly reduced peduncle length, foliage height and width, leaf area and total fresh and dry weights and markedly increased leaf thickness and chlorophyll content but had no effect on number of days to flowering, number of leaves or root fresh weight. Their effect on peduncle length was due to a retardation of the longitudinal growth of the peduncle cells. Although both retardants were considered suitable for reducing plant height, in gerbera, paclobutrazol was the most effective one for reducing plant height. Compact pot plants could be produced by single drench applications of ancymidol at 1.0 mg/plot or paclobutrazol at 0.25-0.5 mg/pot.

Pinched plants of chrysanthemum cultivars, Bright Golden Anne and Yellow Favor were grown in 1.5 litre size pots, and then treated with uniconazole as 3 sprays at 10, 20 or 30 mg/l, uniconazole as one or two soil drenches at 1, 2, 2.4 or 3.6 mg/pot and daminozide (the standard retardant) as 3 sprays at 500 mg/l. Bright Golden Anne was found to be more sensitive than Yellow Favor to uniconazole (Tayama and Carver, 1992). Sprays of uniconazole at 20 or 30 mg were as effective in checking plant height as daminozide.

2.4. Effect on flowering

Application of 20 µg GA_3 to stem apex or a foliar spray of 10-100 ppm hastened flowering by 10 days to 4 weeks in gerberas grown in green house, in autumn and winter (Lindstorm, 1957).

Dooren Bos (1959) in his experiments on China Aster reported that the number of leaves produced by China Aster plants before flower initiation was much greater in short day conditions than in long days and in continuous short days. The long day plants flowered almost simultaneously. Plants transferred from long days to short days 6 weeks after sowing flowered almost a month earlier than those kept in continuous long days. Gibberlic acid did not effect flower initiation in long days but did reduce the number of leaves appearing before the inflorescence in short days.

According to Bocion et al. (1977) Gerbera jamesonii plants sprayed with 0.03 per cent Astrinal (dikegulac) at the 7-9 leaf stage developed 53 flowers/plant as compared with 37 flowers on the unsprayed control.

In their experiments, Sen and Naik (1977) observed, when 60 days old pinched rooted cuttings of chrysanthemum cv. Early White or not pinched at all, sprayed with B 9 and cycocel at 5000-10,000 ppm after 6 days of planting resulted in the highest flower numbers. Flowering was hastened by cycocel at 10,000 ppm and

flower numbers were enhanced by cycocel and B 9 each at the higher concentration. Flower size was slightly increased by B 9 at the lower concentrations.

Four spray applications of GA at 50, 100, 150 or 200 ppm or of chlormequat at 500 or 750 ppm were applied at monthly intervals to Gerbera jamesonii by El Shafie and Hassan (1978). Early flowering was promoted by lower concentration of GA, whereas chlormequat delayed flowering. The number of flowers was increased by GA at 100 ppm during the first season and at 100. 150 and 200 ppm in the second season. Chlormequat at 500 ppm was effective in promoting flowers in both seasons. Fewer but heavier flowers were produced with 750 ppm chlormequat. Both GA and chlormequat slightly increased the flower diameter. Flower peduncle growth was promoted by GA and retarded by chlormequat. The flower number was promoted by GA and retarded by chlormequat.. The number of leaves per plant was markedly reduced by chlormequat at 750 ppm. GA at 150 or 200 ppm and chlormequat at 500 ppm significantly increased the number of shoots/plant.

A trial on China Aster to study the effects of GA, MH and NAA each at various concentrations upto 1000 ppm was conducted by Reddy (1978). Flower number/plant and the duration of flowering were enhanced by GA at 200 or 300 ppm. MH delayed flowering but at the highest concentration vase life was increased by 3-4 days, NAA had little effect on flowering.

Zinner (1982) reported that in chrysanthemum application upto 5000 ppm GA_3 was not the substitute for chilling and no flower buds were formed on GA_3 treated non vernalized plants of both the cultivars Brigitte and Asia Lee. Shoot elongation occured with sufficiently vernalized plants (treated for 10 or 20 days at 8°C instead of the requisite 30 or 40 days). Treatment with 1000 ppm GA_3 resulted in flower formation on plants subsequently grown under short days.

Field trials were conducted during the winter and summer season with the china aster cultivar Vicks' Branching Purple by Reddy and Sulladmath (1983). The plants were treated with GA (100-300 ppm), MH (500-1000 ppm) or NAA (30-60 ppm) at 25 days after transplanting and twice more at 15 days intervals. It was found that GA advanced whereas MH delayed flowering with NAA having no appreciable effect in relation to the control. Duration of flowering was longest in plants treated with GA at 300 ppm (24-30 days) compared with 19-23 days in the control. Vase life was longest (9-12 days) in plants treated with MH at 1000 ppm than (5.5 days) in the control.

Potted chrysanthemum seedlings were sprayed with Accel (a synthetic cytokinin) either 4 or 8 days before pinching back to 7 leaves or on the days of pinching or 4 days after pinching. Accel application had no effect on axillary shoot development and flower production in cultivars Bright Golden Anne, Fiesta, Pot-o-Gold

or Torch but inhibited axillary shoot development and flower production in cv. Surf. Accel application delayed flowering in all cultivars by one to six days (Pound and Tayama, 1984).

Andriasen (1985) applied daminozide (425, 850 or 1275 ppm) as a single, double or triple spray (6, 4 + 6 or 2 + 4 + 6 weeks) to plants of chrysanthemum cultivars Camino Bronze, Geisha, Golden Crystal, Golden Spider, Marguerit, Maximo, Saphir, Smil and White Horun, after start of short days treatment. Inflorescence height was reduced except in Golden Spider with daminozide treatment; same is the case with inflorescence diameter also. Growth mostly ended 6 weeks after the start of short day treatment, therefore daminozide applied at this time had no effect. Spraying thrice at 2 + 4 + 6 weeks was more effective than spraying twice at 4 + 6 weeks. Daminozide produced shorter plants and 1-2 day delay in flowering. In Geisha and White Horun, flower colour was affected and in White Horun shorter ray florets were observed after application of daminozide at 1275 ppm.

Guda and Farina (1985) raised cultivars of Gerbera jamesonii hybrid in 12 h days starting at day/night temperatures of 25°/12°C. Day temperature was gradually lowered to 20°C over a month at which stage 1000 ppm GA_3 (+0.2% dimethyl sulphoxide + 0.2%, Tween 20) was applied as spray. In cultivars Coctail and Peter treated plants had more flowers (+60 and 133%) than control (with GA_3 omitted from the spray) at 20 days after treatment but the difference was less at 40 days. In cv. Joyce there was again an increase

at 20 days but at 40 days the control had more flowers and in cv. Lidy the control had more flowers than GA_3 treated plants at both sampling dates. In cv. Peter it was lower in treated than control plants expecially at 40 days. In cv. Joyce side shoots were lower at 40 days and in cv. Lidy slightly higher. Number of leaves per plant were increased by GA_3 at 20 days in all cultivars except cv. Peter, but lowered in all cultivars at 40 days.

Lal and Mishra (1986) treated Aster and Calendula with GA at 100, 150 or 200 ppm and MH at 500, 1000 or 1500 ppm 15 days after transplanting and again one month later. The greatest number of flowers in both species were produced by plants treated with GA at 200 ppm. Flower size was greatest in plants treated with GA at 150 ppm.

Qrunfleb and Al-Wir (1987) planted rooted cuttings of five green house chrysanthemum cut flower cultivars in 25 cm pots and applied paclobutrazol at 1000, 2000 or 4000 ppm as soil drench. All treatments reduced shoot length but not diameter and delayed flowering by 17-38 days in cultivars Pandian White, Tom Pearce and the delay was less in cv. Bornholm and PR Armyard. Dry weight was reduced by all treatments and the higher rates reduced flower diameter especially in Bornholm and Tom Pearce.

Chrysanthemum cultivars Terrasun, Liflora and Joyce planted in June was treated with 100 ppm GA_3 at monthly intervals between November and February. Between May and September the plants were

rested and the treatments were then resumed until the trial in the following May. Only cv. Joyce gave an appreciable response to the treatment which stimulated cut flower production in the first season but decreased it in the second. GA_3 had no effect on peduncle length but increased inflorescence diameter (Farina et al., 1989).

The possibility of changing the flowering date of chrysanthemum (cv. Forester) by giving 2 application of GA_3 (as a spray at 100 ppm), cycocel (chlormequat) (as a spray or soil drench at 5000 ppm) or nucleic acids (NAS extracted from Zinnia elegans and dissolved in saline to give a concentration of 50 ug/ml) was studied by Koriesh et al. (1989b). The treatments were applied in early August and 20 days later. Both GA_3 and NAS induced earlier flowering, while cycocel as a soil drench delayed flowering. Cycocel treatment resulted in sturdy, thick flowering stems and also improved the quality of the inflorescence.

2.5. Effect on vase life

Rudnicki and Nowak (1976) found that gerberas with wide petals (Alkenade type) showed the longest vase life. Yellow flowers remained fresh longer than red or pink flowers. Vase life was directly correlated with flowering, length of flower stalk, its ability to grow after cutting and inflorescence diameter. The floral preservative Proflonil-72 extended vase life at room temperature in fresh cut flowers which were stored previously at 0-1°C for 7-21 days.

Green house grown gerbera flowers (cv. Peter) were harvested at commercial maturity and placed in different holding solution for 20 h at 1°C. After pre-treatment the flowers were kept in distilled water at 1°C for 4 weeks. The flowers kept well upto 2 weeks only and the best results were obtained after pre-treatment with a solution containing 25 mg/l Ag NO_3 + 200 mg/l 8 HQC (hydroxy quinoline citrate) + 7 per cent sucrose (Nowak, 1981).

The role of sucrose in stabilization of cut gerbera flower stalks was studied by Steinitz (1982). Stems of immature gerbera flowers cv. Clementine were cut when the first circle of stamens were ripe and placed in Ag NO_3 (30 mg/l) or Ag NO_3 (30 mg/l) + 6 per cent sucrose solution. Stems in Ag NO_3 solution softened, lost rigidity and bent within one day. Stems in Ag NO_3 + sucrose increased in rigidity and mechanical stability and flowers remained errect for upto 10 days even after the petals wilted. Histochemical observations of transverse flower stem sections showed a strong post harvest cell wall thickening and lignification of phloem cells in sucrose treated flowers. It is concluded that rigidity promoted by sugar produced irreversible changes in cell wall structure and composition rather than a temporary sugar dependent increase in stem turgor.

Tija et al. (1987) evaluated twenty Gerbera jamesonii cultivars for longevity in deionized water (DI), deionized water containing 1 mg flouride/l and deionized water containing 200 mg 8-hydroxy

quinoline citrate (8-HQC) + 20 g sucrose. Flowers of different cultivars differed in flouride sensitivity. Sensitive cultivars developed necrosis on the tips of the ray florets within 12 to 24 h of keeping in flouridated water, whereas the least sensitive cultivars were injured within 4-6 days. Petal necrosis was the primary factors reducing longevity in flouride treated flowers. Petal necrosis did not occur on flowers held in DI or 8-HQC + sucrose. The mean post-harvest lives of the 20 cultivars held in flouridated water, DI and 8-HQC + sucrose were 2.6, 5.3 and 8.3 days respectively.

Effect of pulsing before transport and the use of preservative solution after transport on the keeping quality and the vase life of cut inflorescences of Gerbera cultivars Marleen and Terranutans, transported dry at 4°C for 48 h, was investigated by Nowak (1989). Pulsing in Ag NO_3 at 200 mg/l or 8-HQC at 200 mg/l with sucrose at 100 g/l for 24 h at 20°C reduced the number of bent or folded stalks and prolonged vase life, in both gerberas kept in water and those kept in preservative solution, after transport. The use of preservative solution after transport considerably improved vase life and the quality of flowers. The best results were obtained when the inflorescence was pulsed in Ag NO_3 (200 mg/l) + 8-HQC (200 mg/l) + sucrose (100 g/l) or in Ag NO_3 (200 mg/l) + sucrose (100 g/l) before transport, and when after transport they were kept continuously in preservative solution consisting of 8-HQC (200 mg/l) + sucrose (30 g/l).

Thangaraj et al. (1990) in their study on the vase life of gerbera, placed freshly cut gerbera flowers of 24 accessions in glass tubes with no water and held at room temperature for 24 h. The following accessions were found suitable for use as cut flowers: GJ 8, GJ 10, GJ 16, GJ 18, GJ 23 and GJ 44. In these, no flower stalk bending, petal drooping and petal necrosis were observed after 24 hours.

Effects of several keeping solutions on the vase life of cut flowers of the semidouble pink gerbera cultivar Rebecca ; investigated by Deambrogio et al. (1991). Post harvest life ; prolonged by all the solutions, which in some cases increased it about four fold compared with control held in distilled water. A solution of 8-hydroxy quinoline sulphate + NaB + aminoxy acetic acid + 3,4,5-T and sucrose not only increased vase life but was also associated with a different type of senescence; the ligulae and disc lost colour, probably because of adequate water uptake and low transpiration losses, whereas in distilled water and other keeping solutions the inflorescence lost turgidity and wilted.

Materials and Methods

MATERIALS AND METHODS

The experiment was carried out at the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara, Thrissur during the year 1991-93. The aim of the experiment was to study the effect of time of planting and growth regulators on flower qualities, and its influence on vase life of Gerbera jamesonii. The suitability of the varieties to Vellanikkara conditions was also evaluated.

3.1. Varieties

Tissue cultured plants of four gerbera varieties were evaluated. They were

V_1 Eoliet

V_2 Presley

V_3 Pritty

V_4 Sunbird

The flower colours of these varieties were red in Eoliet, white in Presley, light pink in Pritty and yellow in Sunbird.

3.2. Treatments

The plants were treated with the growth regulators GA and CCC at different concentrations as given below.

i) T_1 GA 50 ppm

ii) T_2 GA 100 ppm

iii) T_3 CCC 500 ppm

iv) T_4 CCC 750 ppm

v) T_5 Control

The growth regulators were applied as foliar spray and distilled water was sprayed on the control plants.

3.3. Planting time

Planting was done in two seasons. For the first crop, planting was done during June and for the second crop, in October. The same growth regulator treatments were given to both the crops.

3.4. Time of application of growth regulator

The growth regulators were applied three times at the intervals given below

i) 30 days after field planting

ii) 60 days after field planting

iii) 90 days after field planting

3.5. Experimental design

The experiment was laid out in factorial randomised block design with four varieties and five treatments, which were replicated three times.

3.6. Land preparation and planting

Before planting the land was cleared, levelled and ploughed

to a fine tilth. Plants at a spacing of 45 cm x 45 cm, were planted on raised beds.

3.7. Cultural management

3.7.1. Application of fertilizers

At the time of planting well rotten farm yard manure was applied in the prepared beds at the rate of 20 tonnes/ha. Two weeks after planting 5 gm of 20:20 NP + MOP mixture in equal parts was given per plant. Thereafter the fertilizers were applied at the same dose at monthly interval.

3.7.2. Other operations

The beds were irrigated regularly. Earthing up was done after each fertilizer application and weeding was undertaken as and when necessary. Bavistin (@ 1 g/l) was sprayed at fortnightly interval during the rainy months, to protect the plants from rotting.

3.8. Harvesting

Flowers for field observations were allowed to remain on the plant till senescence while those for vase life studies were harvested when the flower had fully opened.

3.9. Observations

In each treatment ten plants were used for recording biometric observations. The parameters on which the observations were recorded are as follows:

3.9.1. Growth parameters

Growth parameters were recorded at monthly interval. First observation was recorded one month after planting before the application of growth regulator. Second, third and fourth observations were recorded after the application of growth regulators. The following growth parameters were recorded.

3.9.1.1. Plant height

The height of the plant in centimeters was measured from the collar region to the tip of the topmost leaf.

3.9.1.2. Spread

The circumference of the plant was measured and recorded in cemtimeters as spread of plants.

3.9.1.3. Leaf number

The total number of leaves present at the time of each observation was recorded.

3.9.1.4. Leaf area

The maximum length and width of each leaf was measured. The area was then computed using the formula.

$$\text{Log } A = 0.241137 + 0.48408 \text{ Log } l + 1.1260 \text{ Log } b$$

Where l = length and b = breadth. The sum of leaf area of individual leaves gave the total leaf area of the plant which was recorded in square centimeters.

3.9.1.5. Leaf weight

The fresh weight and dry weight of leaves were recorded in grams.

3.9.1.6. Petiole length

The length of petiole was noted and expressed in centimeters.

3.9.1.7. Number of lobes

The number of lobes of the leaves were counted and recorded.

3.9.2. Floral characters

3.9.2.1. Time taken for first flower bud emergence

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

3.9.2.2. Longevity in field

Number of days from opening of the flower to wilting was recorded.

3.9.2.3. Number of flowers

Total number of flowers produced in five months was recorded in each season.

3.9.2.4. Bud emergence to opening

Number of days taken from appearance of flower bud to its opening was noted.

3.9.2.5. Flower diameter

The diameter of the head was measured and recorded in centimeters.

3.9.2.6. Stalk length

Length of the stalk from the base to the head was noted and expressed in centimeters.

3.9.2.7. Stalk girth

Maximum width of the stalk was taken and noted in centimeters.

3.9.3. Vase character

Five flowers from each treatment were taken randomly for recording vase characters. Flowers were harvested early in the morning when it had fully opened.

3.9.3.1. Fresh weight of flower

The fresh weight of the flower was taken immediately after harvesting and expressed in grams.

3.9.3.2. Vase life

The vase life was taken as the number of days taken for the fresh flower to show sings of wilting. The flowers after harvest were placed in a conical flask containing 125 ml solution of the following four treatments.

i) . Water

ii) 5% sucrose

iii) 5% sucrose + 20 ppm $AgNO_3$

iv) 5% sucrose + 20 ppm $AgNO_3$ + 500 ppm HQC

The best treatment was used for studying the water uptake.

3.9.3.3. Water uptake

The quantity of water left in the conical flask after the removal of the flower on the last day in vase was measured. The difference between the initial and final water level was recorded which was expressed in ml.

3.10. Interpretation of data

The data generated from the study were subjected to analysis of variance using the methods suggested by Panse and Sukhatme (1985). Correlation were worked out for all the characters. Graphical representation of selected data was done.

Results

RESULTS

Studies were conducted at the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara during 1991-93 to examine the effect of different growth regulators on growth, flowering and flower qualities of gerbera. Four varieties, viz., Eoliet, Presley, Pritty and Sunbird were used for conducting the experiment. The results of the experiments are presented in this chapter.

4.1. Growth parameters

4.1.1. Plant height

4.1.1.1. Varietal influence

The varieties showed significant difference at sixty days after planting in the first season (Table 1a). Maximum height (22.62 cm) was noticed in variety Presley, while Eoliet recorded the minimum height (16.65 cm). Fig.1.

During the second season there was no significant effect of variety on plant height at 60 days after planting.

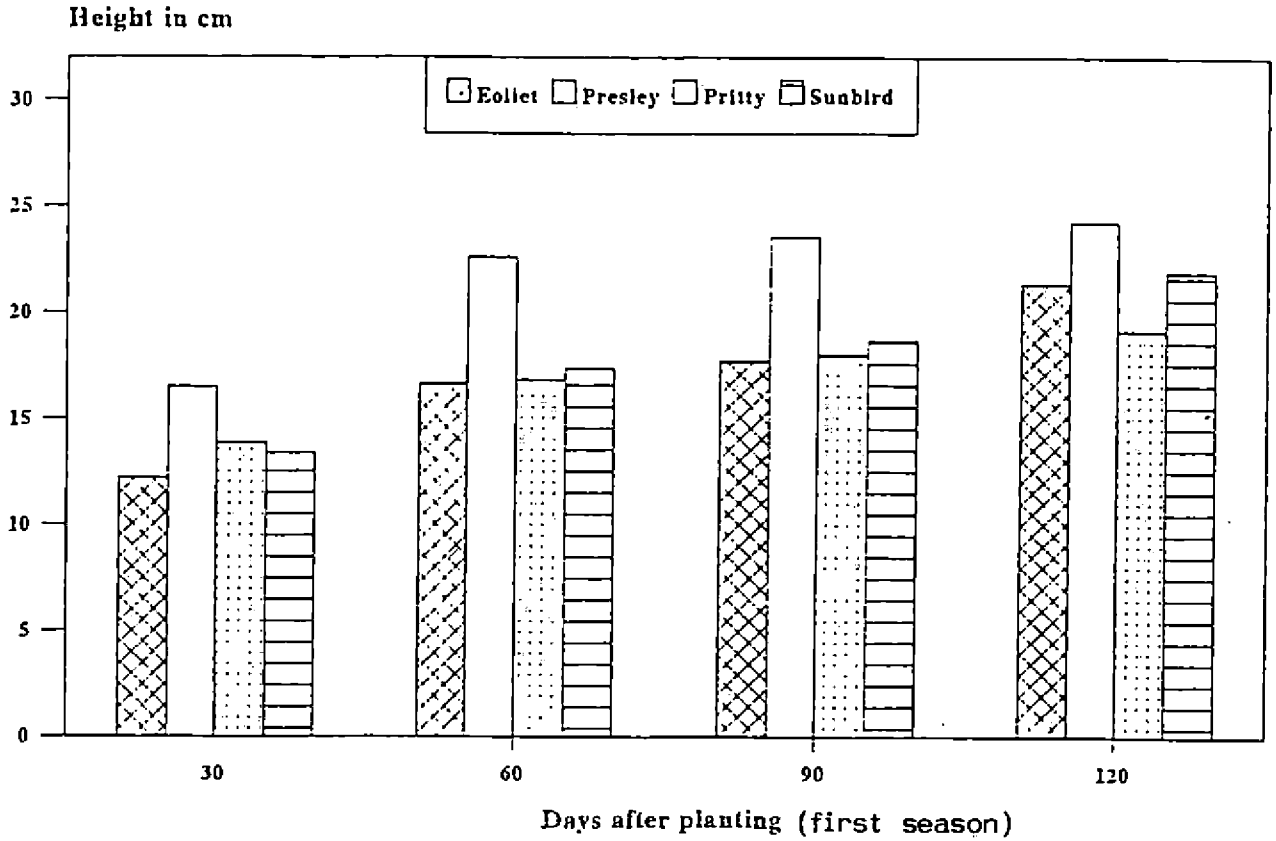
The varieties could exert significant influence on plant height after ninety days of planting in both the seasons. Maximum height was recorded in Presley (23.56 cm) while minimum height was in Eoliet (17.72 cm) during the first season.

During the second season, maximum height was exhibited by Sunbird (15.20 cm) which was on par with Presley. The height was minimum in Eoliet (11.90 cm).

Table 1a. Effect of variety on plant height (cm) in Gerbera jamesonii at different stages of growth

Variety	Plant height (cm)					
	Ist season			2nd season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
Eoliet	16.65	17.72	21.36	6.98	11.91	16.93
Presley	22.62	23.56	24.27	7.97	14.46	15.64
Pritty	16.84	18.00	19.17	7.34	13.47	15.64
Sunbird	17.36	18.69	21.92	8.25	15.20	16.63
CD	2.18	1.66	2.37	NS	1.560	NS
SEm±	0.762	0.581	0.829	0.404	0.545	0.547

Fig. 1. Varietal influence on plant height in *Gerbera jamesonii*



Significant varietal influence on plant height was noticed after 120 days of planting in the first season. Maximum height was recorded in Presley (25.56 cm) while minimum height was recorded in Eoliet (17.72 cm). In the second season the influence was not significant.

4.1.1.2. Treatment effect

The treatments did not have any significant effect on plant height in both the seasons at any stages of growth (Table 1b).

4.1.1.3. Interaction effect

The interaction between variety and treatment was nonsignificant with respect to plant height in both the seasons (Table 1c).

4.1.2. Spread

4.1.2.1. Varietal influence

The difference among the varieties with respect to spread was not significant in both the seasons after 60 days of planting (Table 2a).

Ninety days after planting significant difference in spread was noticed in all the varieties during first season. Presley had the maximum spread of 83.92 cm while minimum spread of 66.35 cm was in variety Sunbird. In second season Eoliet had the maximum spread (36.57 cm) and Sunbird the minimum (32.53 cm). Fig.2

Table 1b. Effect of treatments on plant height (cm) in Gerbera jamesonii at different stages of growth

Treatment	Plant height (cm)					
	Ist season			2nd Season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
GA 50 ppm	19.46	19.74	21.62	6.61	14.01	15.66
GA 100 ppm	19.40	20.17	22.86	7.67	13.48	16.92
CCC 500 ppm	18.38	19.44	22.74	7.70	13.42	15.50
CCC 750 ppm	16.39	18.97	20.03	7.79	13.64	16.25
Control	18.21	19.14	20.66	8.39	14.25	16.71
CD	NS	NS	NS	NS	NS	NS
SEm±	0.852	0.650	0.927	0.452	0.609	0.612

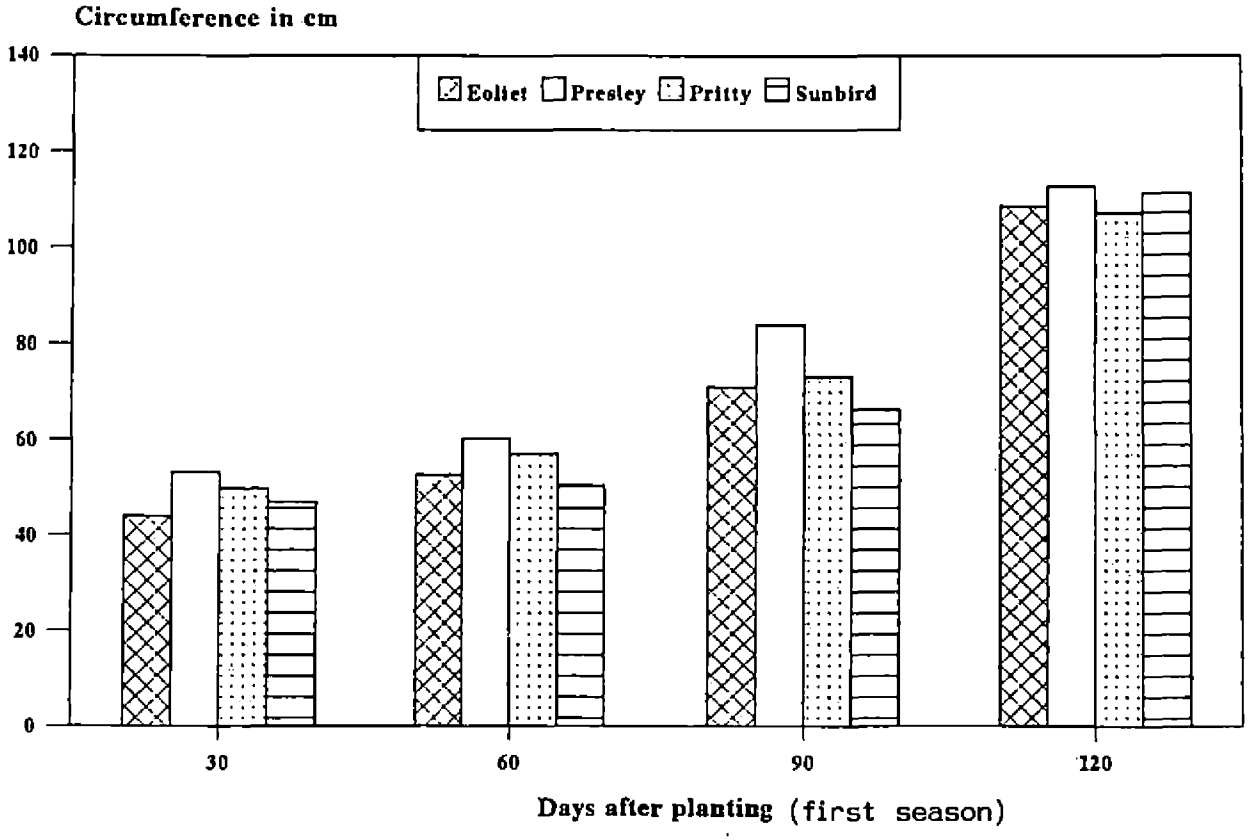
Table 1c. Interaction between variety and treatments for plant height (cm) in Gerbera jamesonii at different stages of growth

Interaction	Plant height (cm)					
	Ist season			2nd season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
Eoliet x GA 50 ppm	17.90	18.33	22.47	5.58	13.20	16.83
Eoliet x GA 100 ppm	17.69	18.00	19.94	7.83	11.68	18.03
Eoliet x CCC 500 ppm	15.85	16.33	23.70	7.52	10.93	15.15
Eoliet x CCC 750 ppm	14.92	17.04	19.59	6.57	12.60	17.32
Eoliet x control	16.83	18.91	21.12	7.40	11.12	17.32
Presley x GA 50 ppm	23.87	24.17	24.23	9.17	13.55	15.88
Presley x GA 100 ppm	23.37	24.93	24.92	7.67	14.02	15.00
Presley x CCC 500 ppm	23.82	26.18	25.52	7.00	14.55	16.77
Presley x CCC 750 ppm	21.54	22.29	21.98	8.33	14.88	14.51
Presley x control	20.48	20.25	24.87	8.67	15.31	16.02
Pritty x GA 50 ppm	16.86	16.79	17.22	6.00	13.68	14.50
Pritty x GA 100 ppm	17.80	18.01	21.12	8.50	13.84	17.69
Pritty x CCC 500 ppm	16.43	17.96	20.14	8.00	12.36	15.09
Pritty x CCC 750 ppm	15.34	17.85	17.94	7.50	12.55	15.76
Pritty x control	17.79	19.41	19.44	6.71	14.94	15.15
Sunbird x GA 50 ppm	19.15	19.68	22.57	9.70	15.62	15.44
Sunbird x GA 100 ppm	18.72	19.75	23.66	6.70	14.38	16.95
Sunbird x CCC 500 ppm	17.44	17.29	21.59	8.28	15.85	14.98
Sunbird x CCC 750 ppm	14.76	18.72	24.58	8.76	14.54	17.42
Sunbird x control	17.72	18.00	17.22	8.80	13.62	13.84
CD	NS	NS	NS	NS	NS	NS
SEm±	1.703	1.301	1.853	0.905	1.218	1.223

Table 2 a. Effect of variety on spread (cm) in Gerbera jamesonii at different stages of growth

Variety	Spread (cm)					
	Ist season			2nd season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
Eoliet	52.66	70.98	108.59	31.07	36.57	42.97
Presley	60.36	83.92	112.69	30.95	33.39	37.30
Pritty	57.09	73.10	107.22	29.93	33.00	42.63
Sunbird	50.48	66.35	111.41	29.27	32.53	41.58
CD	NS	10.59	NS	NS	2.93	3.04
SEm±	3.439	3.698	4.368	0.738	1.025	1.062

Fig. 2. **Varietal influence on spread in *Gerbera jamesonii***



Varietal influence on spread was not found significant at 120 days after planting in first season; but in all the four stages of growth variety Presley recorded the highest value of spread. During second season spread was maximum in Pritty (42.63 cm) and minimum in variety Presley (37.30 cm). Pritty was on par with Eoliet and Sunbird.

4.1.2.2. Treatment effect

Both the growth regulators (GA 50 ppm, GA 100 ppm, CCC 500 ppm and CCC 750 ppm) did not have a significant influence on the spread of varieties (Table 2b) except during the second season at 60 days after planting. T_1 (GA 50 ppm) had the maximum effect on spread. All the other treatments were on par with each other for this character.

4.1.2.3. Interaction effect

The interaction between variety and treatments was not found to be significant at any stage of growth (Table 2c).

4.1.3. Leaf number

4.1.3.1. Varietal influence

The varietal difference with respect to number of leaves was not significant 60 days after planting (Table 3a). In the second season during the same period varietal difference was significant. Variety Sunbird had the maximum number of leaves (4.61) which was on par with varieties Presley and Pritty. Leaf number was minimum (3.63) in variety Eoliet. Fig.3.

Table 2 b. Effect of treatments on spread (cm) in Gerbera jamesonii at different stages of growth

Treatment	Spread (cm)					
	Ist season			2nd season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
GA 50 ppm	57.26	72.78	107.61	33.08	35.67	43.96
GA 100 ppm	52.06	78.43	106.62	29.94	34.46	40.08
CCC 500 ppm	52.94	70.70	112.22	29.12	34.07	37.79
CCC 750 ppm	54.64	70.76	114.48	28.75	34.33	39.71
Control	58.83	75.27	108.96	32.62	34.14	40.44
CD	NS	NS	NS	2.363	NS	NS
SEm±	3.845	4.134	4.884	0.826	1.146	2.375

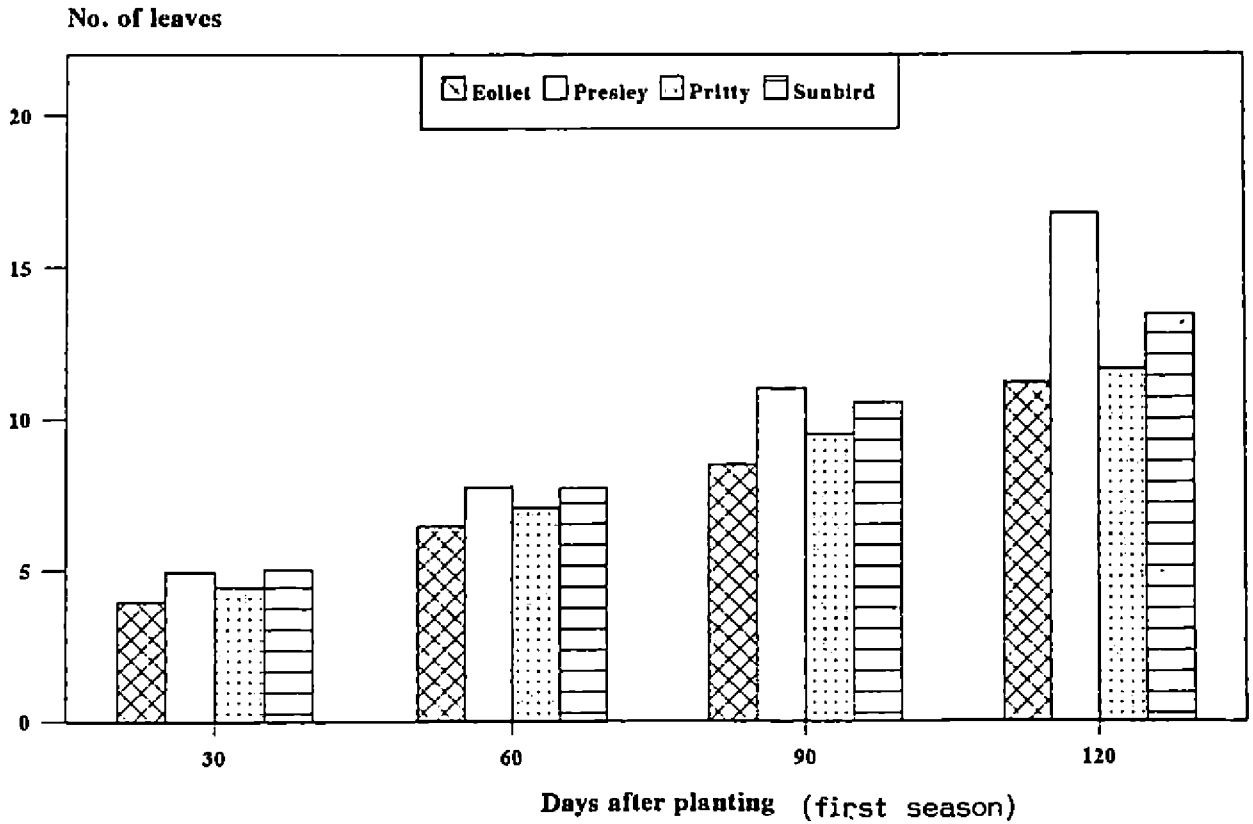
Table 2 c. Interaction between variety and treatments for spread (cm) in Gerbera jamesonii at different stages of growth

Interaction	Spread (cm)					
	1st season			2nd season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
Eoliet x GA 50 ppm	58.83	74.25	107.00	28.33	39.33	49.33
Eoliet x GA 100 ppm	45.97	70.25	108.92	31.00	36.67	44.33
Eoliet x CCC 500 ppm	50.83	60.75	111.25	29.50	39.33	39.33
Eoliet x CCC 750 ppm	55.08	75.33	111.03	29.67	36.00	42.00
Eoliet x Control	52.58	74.30	104.75	30.83	32.50	37.33
Presley x GA 50 ppm	60.50	92.25	108.11	34.33	33.33	39.00
Presley x GA 100 ppm	68.58	93.11	109.50	29.27	35.83	35.33
Presley x CCC 500 ppm	54.67	84.72	112.52	31.83	34.07	33.17
Presley x CCC 750 ppm	56.25	71.67	127.58	29.67	34.00	36.50
Presley x Control	61.80	77.83	105.75	32.63	34.73	34.50
Pritty x GA 50 ppm	58.28	59.94	103.32	32.33	34.67	44.83
Pritty x GA 100 ppm	49.19	80.80	99.61	29.50	32.33	39.83
Pritty x CCC 500 ppm	54.92	76.75	102.64	28.13	34.00	41.33
Pritty x CCC 750 ppm	55.47	68.42	122.53	29.00	33.67	42.00
Pritty x Control	67.58	79.58	108.00	31.67	33.33	40.67
Sunbird x GA 50 ppm	51.42	64.67	112.00	33.33	36.33	44.67
Sunbird x GA 100 ppm	44.50	69.55	108.44	30.00	30.00	41.33
Sunbird x CCC 500 ppm	51.36	60.58	122.47	27.00	31.67	37.33
Sunbird x CCC 750 ppm	51.78	67.61	96.77	26.67	34.67	38.33
Sunbird x Control	53.33	69.36	117.36	29.33	30.00	40.25
CD	NS	NS	NS	NS	NS	NS
SEm±	7.691	8.268	9.768	1.651	2.292	2.375

Table 3 a. Effect of variety on number of leaves in Gerbera jamesonii at different stages of growth

Variety	Number of leaves					
	Ist season			2nd season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
Eoliet	6.47	8.51	11.20	3.63	5.84	7.10
Presley	7.76	11.00	16.76	4.42	6.54	9.47
Pritty	7.08	9.51	11.64	3.99	6.82	8.32
Sunbird	7.73	10.56	13.44	4.61	7.35	9.20
CD	NS	1.59	2.65	0.63	1.05	1.40
SEm±	0.433	0.556	0.925	0.220	0.367	0.487

Fig. 3. **Varietal influence on number of leaves in *Gerbera jamesonii***



At 90 days after planting the difference was found to be significant during both seasons. In first season variety Presley had the maximum number of leaves (11.00) and variety Eoliet had the minimum number of leaves (8.51). During the second season maximum number of leaves was produced by variety Sunbird (7.35). This was on par with varieties Pritty and Presley. Variety Eoliet produced the minimum number of leaves (5.84).

Significant influence of varieties on the number of leaves was found 120 days after planting in both the seasons. Maximum number (16.76) of leaves was produced by variety Presley while variety Eoliet produced the minimum number (11.20). During the second season leaf number was maximum in variety Presley (9.47) which was on par with varieties Sunbird and Pritty. Leaf number was the least in variety Eoliet (7.10).

4.1.3.2. Treatment effect

None of the treatments had any significant influence on the number of leaves produced in both the seasons (Table 3b).

4.1.3.3. Interaction effect

The interaction effect was not significant for the number of leaves produced in both the seasons (Table 3c).

4.1.4. Total leaf area

4.1.4.1. Varietal influence

Sixty days after planting leaf area did not vary significantly (Table 4a). Fig. 4.

Table 3 b. Effect of treatments on number of leaves in Gerbera jamesonii at different stages of growth

Treatment	Number of leaves					
	Ist season			2nd season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
GA 50 ppm	7.20	9.48	12.37	3.74	6.10	8.23
GA 100 ppm	6.82	9.84	12.99	3.92	6.22	8.24
CCC 500 ppm	7.30	9.83	13.75	4.03	6.89	8.44
CCC 750 ppm	7.06	9.97	13.12	4.17	6.76	8.39
Control	7.41	10.36	14.08	4.29	7.21	9.33
CD	NS	NS	NS	NS	NS	NS
SEm±	0.484	0.622	1.035	0.246	0.410	0.545

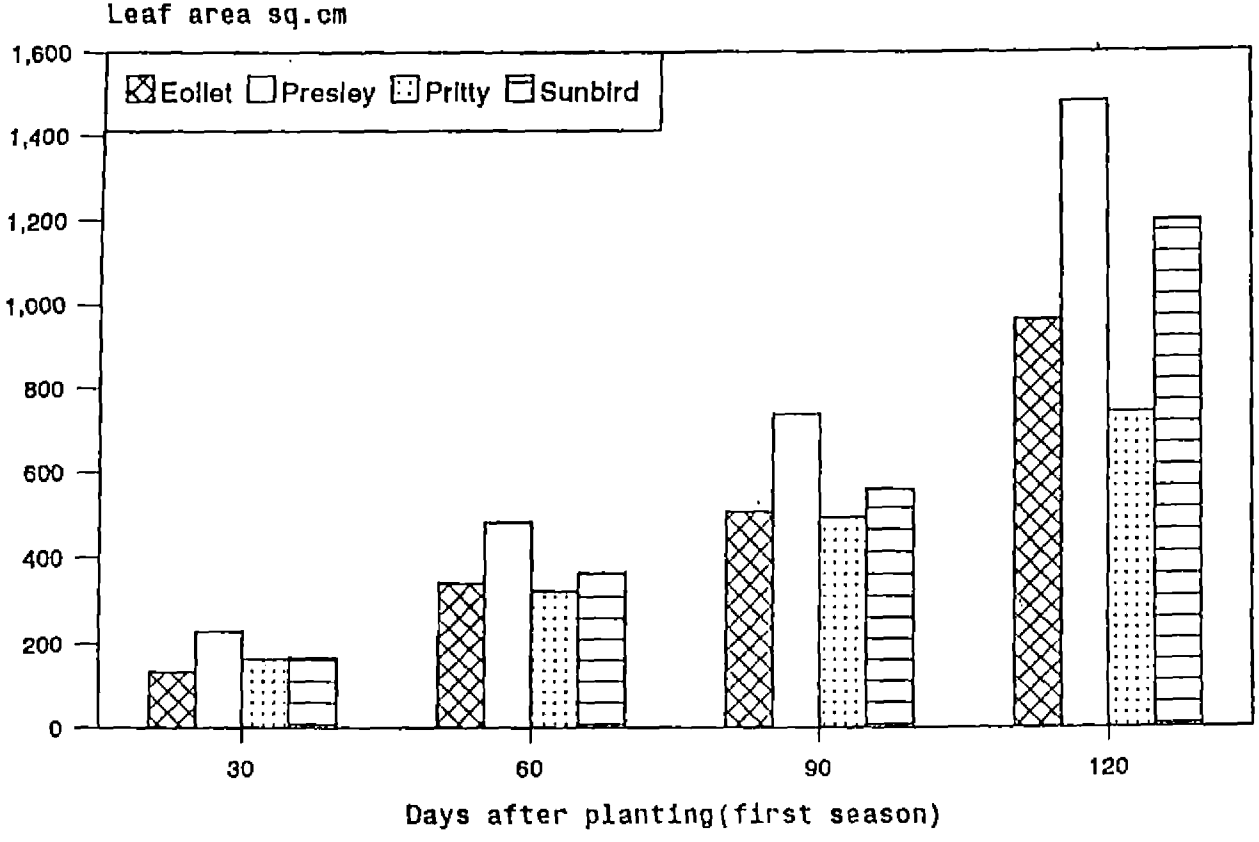
Table 3 c. Interaction between variety and treatments for the number of leaves in Gerbera jamesonii at different stages of growth

Interaction	Number of leaves					
	1st season			2nd season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
Eoliet x GA 50 ppm	5.75	8.50	10.47	3.11	5.11	6.66
Eoliet x GA 100 ppm	5.55	7.58	8.58	3.03	4.55	5.01
Eoliet x CCC 500 ppm	7.37	8.17	13.11	3.01	6.37	7.53
Eoliet x CCC 750 ppm	7.25	9.17	11.36	2.83	5.33	7.51
Eoliet x Control	6.42	9.14	12.50	3.50	7.86	8.80
Presley x GA 50 ppm	8.67	11.83	17.11	4.16	6.66	11.16
Presley x GA 100 ppm	7.67	10.94	17.02	4.00	6.83	10.54
Presley x CCC 500 ppm	7.50	11.47	15.86	5.00	6.50	8.91
Presley x 750 ppm	7.25	10.08	15.83	4.63	7.05	8.08
Presley x Control	7.72	10.67	18.00	4.33	5.66	8.66
Pritty x GA 50 ppm	6.33	7.53	9.17	3.20	5.88	6.75
Pritty x GA 100 ppm	6.64	9.94	12.91	3.56	6.83	8.87
Pritty x CCC 500 ppm	7.67	10.83	13.94	4.03	6.33	9.16
Pritty x CCC 750 ppm	7.03	8.75	10.42	4.55	7.33	7.66
Pritty x Control	7.75	10.50	11.75	4.60	7.72	9.16
Sunbird x GA 50 ppm	8.05	10.05	12.72	4.50	6.77	8.37
Sunbird x GA 100 ppm	7.44	10.89	13.44	5.10	6.66	8.55
Sunbird x CCC 500 ppm	6.67	8.83	12.08	4.06	8.38	8.16
Sunbird x CCC 750 ppm	8.72	11.89	14.89	4.66	7.33	10.23
Sunbird x Control	7.77	11.14	14.08	4.74	7.59	10.68
CD	NS	NS	NS	NS	NS	NS
SEm±	0.967	1.244	2.069	0.493	0.820	1.091

Table 4 a. Effect of variety on leaf area (cm^2) in Gerbera jamesonii at different stages of growth

Variety	Leaf area (cm^2)			
	30 days	60 days	90 days	120 days
Eoliet	131.59	343.58	505.61	963.16
Presley	230.49	481.46	737.09	1479.22
Pritty	163.72	324.36	492.41	740.69
Sunbird	167.69	365.42	558.68	1198.19
CD	42.39	NS	154.37	322.81
SEm±	14.807	44.639	53.920	112.752

Fig.4. Varietal influence on leaf area in *Gerbera jamesonii*



The influence of variety was found significant at 90 and 120 days after planting. At both stages variety Presley recorded the maximum leaf area and variety Pritty, the minimum. At 120 days after planting the maximum leaf area was exhibited by Presley (1479.22 cm^2) which was on par with variety Sunbird. Minimum leaf area (740.69 cm^2) was recorded in variety Pritty.

4.1.4.2. Treatment effect

The treatments did not influence the leaf area of the plants significantly, at any stage of growth (Table 4b).

4.1.4.3. Interaction

The interaction was not significant for leaf area at any stage of growth (Table 4c).

4.1.5. Leaf weight

4.1.5.1. Varietal influence

The influence of variety on fresh weight and dry weight of leaves was not significant (Table 5a).

4.1.5.2. Treatment effect

The treatments had significant influence on the fresh weight of leaves (Table 5b). GA 50 ppm recorded the maximum fresh weight (5.31 g) which was on par with GA 100 ppm and CCC 500 ppm. Control recorded the minimum fresh weight (3.42 g). The treatments did not have significant influence on the dry weight of leaves.

Tablee 4 b. Effect of treatments on leaf area (cm^2) in Gerbera jamesonii at different stages of growth

Treatment	Leaf area (cm^2)			
	30 days	60 days	90 days	120 days
GA 50 ppm	177.55	385.75	538.01	988.31
GA 100 ppm	157.62	350.61	554.56	1045.42
CCC 500 ppm	177.11	394.51	584.74	1184.63
CCC 750 ppm	173.58	393.84	601.13	1092.42
Control	181.00	368.83	588.79	1165.79
CD	NS	NS	NS	NS
SEm±	76.555	49.908	60.284	126.061

Table 4 c. Interaction between variety and treatments for leaf area (cm^2) in Gerbera jamesonii at different stages of growth

Interaction	Leaf area (cm^2)			
	30 days	60 days	90 days	120 days
Eoliet x GA 50 ppm	148.58	317.55	556.93	956.40
Eoliet x GA 100 ppm	108.24	292.76	449.31	664.00
Eoliet x CCC 500 ppm	116.83	361.65	416.32	1151.61
Eoliet x CCC 750 ppm	147.32	381.30	541.75	900.14
Eoliet x Control	136.96	364.65	563.74	1143.63
Presley x GA 50 ppm	232.78	534.52	785.79	1366.62
Presley x GA 100 ppm	228.42	459.08	620.13	1438.04
Presley x CCC 500 ppm	264.55	564.72	884.50	1569.66
Presley x CCC 750 ppm	198.05	407.78	686.13	1383.58
Presley x Control	228.65	441.21	708.92	1638.19
Pritty x GA 50 ppm	113.20	313.08	331.95	563.49
Pritty x GA 100 ppm	137.72	295.45	523.65	835.14
Pritty x CCC 500 ppm	170.49	365.86	592.81	924.48
Pritty x CCC 750 ppm	187.77	326.38	486.41	652.39
Pritty x Control	209.44	321.02	527.21	727.94
Sunbird x GA 50 ppm	215.64	377.86	477.38	1066.74
Sunbird x GA 100 ppm	156.09	355.15	625.17	1244.48
Sunbird x CCC 500 ppm	156.58	285.81	445.34	1092.75
Sunbird x CCC 750 ppm	161.19	459.88	690.21	1433.55
Sunbird x Control	148.97	348.41	555.29	1153.41
CD	NS	NS	NS	NS
SEm±	33.110	99.815	120.569	252.122

Table 5 a. Effect of variety on fresh weight and dry weight of leaves in Gerbera jamesonii

Variety	Fresh weight (g)	Dry weight (g)
Eoliet	4.22	1.29
Presley	3.80	1.20
Pritty	4.63	1.28
Sunbird	4.15	1.19
CD	NS	NS
SEm±	0.344	0.101

Table 5 b. Effect of treatments on fresh weight and dry weight of leaves in Gerbera jamesonii

Treatment	Fresh weight (g)	Dry weight (g)
GA 50 ppm	5.31	1.30
GA 100 ppm	4.40	1.22
CCC 500 ppm	4.21	1.25
CCC 750 ppm	3.67	1.14
Control	3.42	1.28
CD	1.10	NS
SEm±	0.385	0.113

4.1.5.3. Interaction effect

The interaction effect for fresh weight was not found significant (Table 5c) whereas the interaction for dry weight of leaves was significant.

In Eoliet, T_1 (GA 50 ppm) and T_4 (CCC 750 ppm) had the best effect on dry weight of leaves (1.40 g, each). This was on par with T_2 (GA 100 ppm), T_3 (CCC 500 ppm) and T_5 (Control).

In Presley maximum dry weight of leaves (1.57 g) was in T_1 (GA 50 ppm) which was on par with T_4 (CCC 750 ppm), T_3 (CCC 500 ppm), T_2 (GA 100 ppm) and T_5 (Control).

In Pritty all the treatments were on par. In variety Sunbird T_5 (control) had the best effect (1.53 g). This was on par with T_2 (GA 100 ppm), T_1 (GA 50 ppm), T_3 (CCC 500 ppm). T_4 (CCC 750 ppm) had the least effect (0.80 g).

4.1.6. Petiole length

4.1.6.1. Varietal influence

At sixty days after planting, there was significant influence of varieties on the petiole length (Table 6a). Variety Presley recorded the maximum petiole length (5.07 cm) and variety Pritty the minimum (2.62 cm), during the first season. Fig.5.

Significant influence of variety was noticed after 90 days of planting. Maximum petiole length was recorded in Presley (5.22 cm) and minimum in Pritty (2.37 cm).

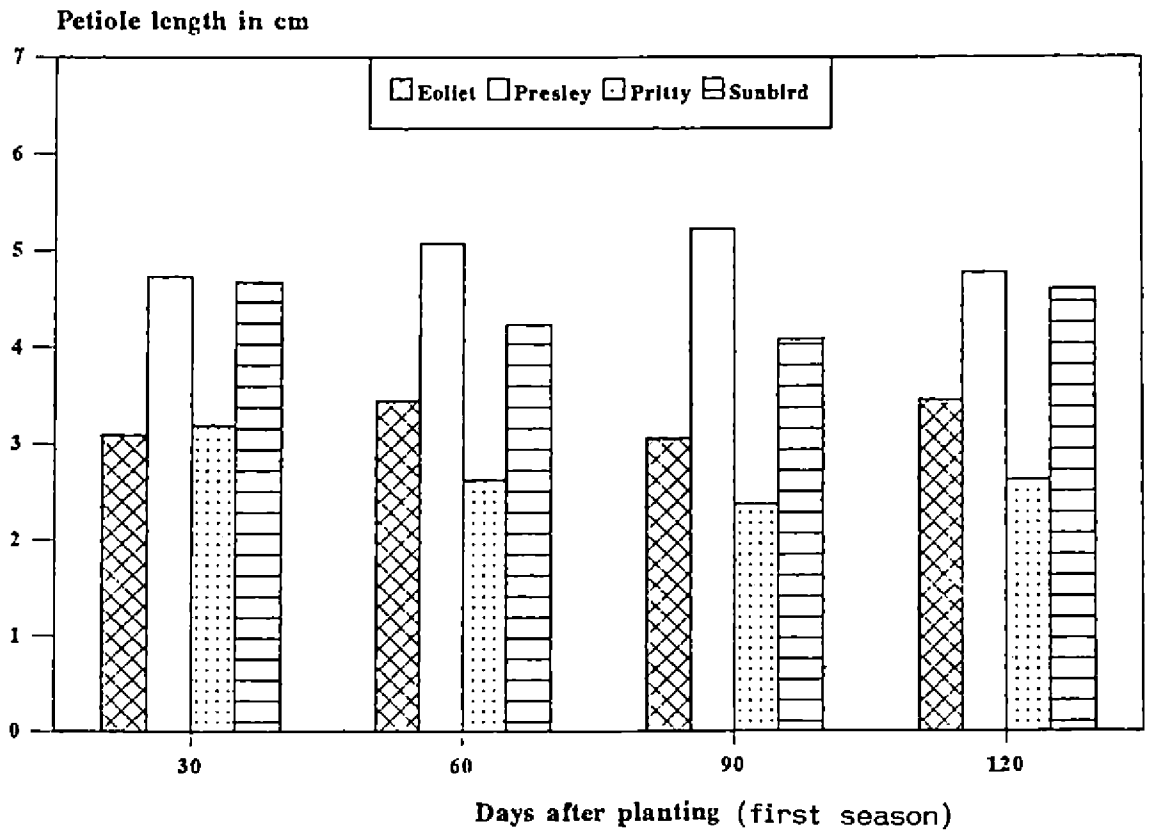
Table 5 c. Interaction between variety and treatments on fresh weight and dry weight of leaves in Gerbera jamesonii

Interaction	Fresh weight (g)	Dry weight (g)
Eoliet x GA 50 ppm	5.33	1.40
Eoliet x GA 100 ppm	5.00	1.30
Eoliet x CCC 500 ppm	4.50	1.30
Eoliet x CCC 750 ppm	3.25	1.40
Eoliet x Control	3.00	1.07
Presley x GA 50 ppm	5.50	1.57
Presley x GA 100 ppm	2.83	0.97
Presley x CCC 500 ppm	3.33	1.10
Presley x CCC 750 ppm	3.67	1.13
Presley x Control	3.67	1.23
Pritty x GA 50 ppm	5.17	1.00
Pritty x GA 100 ppm	5.25	1.35
Pritty x CCC 500 ppm	5.25	1.50
Pritty x CCC 750 ppm	3.83	1.23
Pritty x Control	3.67	1.30
Sunbird x GA 50 ppm	5.25	1.25
Sunbird x GA 100 ppm	4.50	1.27
Sunbird x CCC 500 ppm	3.75	1.10
Sunbird x CCC 750 ppm	3.92	0.80
Sunbird x Control	3.33	1.53
CD	NS	0.65
SEm±	0.770	0.226

Table 6 a. Effect of variety on petiole length (cm) in Gerbera jamesonii at different stages of growth

Variety	Petiole length (cm)					
	Ist season			2nd season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
Eoliet	3.44	3.05	3.45	3.80	3.29	2.98
Presley	5.07	5.22	4.77	3.74	3.45	3.28
Pritty	2.62	2.37	2.62	3.10	2.93	3.21
Sunbird	4.23	4.08	4.60	3.71	3.40	3.11
CD	0.59	0.54	0.52	NS	NS	NS
SEm±	0.205	0.189	0.180	0.301	0.265	0.067

Fig. 5. **Varietal influence on petiole length in *Gerbera jamesonii***



Varieties did not have any significant influence on petiole length during 60 and 90 days after planting in the second season.

Varietal influence was significant after 120 days of planting in the first season. Variety Presley had the maximum petiole length (4.77 cm) which was on par with Sunbird (4.60 cm). Variety Pritty had the minimum petiole length (2.62 cm). In the second season varietal difference was not significant during the same period.

4.1.6.2. Treatment effect

There was no significant influence of treatments on the petiole length of the varieties at any stage of growth in both the seasons (Table 6b).

4.1.6.3. Interaction effect

The interaction effect for petiole length was not significant at any stage of growth in both the seasons (Table 6c).

4.1.7. Number of lobes

4.1.7.1. Varietal influence

Varietal difference for the number of lobes was not significant at 60 and 90 days after planting (Table 7a).

At 120 days after planting significant varietal difference for number of lobes was noticed. Variety Presley recorded the maximum number of lobes (5.66) which was on par with variety Eoliet and Pritty. Minimum number of lobes was recorded in variety Sunbird (4.69).

Table 6 b. Effect of treatments on petiole length (cm) in Gerbera jamesonii at different stages of growth

Treatments	Petiole length (cm)					
	Ist season			2nd season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
GA 50 ppm	4.08	3.81	3.81	3.63	3.07	3.09
GA 100 ppm	4.08	4.07	4.09	3.29	3.44	3.27
CCC 500 ppm	3.88	3.66	3.88	3.29	3.20	2.99
CCC 750 ppm	3.65	3.52	3.99	3.37	3.40	3.29
Control	3.52	3.36	3.52	3.35	3.23	3.08
CD	NS	NS	NS	NS	NS	NS
SEm±	0.229	0.211	0.201	0.366	0.297	0.075

Table 6 c. Interaction between variety and treatments on petiole length (cm) in Gerbera jamesonii at different stages of growth

Interaction	Petiole length (cm)					
	1st season			2nd season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
Eoliet x GA 50 ppm	3.58	3.21	3.59	2.37	3.92	2.70
Eoliet x GA 100 ppm	3.53	3.46	3.55	2.11	4.00	3.20
Eoliet x CCC 500 ppm	3.99	3.00	3.69	3.50	3.52	2.60
Eoliet x CCC 750 ppm	2.96	2.68	3.05	3.33	2.33	3.10
Eoliet x Control	3.12	2.91	3.35	3.70	2.67	3.33
Presley x GA 50 ppm	5.16	5.58	5.06	3.84	2.40	3.64
Presley x GA 100 ppm	5.75	5.79	5.13	4.55	3.68	3.71
Presley x CCC 500 ppm	5.21	5.50	4.88	4.18	3.29	2.88
Presley x CCC 750 ppm	5.00	5.13	4.55	3.12	4.22	3.32
Presley x Control	4.25	4.04	4.22	3.00	3.65	2.84
Pritty x GA 50 ppm	2.64	2.17	2.58	3.82	2.91	3.17
Pritty x GA 100 ppm	2.87	2.39	2.85	2.47	2.98	3.10
Pritty x CCC 500 ppm	2.20	2.49	2.99	2.17	3.10	3.48
Pritty x CCC 750 ppm	2.84	2.19	2.49	3.79	2.91	3.26
Pritty x Control	2.55	2.64	2.19	3.27	2.77	3.03
Sunbird x GA 50 ppm	4.93	4.28	4.03	4.49	3.04	2.86
Sunbird x GA 100 ppm	4.16	4.63	4.83	4.04	3.09	3.06
Sunbird x CCC 500 ppm	4.14	3.57	3.95	3.33	2.89	3.01
Sunbird x CCC 750 ppm	3.82	4.08	4.89	3.26	4.13	3.48
Sunbird x Control	4.15	3.84	4.32	3.43	3.84	3.13
CD	NS	NS	NS	NS	NS	NS
SEm±	0.458	0.423	0.403	0.672	0.593	0.151

Table 7 a. Effect of variety on number of lobes in Gerbera jamesonii at different stages of growth

Variety	Number of lobes					
	1st season			2nd season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
Eoliet	4.86	5.41	7.72	4.45	4.54	5.18
Presley	5.06	5.66	6.10	4.83	4.65	5.78
Pritty	5.24	5.31	7.56	4.89	4.98	5.12
Sunbird	4.74	4.69	7.20	4.60	4.51	4.60
CD	NS	0.62	0.89	NS	NS	NS
SEm±	0.200	0.217	0.313	0.157	0.198	0.261

During the second season there was no significant difference among the varieties for the number of lobes.

4.1.7.2. Treatment effect

None of the treatments had any significant effect on number of lobes at any stage of growth in both the seasons (Table 7b).

4.1.7.3. Interaction effect

The interaction was not significant for the number of lobes at any stage of growth in both the seasons (Table 7c).

4.2. Floral characters

4.2.1. Time taken for first flower bud emergence

4.2.1.1. Varietal influence

Significant variation in time taken for first flower bud emergence was noticed among varieties (Table 8a). Flower buds were produced earliest in variety Presley (85.40 days) which was on par with variety Pritty. Maximum number of days for first flower bud emergence was in variety Eoliet (95.73 days).

4.2.1.2. Treatment effect

Significant influence of growth regulators was noticed on the time taken for first flower bud emergence (Table 8b). T_1 (GA 50 ppm) hastened flowering (83.08 days) which was on par with T_2 (GA 100 ppm) and T_5 (control). In general T_3 (CCC 500 ppm) delayed flowering (99.58 days). This was on par with T_4 (CCC 750 ppm).

Table 7 b. Effect of treatments on number of lobes in Gerbera jamesonii at different stages of growth

Treatment	Number of lobes					
	1st season			2nd season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
GA 50 ppm	4.80	5.13	7.38	4.51	4.82	5.15
GA 100 ppm	5.05	5.24	7.32	4.60	5.05	5.13
CCC 500 ppm	5.22	5.22	6.94	4.96	4.31	5.02
CCC 750 ppm	4.90	5.51	7.16	4.79	4.63	5.32
Control	4.91	5.23	6.93	4.67	4.48	4.98
CD	NS	NS	NS	NS	NS	NS
SEm±	0.225	0.242	0.350	0.140	0.177	0.233

Table 7 c. Interaction between variety and treatments for the number of lobes in Gerbera jamesonii at different stages of growth

Interaction	Number of lobes					
	1st season			2nd season		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
Eoliet x GA 50 ppm	5.16	5.22	8.25	4.33	4.66	5.10
Eoliet x GA 100 ppm	5.11	5.25	8.20	4.37	4.81	5.10
Eoliet x CCC 500 ppm	5.25	5.47	6.14	4.91	5.26	5.04
Eoliet x CCC 750 ppm	4.23	5.43	7.90	4.19	4.06	5.56
Eoliet x Control	4.53	5.66	8.11	4.45	4.19	5.13
Presley x GA 50 ppm	4.83	5.89	6.28	4.69	4.39	6.29
Presley x GA 100 ppm	5.22	5.78	6.27	4.86	4.85	5.51
Presley x CCC 500 ppm	5.18	5.49	6.09	5.10	4.75	5.31
Presley x CCC 750 ppm	4.75	5.50	6.21	4.67	4.35	5.41
Presley x Control	5.35	5.64	5.66	4.85	5.20	5.38
Pritty x GA 50 ppm	4.30	4.35	7.11	4.13	4.09	4.05
Pritty x GA 100 ppm	5.36	5.47	7.38	4.91	5.26	5.39
Pritty x CCC 500 ppm	5.46	5.63	7.66	4.88	5.16	5.50
Pritty x CCC 750 ppm	5.60	5.72	8.40	5.52	5.33	5.28
Pritty x Control	5.47	5.36	7.25	5.04	5.13	5.36
Sunbird x GA 50 ppm	4.89	5.07	7.87	4.90	4.78	5.15
Sunbird x GA 100 ppm	4.52	4.48	7.44	4.24	4.37	4.51
Sunbird x CCC 500 ppm	4.99	4.28	7.87	4.96	5.01	4.24
Sunbird x CCC 750 ppm	5.00	5.37	6.13	4.79	4.50	5.05
Sunbird x Control	4.31	4.25	6.69	4.33	4.00	4.07
CD	NS	NS	NS	NS	NS	NS
SEm±	0.449	0.485	0.699	0.314	0.396	0.273

Table 8a. Effect of variety on days to first flower bud emergence and longevity of flowers in Gerbera jamesonii

Variety	Days to first flower bud emergence	Longevity (days)	
		1st season	2nd season
Eoliet	95.73	13.27	11.88
Presley	85.40	10.87	10.13
Pritty	87.33	11.33	10.50
Sunbird	92.80	12.07	11.43
CD	5.41	1.40	NS
SEm±	1.891	0.488	0.545

Table 8b. Effect of treatments on days to first bud emergence and longevity of flowers in Gerbera jamesonii

Treatment	Days to first flower bud emergence	Longevity (days)	
		1st season	2nd season
GA 50 ppm	83.08	12.00	11.08
GA 100 ppm	86.83	11.08	10.45
CCC 500 ppm	99.58	10.75	9.87
CCC 750 ppm	93.08	13.25	12.04
Control	89.00	12.33	11.47
CD	6.05	1.56	NS
SEm±	2.114	0.545	0.609

4.2.1.3. Interaction effect

Interaction effect was significant for the days to first flower bud emergence (Table 8c). Earliest flower bud emergence (79 days) was noticed in V_2T_2 (Presley x GA 100 ppm). Longest time (107.67 days) was taken by V_1T_3 (Eoliet x CCC 500 ppm). Both the concentrations of GA showed a significant decrease in the time taken for flower bud emergence compared to CCC 500 ppm, irrespective of the variety.

In Eoliet, T_2 (GA 100 ppm) produced flowers earlier (89 days) which was on par with T_1 (GA 50 ppm). Flowering was delayed (107.67 days) by T_3 (CCC 500 ppm).

Flowering was hastened in Presley (79 days) by T_2 (GA 100 ppm) and delayed (103.67 days) by T_3 (CCC 500 ppm). T_2 (GA 100 ppm) was on par with T_1 (GA 50 ppm) and T_4 (CCC 750 ppm).

T_1 (GA 50 ppm) hastened flowering (82.67 days) in Pritty, which was on par with T_4 (CCC 750 ppm), T_2 (GA 100 ppm) and T_5 (control). T_3 (CCC 500 ppm) delayed flowering (99.33 days).

The shortest time period (79.67 days) for first flower bud emergence was taken by T_1 (GA 50 ppm) in variety Sunbird. This was significantly superior to T_3 (CCC 500 ppm) which recorded the longest duration (103.67 days).

Table 8c. Interaction between variety and treatments for days to first flower bud emergence and longevity of flowers in Gerbera jamesonii

Interaction	Days to first flower bud emergence	Longevity (days)	
		1st season	2nd season
Eoliet x GA 50 ppm	90.00	13.00	11.66
Eoliet x GA 100 ppm	89.00	11.00	10.00
Eoliet x CCC 500 ppm	107.67	11.67	10.50
Eoliet x CCC 750 ppm	96.33	16.67	14.60
Eoliet x Control	95.67	14.00	13.08
Presley x GA 50 ppm	80.00	13.00	12.00
Presley x GA 100 ppm	79.00	13.00	12.66
Presley x CCC 500 ppm	103.67	7.67	7.00
Presley x 750 ppm	81.67	10.67	9.83
Presley x Control	82.67	10.00	9.16
Pritty x GA 50 ppm	82.67	10.00	9.33
Pritty x GA 100 ppm	84.00	10.00	9.33
Pritty x CCC 500 ppm	99.33	11.67	10.66
Pritty x CCC 750 ppm	83.67	13.67	12.50
Pritty x Control	87.00	11.33	10.66
Sunbird x GA 50 ppm	79.67	12.00	11.33
Sunbird x GA 100 ppm	95.33	10.33	9.83
Sunbird x CCC 500 ppm	103.67	12.00	11.33
Sunbird x CCC 750 ppm	94.67	12.00	11.66
Sunbird x Control	90.67	14.00	13.00
CD	12.11	3.12	NS
SEm±	4.229	1.091	1.218

100 ppm). T_3 (CCC 500 ppm) and T_1 (GA 50 ppm) were on par with T_2 (GA 100 ppm).

Longevity of flower in Presley was maximum (13 days) in T_1 (GA 50 ppm) and T_2 (GA 100 ppm) which was on par with T_4 (CCC 750 ppm). Longevity was the shortest (7.67 days) in T_3 (CCC 500 ppm).

In Pritty the maximum longevity (13.67 days) was recorded in T_4 (CCC 750 ppm) which was on par with T_3 (CCC 500 ppm). Longevity was minimum (10 days, each) in T_1 (GA 50 ppm) and T_2 (GA 100 ppm).

T_5 (control) recorded the longest duration for longevity in Sunbird (14 days) which was on par with T_1 (GA 50 ppm), T_3 (CCC 500 ppm) and T_4 (CCC 750 ppm). The minimum period (10.33 days) was exhibited by T_2 (GA 100 ppm).

The interaction effect was not significant in the second season.

4.2.3. Number of flowers

4.2.3.1. Varietal influence

Varieties differed significantly with respect to the number of blooms produced in the first season (Table 9a). Variety Presley had significantly higher (22.40) number of blooms. Number of blooms was the lowest in variety Eoliet (10.93) which was on par with Pritty (11.33). Compared to Eoliet and Pritty, Sunbird produced significantly higher number of flowers (19.53).

4.2.2. Longevity (of flowers) in field

4.2.2.1. Varietal influence

Varieties differed significantly with respect to longevity of flowers under field conditions in the first season (Table 8a). Longevity was maximum in variety Eoliet (13.27 days) which was on par with variety Sunbird. Variety Presley had the least longevity (10.87 days). In the second season the influence was not significant.

4.2.2.2. Treatment effect

Under field conditions treatments significantly influenced the longevity of flowers in the first season (Table 8b). T_4 (CCC 750 ppm) was found to have the best effect (13.25 days) which was on par with T_1 (GA 50 ppm). T_3 (CCC 500 ppm) showed an adverse effect by reducing the longevity of flower to 10.75 days. The treatments did not have any significant effect in the second season.

4.2.2.3. Interaction effect

Variety treatment interaction for longevity of flowers under field conditions was found highly significant (Table 8c). Longevity of flowers was prolonged (16.67) in V_1T_4 (Eoliet x CCC 750 ppm). Minimum longevity (7.67 days) was recorded in V_2T_3 (Presley x CCC 500 ppm).

In Eoliet maximum longivity (16.67 days) was recorded in T_4 (CCC 750 ppm) while it was minimum (11.00 days) in T_2 (GA

Table 9 a. Effect of variety on total flower production (in 5 months) in *Gerbera jamesonii*

Variety	Number of flowers	
	1st season	2nd season
Eoliet	10.93	6.40
Presley	22.40	5.73
Pritty	11.33	5.53
Sunbird	19.53	6.53
CD	1.87	NS
SEm±	0.654	0.448

In the second season varietal influence was not found to be significant.

4.2.3.2. Treatment effect

In the first season treatments were found to influence significantly the number of blooms produced (Table 9b). T_4 (CCC 750 ppm) had the best influence (18.75) which was on par with T_2 (GA 100 ppm). T_5 (control) had the least (12.83) effect.

The treatments did not significantly influence the flower number in the second season.

4.2.3.3. Interaction

The interaction between variety and treatment for flower production was not significant in both the seasons (Table 9c).

4.2.4. Bud emergence to opening

4.2.4.1. Varietal influence

Varietal influence on bud emergence to opening differed significantly in all months (December, January, February) except March.

All the varieties except Eoliet bloomed in December (Table 10a). Sunbird took significantly lesser time (6.27 days) from bud emergence to opening compared to Presley (10.2 days).

Variety Pritty took minimum number of days during January and February which was on par with Eoliet (13.07 and 13.87 days,

Table 9 b. Effect of treatments on total flower production (in 5 months) in Gerbera jamesonii

Treatment	Number of flowers	
	1st season	2nd season
GA 50 ppm	15.33	5.25
GA 100 ppm	17.25	6.58
CCC 500 ppm	16.08	6.16
CCC 750 ppm	18.75	5.72
Control	12.83	6.50
CD	2.09	NS
SEm±	0.731	0.400

Table 9 c. Interaction between variety and treatments for total flower production (in 5 months) in Gerbera jamesonii

Interaction	Number of flowers	
	1st season	2nd season
Eoliet x GA 50 ppm	10.33	5.66
Eoliet x GA 100 ppm	11.67	7.66
Eoliet x CCC 500 ppm	11.00	7.66
Eoliet x CCC 750 ppm	12.33	4.66
Eoliet x Control	9.33	6.33
Presley x GA 50 ppm	21.00	5.00
Presley x 100 ppm	21.67	6.66
Presley x CCC 500 ppm	25.00	4.00
Presley x CCC 750 ppm	25.67	6.00
Presley x Control	18.67	7.00
Pritty x GA 50 ppm	10.67	4.00
Pritty x GA 100 ppm	13.00	6.00
Pritty x CCC 500 ppm	11.33	5.00
Pritty x CCC 750 ppm	12.67	6.00
Pritty x Control	9.00	6.66
Sunbird x GA 50 ppm	12.00	6.33
Sunbird x GA 100 ppm	22.67	6.00
Sunbird x CCC 500 ppm	17.00	8.00
Sunbird x CCC 750 ppm	24.33	6.33
Sunbird x Control	14.33	6.00
CD	3.12	NS
SEm±	1.091	0.896

Table 10 a. Effect of variety on bud emergence to opening in *Gerbera jamesonii* in different months.

Variety	Bud emergence to opening (days)			
	December	January	February	March
Eoliet	0.0	13.80	14.00	14.27
Presley	10.20	15.27	15.33	15.73
Pritty	7.40	13.07	13.87	15.33
Sunbird	6.27	15.60	16.13	16.20
CD	2.83	1.72	1.22	NS
SEm±	0.989	0.602	0.425	0.580

respectively). Both in January and February variety Sunbird took the maximum number of days (15.60 and 16.13 days, respectively).

4.2.4.2. Treatment effect

Treatments did not significantly influence the period from bud emergence to opening during January (Table 10b).

Treatments exerted significant influence during February. T_5 (control) had the shortest period (13.67 days) from bud emergence to opening. This was on par with T_1 (GA 50 ppm) and T_2 (GA 100 ppm). This period was delayed by T_3 (CCC 500 ppm) which was on par with T_4 (CCC 750 ppm).

There was significant influence of treatments during March. T_5 (control) took the shortest period (14.50 days) from bud emergence to opening. This was on par with T_1 (GA 50 ppm) and T_2 (GA 100 ppm). T_4 (CCC 750 ppm) extended the period (17.08 days). It took three more days for opening compared to control.

4.2.4.3. Interaction effect

The interaction effect was not significant during any of the months (Table 10c).

4.2.5. Flower diameter

4.2.5.1. Varietal influence

Variety had no significant influence on flower diameter during January (Table 11a).

Table 10 b. Effect of treatment on bud emergence to opening in Gerbera jamesonii in different months

Treatment	Bud emergence to opening (days)			
	December	January	February	March
GA 50 ppm	7.33	13.50	14.17	14.67
GA 100 ppm	3.83	13.67	14.33	14.67
CCC 500 ppm	3.75	14.00	16.58	16.00
CCC 750 ppm	5.92	15.58	15.92	17.08
Control	9.25	15.42	13.67	14.50
CD	3.17	NS	1.36	1.86
SEm±	1.106	0.673	0.476	0.648

Table 10 c. Interaction between variety and treatments on bud emergence to opening in Gerbera jamesonii in different months

Interaction	Bud emergence to opening (days)			
	December	January	February	March
Eoliet x GA 50 ppm	0.00	14.00	14.00	14.67
Eoliet x GA 100 ppm	0.00	15.33	14.00	13.33
Eoliet x CCC 500 ppm	0.00	11.00	15.00	15.67
Eoliet x CCC 750 ppm	0.00	16.00	14.33	15.00
Eoliet x Control	0.00	12.67	12.67	12.67
Presley x GA 50 ppm	13.00	15.33	14.00	15.00
Presley x GA 100 ppm	9.33	14.00	15.67	16.00
Presley x CCC 500 ppm	0.00	14.67	17.67	17.00
Presley x CCC 750 ppm	15.33	16.33	16.00	16.67
Presley x Control	13.33	16.80	13.33	14.00
Pritty x GA 50 ppm	0.00	11.00	14.33	14.67
Pritty x GA 100 ppm	5.00	10.33	13.00	13.67
Pritty x CCC 500 ppm	15.00	15.00	16.00	16.00
Pritty x CCC 750 ppm	8.33	14.00	15.00	19.33
Pritty x Control	8.66	15.00	11.00	13.00
Sunbird x GA 50 ppm	16.33	13.67	14.33	14.33
Sunbird x GA 100 ppm	0.00	15.00	14.67	15.67
Sunbird x CCC 500 ppm	0.00	15.33	17.67	15.33
Sunbird x CCC 750 ppm	0.00	16.00	18.33	17.33
Sunbird x Control	15.00	18.00	15.67	15.33
CD	6.33	NS	NS	NS
SEm±	2.212	1.347	0.951	1.297

Table 11 a. Effect of variety on flower diameter (cm) in Gerbera jamesonii in different months

Variety	Flower diameter (cm)					
	1st season				2nd season	
	December	January	February	March	February	March
Eoliet	0.00	9.97	10.21	9.41	7.49	8.49
Presley	7.34	9.89	9.07	8.98	9.77	7.86
Pritty	4.62	9.55	9.44	9.18	8.82	8.13
Sunbird	4.16	10.22	9.36	9.97	8.53	8.61
CD	1.42	NS	0.40	0.39	0.86	NS
SEm±	0.495	0.198	0.139	0.317	0.300	0.290

During February significant varietal influence was noticed. Eoliet produced the largest flower (10.21 cm) while Presley produced the smallest (9.07 cm) in the first season. In the second season variety Eoliet had the minimum diameter (7.49 cm) while variety Presley had the maximum (9.77 cm) diameter.

In March flower diameter was significantly influenced by variety. Flower diameter was maximum in variety Sunbird (9.97 cm). Minimum diameter was in variety Presley (8.98 cm) in the first season. Even though the varieties failed to influence flower diameter during the same period in second season, variety Sunbird recorded the maximum flower diameter (8.61 cm).

4.2.5.2. Treatment effect

Treatments were found significant for flower diameter during January (Table 11b). T_4 (CCC 750 ppm) had the best effect (10.47 cm) which was on par with T_1 (GA 50 ppm) and T_2 (GA 100 ppm). T_5 (control) had the least effect (9.35 cm) on flower diameter.

During February and March the effect was non significant.

The effect of treatments on flower diameter was not significant during the second season.

4.2.5.3. Interaction effect

In January none of the treatments produced significant interaction for flower diameter (Table 11c). During February and March

Table 11 b. Effect of treatments on flower diameter (cm) in Gerbera jamesonii in different months

Treatment	Flower diameter (cm)					
	1st season				2nd season	
	December	January	February	March	February	March
GA 50 ppm	4.29	9.95	9.61	9.54	7.82	8.62
GA 100 ppm	2.58	10.20	9.99	9.55	8.98	8.89
CCC 500 ppm	2.32	9.57	9.43	9.47	8.02	8.08
CCC 750 ppm	4.05	10.47	9.38	9.48	8.85	8.07
Control	6.90	9.35	9.28	9.08	7.94	8.31
CD	1.58	0.63	NS	NS	NS	NS
SEm±	0.554	0.221	0.115	0.153	0.336	0.324

Table 11 c. Interaction between variety and treatments on flower diameter (cm) in *Gerbera jamesonii* in different months

Interaction	Flower diameter (cm)					
	1st season				2nd season	
	December	January	February	March	February	March
Eoliet x GA 50 ppm	0.00	9.97	11.15	9.77	7.35	9.48
Eoliet x GA 100 ppm	0.00	10.26	10.75	9.75	7.86	9.08
Eoliet x CCC 500 ppm	0.00	9.92	9.89	9.65	7.58	7.68
Eoliet x CCC 750 ppm	0.00	9.88	9.29	8.79	6.88	7.60
Eoliet x Control	0.00	9.82	9.82	9.72	6.37	8.63
Presley x GA 50 ppm	6.60	9.90	8.65	8.90	7.56	8.23
Presley x GA 100 ppm	10.33	10.39	9.35	9.15	8.38	9.25
Presley x CCC 500 ppm	0.00	9.00	8.95	9.11	7.00	8.38
Presley x CCC 750 ppm	10.05	10.82	9.17	8.64	8.02	7.96
Presley x Control	9.72	9.33	9.33	9.11	7.32	7.50
Pritty x GA 50 ppm	0.00	9.53	9.67	9.87	9.20	8.56
Pritty x GA 100 ppm	0.00	9.99	9.80	9.98	9.25	9.90
Pritty x CCC 500 ppm	9.30	9.56	9.40	9.29	8.96	7.53
Pritty x CCC 750 ppm	6.13	10.30	9.12	9.42	9.30	8.45
Pritty x Control	7.67	8.38	9.20	8.15	7.38	8.20
Sunbird x GA 50 ppm	10.57	10.39	8.97	10.27	7.18	8.23
Sunbird x GA 100 ppm	0.00	10.17	9.38	10.23	8.83	8.93
Sunbird x CCC 500 ppm	0.00	9.82	9.50	9.84	8.55	8.73
Sunbird x CCC 750 ppm	0.00	10.87	9.53	10.28	8.40	8.26
Sunbird x Control	10.23	9.88	9.43	9.32	8.70	8.90
CD	3.17	NS	0.89	0.88	NS	NS
SEm±	1.107	0.442	0.310	0.307	0.672	0.649

there was significant effect of treatments on flower diameter in all the varieties.

In variety Eoliet T_1 (GA 50 ppm) was found superior (11.15 cm) to all other treatments which was on par with T_2 (GA 100 ppm). T_4 (CCC 750 ppm) was found inferior (9.29 cm).

In Presley all the treatments were on par. In Pritty T_2 (GA 100 ppm) was found the best treatment in February and March. In February this was on par with all the other treatments, whereas in March it was significantly superior to others.

In Sunbird also there was significant difference between treatments for flower diameter. T_4 (CCC 750 ppm) emerged as the best treatment during all the three months. This was found to be on par with all the other treatments during the month of February. In March, all the treatments were on par and significantly higher than control.

No significant interaction was found during the second season for flower diameter.

4.2.6. Stalk length

4.2.6.1. Varietal influence

Significant variation in the length of the stalk was noticed during all the three months (Table 12a). In January variety Sunbird produced the longest stalks (37.56 cm) while variety Pritty had the shortest stalks (26.44 cm).

Table 12 a. Effect of variety on stalk length (cm) in Gerbera jamesonii in different months

Variety	Stalk length (cm)					
	1st season				2nd season	
	December	January	February	March	February	March
Eoliet	0.00	28.14	30.28	28.13	28.43	27.80
Presley	23.74	34.59	31.01	28.58	31.13	28.33
Pritty	14.69	26.44	27.89	27.82	28.73	28.26
Sunbird	13.90	37.56	32.50	36.51	32.46	28.86
CD	4.73	2.96	3.12	2.25	NS	NS
SEm±	1.651	1.034	1.090	0.787	1.308	0.281

Variety had significant influence on stalk length during February, with Sunbird having maximum stalk length (32.50 cm) which was on par with varieties Presley and Eoliet. Pritty had the shortest stalk (27.89 cm).

Significant difference in stalk length of different varieties was noticed in March. The longest stalks were that of Sunbird (36.51 cm) while the shortest stalks were that of Pritty (27.82 cm).

During the second season varietal influence on stalk length was not significant.

4.2.6.2. Treatment effect

Treatments significantly influenced the stalk length in December and January (Table 12b). In January T_4 (CCC 750 ppm) produced the longest stalks (34.60 cm) which was on par with T_2 (GA 100 ppm) and T_3 (CCC 500 ppm). T_5 (control) produced the shortest stalks (29.50 cm).

No significant influence of treatments on stalk length was recorded in February and March.

Treatments did not have any significant influence on stalk length during the second season.

4.2.6.3. Interaction effect

The interaction effect for stalk length was not found significant

Table 12 b. Effect of treatments on stalk length (cm) in Gerbera jamesonii in different months

Treatment	Stalk length (cm)					
	1st season				2nd season	
	December	January	February	March	February	March
GA 50 ppm	15.17	30.60	31.00	30.78	28.79	29.25
GA 100 ppm	8.31	34.56	32.36	31.96	30.08	30.41
CCC 500 ppm	8.00	32.14	30.81	29.65	28.66	29.33
CCC 750 ppm	11.48	34.60	30.24	28.88	29.33	27.66
Control	22.45	29.50	27.69	30.04	27.91	27.91
CD	5.29	3.31	NS	NS	NS	NS
SEm±	1.846	1.157	1.220	0.880	1.463	0.314

during any of the months viz., January, February and March (Table 12c).

4.2.7. Stalk girth

4.2.7.1. Varietal influence

Stalk diameter had significant varietal influence during December, January and March (Table 13a). In January variety Sunbird produced stalks with maximum girth (2.32 cm) which was on par with Eoliet. Variety Pritty had the minimum stalk girth (2.08 cm).

The varieties did not have any significant influence on stalk girth in February.

In March significant varietal influence on stalk girth was noticed. Maximum stalk girth was in variety Eoliet (2.15 cm) which was on par with Sunbird (2.11 cm). Stalk girth was the minimum in variety Pritty (1.91 cm).

In the second season there was no varietal influence on stalk girth.

4.2.7.2. Treatments effect

The treatments did not have any significant effect on the stalk girth in both the seasons in any of the three months (Table 13b) viz., January, February and March.

Table 12 c. Interaction between variety and treatments on stalk length (cm) in Gerbera jamesonii in different months

Interaction	Stalk length (cm)					
	1st season				2nd season	
	December	January	February	March	February	March
Eoliet x GA 50 ppm	0.00	29.93	31.00	25.44	27.50	32.33
Eoliet x GA 100 ppm	0.00	27.26	33.00	30.43	23.33	27.00
Eoliet x CCC 500 ppm	0.00	27.67	27.67	30.50	22.66	27.33
Eoliet x CCC 750 ppm	0.00	27.98	27.36	24.00	25.33	25.66
Eoliet x Control	0.00	27.87	32.37	30.29	24.66	26.66
Presley x GA 50 ppm	23.19	34.22	30.75	29.11	34.00	32.33
Presley x GA 100 ppm	33.25	34.63	30.43	30.17	30.33	28.33
Presley x CCC 500 ppm	0.00	34.25	33.08	27.00	30.66	29.00
Presley x CCC 750 ppm	31.42	38.00	31.17	28.60	30.66	28.66
Presley x Control	30.85	31.84	29.62	28.00	28.00	23.33
Pritty x GA 50 ppm	0.00	22.00	29.77	30.33	24.00	26.33
Pritty x GA 100 ppm	0.00	28.00	31.75	29.50	25.00	30.33
Pritty x CCC 500 ppm	32.00	26.99	28.00	26.37	28.33	30.33
Pritty x CCC 750 ppm	14.50	30.67	28.68	28.42	23.00	29.00
Pritty x Control	26.93	24.55	21.25	24.50	28.33	29.33
Sunbird x GA 50 ppm	37.50	36.28	32.50	38.23	32.66	30.00
Sunbird x GA 100 ppm	0.00	36.36	34.25	39.75	33.66	29.00
Sunbird x CCC 500 ppm	0.00	39.67	34.50	34.71	33.00	30.66
Sunbird x CCC 750 ppm	0.00	41.75	33.77	34.49	33.33	27.33
Sunbird x Control	32.00	33.75	27.50	37.37	29.66	28.33
CD	10.57	NS	NS	NS	NS	NS
SEm±	3.693	2.313	2.439	1.760	2.926	0.629

Table 13 a. Effect of variety on stalk (girth) (cm) in Gerbera jamesonii in different months

Variety	Stalk diameter (cm)					
	1st season				2nd season	
	December	January	February	March	February	March
Eoliet	0.00	2.30	2.12	2.15	1.64	1.67
Presley	1.56	2.10	2.00	1.99	1.81	1.87
Pritty	1.08	2.08	2.03	1.93	1.80	1.65
Sunbird	0.90	2.32	2.13	2.16	1.70	1.55
CD	0.32	0.21	NS	0.13	NS	NS
SEm±	0.112	0.073	0.044	0.048	0.063	0.057

Table 13 b. Effect of treatments on stalk girth (cm) in Gerbera jamesonii in different months

Treatment	Stalk diameter (cm)					
	1st season				2nd season	
	December	January	February	March	February	March
GA 50 ppm	0.93	2.11	2.17	2.13	1.79	1.83
GA 100 ppm	0.59	2.29	2.02	2.09	1.85	1.64
CCC 500 ppm	0.49	2.10	1.02	1.03	1.65	1.62
CCC 750 ppm	0.90	2.32	2.08	2.00	1.60	1.67
Control	1.52	2.17	2.06	1.99	1.66	1.66
CD	0.36	NS	NS	NS	NS	NS
SEm±	0.126	0.082	0.050	0.054	0.070	0.063

4.2.7.3. Interaction effect

The interaction effect of varieties and treatments was not significant during January (Table 13c).

Variety treatment interaction was found to be significant during February and March. In February V_1T_1 (Eoliet x GA 50 ppm) had the maximum stalk girth (2.60 cm) while V_2T_1 (Presley x GA 50 ppm) had the minimum stalk girth (1.85 cm).

In variety Eoliet maximum stalk girth (2.60 cm) was in T_1 (GA 50 ppm) and minimum (1.85 cm) in T_2 (GA 100 ppm).

T_2 (GA 100 ppm) had the maximum girth in Presley (2.08 cm) which was on par with T_2 (control), T_4 (CCC 750 ppm), T_3 (CCC 500 ppm) and T_1 (GA 50 ppm).

In variety Pritty all the treatments were on par.

In variety Sunbird T_1 (GA 50 ppm) had the maximum (2.29 cm) influence on stalk girth and this was on par with all the other treatment i.e., T_3 (CCC 750 ppm), T_2 (GA 100 ppm), T_4 (CCC 750 ppm) and T_5 (control).

In March T_1 (GA 50 ppm) had the best effect on stalk girth in Eoliet (2.32 cm). This was on par with all the other

Table 13 c. Interaction between variety and treatments on stalk girth (cm) in Gerbera jamesonii in different months

Interaction	Stalk diameter (cm)					
	1st season				2nd season	
	December	January	February	March	February	March
Eoliet x GA 50 ppm	0.00	2.27	2.60	2.32	1.68	1.86
Eoliet x GA 100 ppm	0.00	2.37	1.85	2.23	1.72	1.65
Eoliet x CCC 500 ppm	0.00	2.35	2.00	2.07	1.48	1.50
Eoliet x CCC 750 ppm	0.00	2.23	1.91	2.03	1.65	1.66
Eoliet x Control	0.00	2.28	2.25	2.22	1.67	1.76
Presley x GA 50 ppm	1.39	2.27	1.80	1.88	1.67	1.60
Presley x 100 ppm	2.37	2.17	2.08	2.00	1.92	2.00
Presley x CCC 500 ppm	0.00	1.70	2.02	1.95	1.72	1.74
Presley x CCC 750 ppm	2.13	2.25	2.05	1.90	1.82	1.80
Presley x Control	1.92	2.12	2.06	2.20	1.81	1.66
Pritty x GA 50 ppm	0.00	1.65	2.13	2.17	1.93	1.80
Pritty x GA 100 ppm	0.00	2.29	2.00	1.93	2.03	1.98
Pritty x CCC 500 ppm	1.97	2.18	1.80	1.99	1.73	1.73
Pritty x CCC 750 ppm	1.47	2.13	2.01	2.00	1.81	1.83
Pritty x Control	1.95	2.13	1.95	1.58	1.50	1.73
Sunbird x GA 50 ppm	2.32	2.26	2.29	2.28	1.86	1.63
Sunbird x GA 100 ppm	0.00	2.34	2.18	2.20	1.94	1.83
Sunbird x CCC 500 ppm	0.00	2.15	2.20	2.10	1.70	1.50
Sunbird x CCC 750 ppm	0.00	2.68	2.13	2.06	1.83	1.60
Sunbird x Control	2.20	2.16	2.00	1.95	1.66	1.50
CD	0.72	NS	0.28	0.31	NS	NS
SEm±	0.251	0.164	0.099	0.107	0.147	0.127

treatments viz., T_2 (GA 100 ppm), T_5 (control), T_3 (CCC 500 ppm) and T_4 (CCC 750 ppm).

In variety Presley T_5 (control) produced the maximum (2.20 cm) girth of stalks which was on par with T_2 (GA 100 ppm), T_3 (CCC 500 ppm) and T_4 (CCC 750 ppm). T_1 (GA 50 ppm) produced the minimum (1.88 cm) stalk girth

T_1 (GA 50 ppm) had the greatest influence (2.17 cm) on stalk girth in variety Pritty. This was on par with T_4 (CCC 750 ppm), T_3 (CCC 500 ppm) and T_2 (GA 100 ppm). T_5 (control) had the least (1.58 cm) influence.

In variety Sunbird T_1 (GA 50 ppm) produced the maximum (2.28 cm) stalk girth which was on par with all the other treatments.

There was no significant interaction effect for stalk girth in the second season.

4.3. Vase studies

4.3.1. Vase life

The effects of different treatments given to extend the vase life of flowers of different varieties are given in Table 14a. The flowers of all the varieties recorded the maximum vase life in the holding solution of 5 per cent sucrose + 20 ppm $AgNO_3$ (12.66 days). This was on par with 5 per cent sucrose + 20 ppm $AgNO_3$

Table 14a. Effect of vase treatments on the vase life (days) of flowers

Variety	Vase life (days)			
	Water	5% sucrose	5% sucrose + 20 ppm $AgNO_3$	5% sucrose + 20 ppm $AgNO_3$ + 500 ppm HQC
Eoliet	1.58	3.16	12.39	10.70
Presley	1.25	4.16	11.41	10.16
Pritty	1.75	5.00	13.69	9.75
Sunbird	1.58	3.00	13.16	13.08
Mean	1.54	3.83	12.66	10.92
CD for comparing treatments	2.29			
SEm±	0.8			

+ 500 ppm HQC (10.92 days). Minimum vase life was recorded in water (1.54 days).

The best vase treatment was used for studying the water uptake of flowers.

4.3.1.1. Varietal influence

Varieties had significant influence on the vase life of flowers (Table 14b). Vase life was the maximum in variety Pritty (10.95 days). This was on par with Sunbird (10.53 days) and Eoliet (9.91 days). Variety Presley recorded the least number of days in vase (9.13 days).

4.3.1.2. Treatment effect

The treatments given to plants had significant influence on the vase life of flowers (Table 14c). Vase life was extended (11.42 days) by T_2 (GA 100 ppm). This was on par with T_4 (CCC 750 ppm) and T_3 (CCC 500 ppm). T_1 (GA 50 ppm) resulted in least vase life (8.71 days).

4.3.1.3. Interaction effect

The interaction effect of varieties and treatments was not significant for vase life in water, in 5 per cent sucrose and in 5 per cent sucrose with 20 ppm $AgNO_3$ (Table 14d).

With 5 per cent sucrose, 20 ppm $AgNO_3$ and 500 ppm HQC in Eoliet maximum (9.97 days) vase life was in T_5 (control). This

Table 14b. Effect of variety on vase life (days), fresh weight (g) and water uptake (ml) in flowers of *Gerbera jamesonii*

Variety	Vase life (days)				Fresh weight (g)	Water uptake (ml)
	Water	5% sucrose	5% sucrose + 20 ppm $AgNO_3$	5% sucrose + 20 ppm $AgNO_3$ + 500 ppm HQC		
Eoliet	1.27	2.40	9.91	8.53	17.51	62 59
Presley	1.33	3.33	9.13	8.13	16.75	52.54
Pritty	1.40	4.00	10.95	7.80	18.08	63.10
Sunbird	1.27	2.40	10.53	10.47	17.79	67.08
CD	NS	1.03	1.10	1.27	NS	10.00
SEm±	0.126	0.359	0.385	0.443	0.541	3.494

Table 14c. Interaction between variety and treatments on vase life (days), fresh weight (g) and water uptake (ml) in flowers of *Gerbera jamesonii*

Interaction	Vase life (days)				Fresh weight (g)	Water uptake (ml)
	Water	5% sucrose	5% sucrose + 20 ppm $AgNO_3$	5% sucrose + 20 ppm $AgNO_3$ + 500 ppm HQC		
Eoliet x GA 50 ppm	1.33	2.00	7.77	6.33	19.20	59.55
Eoliet x GA 100 ppm	1.67	2.33	11.00	8.67	21.20	76.37
Eoliet x CCC 500 ppm	1.00	3.00	10.25	9.33	16.17	68.43
Eoliet x CCC 750 ppm	1.33	2.67	11.00	8.67	15.20	51.50
Eoliet x control	1.00	2.00	9.55	9.67	15.78	57.08
Presley x GA 50 ppm	1.67	4.33	8.08	8.67	15.78	61.67
Presley x GA 100 ppm	1.33	3.67	10.83	9.00	15.66	46.12
Presley x CCC 500 ppm	1.00	4.00	11.00	7.00	18.76	47.62
Presley x CCC 750 ppm	1.33	2.67	8.00	6.33	16.33	47.08
Presley x control	1.33	2.00	7.75	9.67	17.23	60.18
Pritty x GA 50 ppm	1.33	2.33	9.83	8.33	18.44	55.18
Pritty x GA 100 ppm	1.67	6.00	11.83	7.00	19.75	86.67
Pritty x CCC 500 ppm	1.00	5.00	10.33	7.67	17.92	63.13
Pritty x CCC 750 ppm	2.00	3.33	12.17	8.67	17.72	55.75
Pritty x control	1.00	3.33	10.61	7.33	16.55	54.79
Sunbird x GA 50 ppm	1.33	1.67	9.16	12.00	15.83	58.45
Sunbird x GA 100 ppm	1.00	2.33	12.00	10.33	19.80	78.50
Sunbird x CCC 500 ppm	1.67	3.00	9.67	11.00	17.71	64.58
Sunbird x CCC 750 ppm	1.00	3.00	12.00	11.33	19.62	66.37
Sunbird x control	1.33	2.00	9.83	7.67	17.00	67.50
CD	NS	NS	NS	2.84	3.46	NS
SEm±	0.282	0.803	0.861	0.991	1.210	7.813

Table 14d. Effect of treatments on vase life (days), fresh weight (g) and water uptake (ml) in flowers of Gerbera jamesonii

Treatment	Vase life (days)				Fresh weight (g)	Water uptake (ml)
	Water	5% sucrose	5% sucrose + 20 ppm $AgNO_3$	5% sucrose + 20 ppm $AgNO_3$ + 500 ppm HQC		
GA 50 ppm	1.42	2.58	8.71	8.83	17.31	58.71
GA 100 ppm	1.42	3.58	11.42	8.75	19.10	71.92
CCC 500 ppm	1.17	3.75	10.31	8.75	17.64	60.95
CCC 750 ppm	1.42	2.92	10.79	8.75	17.22	55.18
Control	1.17	2.33	9.44	8.58	16.64	59.89
CD	NS	NS	1.23	NS	NS	11.18
SEm±	0.141	0.401	0.431	0.495	0.605	3.906

was on par with T_3 (CCC 500 ppm), T_4 (CCC 750 ppm) and T_2 (GA 100 ppm), T_1 (GA 50 ppm) recorded the least (6.33) life in vase.

In Presley T_5 (control) exhibited maximum life in vase (9.67 days) which was on par with T_2 (GA 100 ppm), T_1 (GA 50 ppm) and T_3 (CCC 500 ppm). T_4 (CCC 750 ppm) had the minimum vase life (6.33 days).

In Pritty maximum (8.67 days) vase life was in T_4 (CCC 750 ppm) and this was on par with all the other treatments i.e., T_1 (GA 50 ppm), T_3 (CCC 500 ppm), T_5 (control) and T_2 (GA 100 ppm).

T_1 (GA 50 ppm) was found to be the best treatment (12.00 days) in Sunbird. This was on par with T_4 (CCC 750 ppm), T_3 (CCC 500 ppm) and T_2 (GA 100 ppm). T_5 (control) had the least effect in increasing vase life (7.67 days).

4.3.2. Fresh weight of flowers

4.3.2.1. Varietal influence

There was no significant influence of variety on the fresh weight of the flowers (Table 14a).

4.3.2.2. Treatment effect

The treatments did not have any significant influence on fresh weight of flowers (Table 14b).

4.3.2.3. Interaction effect

The interaction effect was significant for the fresh weight of flowers (Table 14c). Maximum interaction (21.20 g) was in V_1T_2 (Eoliet x GA 100 ppm). This was on par with V_4T_2 (Sunbird x GA 100 ppm), V_3T_2 (Pritty x GA 100 ppm), V_4T_4 (Sunbird x CCC 750 ppm), V_1T_1 (Eoliet x GA 50 ppm), V_2T_3 (Presley x CCC 500 ppm), V_3T_1 (Pritty x GA 50 ppm) and V_3T_3 (Pritty x CCC 500 ppm). Fresh weight was minimum (15.20 g) in V_1T_4 (Eoliet x CCC 750 ppm).

In variety Eoliet T_2 (GA 100 ppm) recorded significantly higher value for the fresh weight of flowers (21.20 g). This was on par with T_1 (GA 50 ppm). T_4 (CCC 750 ppm) recorded the least fresh weight of 15.20 g.

Maximum fresh weight (18.70 g) was recorded in T_3 (CCC 500 ppm) in Presley. This was on par with all the other treatments viz., T_5 (control), T_4 (CCC 750 ppm), T_1 (GA 50 ppm) and T_2 (GA 100 ppm).

In variety Pritty maximum weight (19.75 g) was recorded in T_2 (GA 100 ppm) which was on par with T_1 (GA 50 ppm), T_3 (CCC 500 ppm), T_4 (CCC 750 ppm) and T_5 (control).

Significant interaction effect was noticed in variety Sunbird also for fresh weight of flowers. Fresh weight was found to be highest (19.80 g) in T_2 (GA 100 ppm) which was on par with T_4

(CCC 750 ppm), T_3 (CCC 500 ppm) and T_5 (control). T_1 (GA 50 ppm) recorded the least fresh weight of 15.83 g.

4.3.3. Water uptake

The treatment which was found least in vase life studies was used for observing the water uptake.

4.3.3.1. Varietal influence

Significant influence of variety on water uptake was noticed (Table 14a). Maximum water uptake (67.08 ml) was recorded in variety Sunbird which was on par with varieties Pritty and Eoliet. Variety Presley had the minimum water uptake (52.54 ml).

4.3.3.2. Treatment effect

The treatments were found to have significant influence on the water uptake (Table 14b). Treatment T_2 (GA 100 ppm) had the maximum water uptake of 71.92 ml. This was on par with T_3 (CCC 500 ppm). T_4 (CCC 750 ppm) resulted in least uptake of water by the harvested flowers (55.18 ml).

4.3.3.3. Interaction effect

The variety treatment interaction for water uptake was not significant (Table 14c).

4.4. Correlation studies

The results of the studies on the correlation among vegetative and floral characters of gerbera are given in Table 15.

The plant height was found to be significantly and positively correlated with flower number. Highly significant negative correlation of leaf area with petiole length and flower number was noticed but this character had positive significant correlation with stalk length and flower number.

Petiole length showed a high positive correlation with flower diameter and leaf number; while it had highly significant negative correlation with stalk length and leaf area. Number of lobes had positive correlation with plant height, flower number and leaf area. Highly significant negative correlation of stalk diameter with stalk length and significant positive correlation with flower diameter was also seen.

The correlation among different vase characters of flowers are given in Table 16. The correlation of vase life with three characters, namely, fresh weight of flowers, stalk length and water uptake, was considered and only fresh weight of flowers had positive correlation with vase life which was significant at one per cent level. Other factors had no significant correlation with vase life.

Table 15. Correlation between different vegetative and floral characters

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
Plant height	-	-0.1865	0.8202*	-0.0215	0.2671	0.3814*	0.6784	0.2514	0.1301	-0.1171
Spread		-	0.0454	-0.3645	-0.4002	0.3266	0.2226	-0.3146	0.3750	-0.3994
Number of lobes			-	-0.0099	0.2735	0.4994**	0.7808*	0.2801	0.2016	-0.1354
Petiole length				-	0.6425*	-0.8355*	-0.1566	0.8780**	-0.8604*	0.9676*
Leaf number					-	-0.3899	0.3506	0.4976**	-0.4740**	0.7275*
Leaf area						-	0.5299*	-0.6358*	0.7824*	-0.8604*
Flower number							-	0.0390	0.3352	-0.2018
Flower diameter								-	-0.5944*	0.7494*
Stalk length									-	-0.8733*
Stalk diameter										-

* Significant at 1%
** Significant at 5%

Table 16. Correlation for vase life

	X_1	X_2	X_3	X_4
X_1	-	0.3926	0.6339**	0.3459
X_2		-	0.3606	-0.0994
X_3			-	0.3887
X_4				-

X_1 Water uptake
X_2 Stalk length
X_3 Fresh weight
X_4 Vase life

Discussion

DISCUSSION

Results generated from the studies conducted to examine the effect of time of planting and growth regulators on flower qualities and vase life of gerbera are discussed hereunder.

Gerbera is one of the important commercial flowers in the world. Because of its rich variety of colours and long vase life it is very popular. The present experiments were aimed at examining the effect of growth regulators on flower qualities and to examine vase life. Four varieties, viz., Eoliet, Presley, Pritty and Sunbird were used for the study. GA and CCC were the growth regulators tried.

From this experiment it was found that varieties differed significantly with respect to plant height. Variety Presley had maximum height at 60, 90 and 120 days after planting in the first season. During the second season variety Sunbird had maximum height at 60 days after planting while variety Eoliet had the maximum height at 120 days after planting. Presley exhibited maximum spread during the first season. During the second season varietal influence was significant at 90 and 120 days after planting with variety Eoliet exhibiting maximum spread at 90 days and Pritty at 120 days after planting.

The difference between the varieties for leaf number was significant at 90 and 120 days after planting. Variety Presley had

maximum number of leaves at 90 and 120 days after planting. Variety Sunbird had maximum leaf number at 60 and 90 days while Presley had maximum leaf number at 120 days during the second season. Significant varietal influence on leaf area was noticed at 90 and 120 days after planting. Area of the leaves was found to be maximum in Presley at 90 and 120 days after planting. During the first season significant influence of varieties on petiole length and number of lobes was noticed.

Number of days taken for the first bud emergence varied significantly among the varieties. Presley was found to be the earliest among the four varieties. Variety Eoliet was found to have maximum longevity of flowers under the field conditions and Presley produced maximum number of flowers. During January and February varieties had significant influence on the period for bud emergence to opening. In both the months variety Pritty required minimum number of days for complete opening of the bud. This clearly shows the varietal difference among the varieties.

In the first season, during February Eoliet produced flowers with maximum diameter while in March Sunbird had flowers with maximum diameter. During the second planting Presley had flowers with largest diameter in February. Variety Sunbird was found to have longest stalk in the first season and Sunbird had the maximum stalk girth.

Varietal differences have been reported with respect to vegetative characters of the plant, time taken for flowering, duration of flowering, uniformity and quality of flowers and productivity. This is in accordance with the finding of Steen (1975), Bailot (1976), Vidalie et al. (1985), Fischer et al. (1985), Geldera and Reijnders (1985),Loeser (1986a), Loeser (1986b), Reimherr et al. (1986), Nalawadi et al. (1976) and Thangaraj et al. (1990).

In correlation studies plant height was found to be significantly and positively correlated with flower number. Highly significant negative correlation of leaf area with petiole length and flower number was noticed but this character had positive significant correlation with stalk length and flower number.

Petiole length showed a high positive correlation with flower diameter and leaf number, while it had highly significant negative correlation with stalk length and leaf area. Number of lobes had positive correlation with plant height, flower number and leaf area. Highly significant negative correlation of stalk girth with stalk length and significant positive correlation with flower diameter was also seen.

The flowering and yield of any crop is a reflection of its growth during the pre-flowering stage. In a crop like gerbera, where the cut flowers form the main consumable product, a healthy and vigorous pre-flowering period is an important contributing factor.

Though plant height need not have a direct correlation with the yield, its importance is that, the number of leaves produced by the plant is related to the stem length. The internodal length may also play a role in single stemed plants; but in gerbera, since the stem is beneath the soil, this does not manifest 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. As such, the factors that influence the number of leaves produced and the length of leaves also influence the plant height.

From this experiment it was found that the growth regulators did not have any significant influence on plant height and spread in both the seasons. This is in accordance with the findings of Farina et al. (1989) who reported differential response of gerbera cultivars to GA_3 treatments. According to them the quality and the extent of the response of gerbera to growth regulators depended on conditions of cultivation and vigour of the plant. Mukherjee and Bose (1972) reported that different genera under the family Compositae do not show similar response to CCC. On two species of the genus Centaurea CCC showed opposite effects.

Of all the vegetative parameters, the number of leaves and their size form the prominent factors that influence the growth and yield of a crop. This points to the quantity of photosynthates that are accumulated by the plant and hence influence the floral characters too. Flower production is also depended upon the leaf characters.

The results pertaining to the effect of treatments on the number of leaves showed that the treatments did not have any significant influence on the same.

Though the number of leaves is an important potential factor, its significance will be more pronounced when the size of leaves is also taken into account. This in turn relates to the leaf area. Since the area of large number of leaves had to be taken in the present study and no mathematical factor was available to compute the area from linear measurements of the leaf, as a corollary to the study, an equation was also derived.

In the case of leaf area, there was no significant influence of treatments. This is in variance with the findings of Reddy (1978) who reported an increase in leaf area and leaf area index with GA at 100 ppm in China aster.

Fresh leaves have higher weight because of its water content. The age of leaf and size of leaf are some of the other factors which influence the fresh and dry weight of leaves.

In the present study GA treated plants produced leaves with significantly higher fresh weight. Both the concentrations (GA 50 ppm and GA 100 ppm) showed almost the same effect. Compared to GA, CCC treatments recorded lower fresh weight which was in confirmity with the findings of Lee and Lee (1990) where the growth retardants reduced the fresh weight of gerbera leaves.

There was no significant variation in the dry weight of leaves among the treatments. This is in variance with the finding of Reddy (1978) who reported increased dry weight of plants with GA because of increased net assimilation rate, in china aster.

Growth regulators did not have any significant influence on the petiole length of the leaves. This is in variance with the findings of Reddy (1978) who reported increase in internodal length of china aster with increase in concentration of GA.

Number of lobes is a varietal character controlled by genetic factors and not easily influenced by any treatment. In gerbera, leaves are highly lobed with the number of lobes differing in each variety. The treatments did not have any significant influence on the number of lobes.

Duration from planting to first flower bud emergence indicates the early or delayed flowering. In the study under report, earlier flowering was observed with GA at both the concentrations (50 ppm and 100 ppm), while CCC had a delaying effect. The positive effect of GA on flowering is well known. Promotion in flowering by GA and delay by CCC in Chrysanthemum is reported by Koriesh et al. (1989b). Earlier flowering by GA at lower concentrations and delay in flowering by CCC in gerbera has been observed by El-Shafie and Hassan (1978). Positive effect of GA on advancing flowering is reported by Reddy and Sulladmath (1983) in china aster.

Under Vellanikkara condition, the maximum daily temperature recorded an increase from 31 to 35°C during the period from October to March (Appendix I). In gerbera, the period from bud emergence to its opening was found to be influenced by climatic conditions especially the temperature. Treatments were found to significantly influence this character. Among the different treatments GA took minimum period for flower opening while the plants treated with both the concentrations of CCC required more number of days for the same.

Number of flowers is one of the important factors which contributes towards the acceptability of a variety for commercial purpose.

Differential response of varieties to treatments was noticed with respect to number of flowers. CCC 750 ppm promoted flowering and this was on par with GA 100 ppm. Promotion of flowering by GA and CCC in Gerbera cultivars has been reported by El-Shafie and Hassan (1978). Reddy (1978) reported increased number of flowers per plant with GA application in china aster.

The number of days the flower remains fresh in the field has a strong climatic influence. There is negative relationship between temperature and longevity of flowers (Appendix-I). Treatments also significantly influenced this factor, with CCC 750 ppm increasing the longevity.

This is in accordance with the studies conducted by Leffring (1975) who used two gerbera clones (differing in shoot and flower production) to different temperature and day lengths. He recorded reduced production of flowers under glass in winter due to poor light and low temperature. After mid-February when the amount of light was increased, flower production was found to increase on all the side shoots proportionately. In trials with 30 clones, a number of clones produced more flowers/m^2 in a cooler green house (16°C day and 12°C night) than in a warm one (20°C day, 16°C night). It was also found that plants produced more flowers when the difference between air and soil temperature was less. Flower quality was better in cool green house than in warm one, in autumn and winter (Bulthuis, 1979).

Flower diameter is one of the most important factors which gives the flower a bold effect and adds to its attractiveness. Varietal and treatment effects were found to be influenced by the period the flower was produced. In general, all the varieties produced larger flowers during the second month of flowering and thereafter a slight decrease was noticed in flower diameter. Increased flower diameter with CCC and GA has been reported by El-Shafie and Hassan (1978) in Gerbera. In marigold, aster and gerbera GA has been reported to increase flower diameter (Lal and Mishra, 1986; Farina et al., 1989). Variety Presley produced comparatively smaller flowers. This may be due to the fact that the

higher number of flowers produced by Presley negatively influenced the flower size. The size of the flowers was considerably less during the second season.

Stalk length increases the attractiveness of the flower. Flowers with longer stalks are prefered commercially. Stalk length was significantly influenced by the variety. In general Sunbird had the longest stalks in all the months during both the seasons. Shortest stalk was produced by variety Pritty in the first season while in the second season remarkable difference was not noticed between the varieties. Only during January treatments were found significant. CCC 750 ppm and GA 100 ppm had the maximum effect on stalk length. No effect of treatments on peduncle was found by Farina et al. (1989) in Chrysanthemum. At the same time El-Shafie and Hassan (1978) reported about the positive effect of GA on gerbera flower stalk. Reddy and Sulladmath (1983) reported increased peduncle length with GA in china aster.

Varieties had significant influence on the stalk girth during January and March. Variety Sunbird had the maximum stalk girth closely followed by Eoliet during the first season. In the second season there is hardly any significant difference among varieties with respect to stalk girth. All the varieties had slender stalks in the second season compared to the first season. Different treatments had no effect on the stalk girth during both the seasons.

Gerbera flowers have a tendency to bend when placed in fresh water or in sucrose solution. This is because when a cut flower is placed in water the resistance to the water flow through the stem may increase with time (Rogers, 1973). The increase in resistance ("blockage" or "stem plugging") can be caused by the activity of microorganisms in the water or by an unknown physiological reaction of the flower.

It is suggested that there are two different pathways of water uptake, a direct one through the xylem vessels at the cut surface, and indirect one through the cavity in the stem. Only the direct water uptake is strongly inhibited by growth of bacteria in the vase water. Stem break occurs when the direct water uptake is inhibited by bacterial activity and the indirect uptake is hampered. Since the occurrence of stem break is preceded by a decline of the fresh weight of the flower and of the water potential, it is assumed that stem break is caused by water stress, like bent neck in cut roses (Burdett, 1970; Sacalis, 1974 and 1975). The part of the Gerbera stem where the break occurs has the highest water content and the greatest cell elongation of the stem (Sachs, 1968).

Fresh weight of the flower is a noteworthy character which will influence the vase life of the flower by increasing the water uptake. Even though a significant difference in fresh weight was not found, in the present study varieties Pritty and Sunbird exhibited comparatively more weight. In these varieties, the plants

treated with 100 ppm GA showed a significant effect on this character along with CCC 750 or 500 ppm. The favourable influence of CCC on flower weight was reported by El-Shafie and Hassan (1978) in gerbera.

In the correlation among different characters with vase life only fresh weight of flowers had positive correlation with vase life. Stalk length and water uptake did not have any significant correlation with vase life.

The water balance of the flower is the result of water uptake and transpiration rate. After cutting the transpiration rate of the flower remains nearly constant, while the absorption rate declines continuously. The absorption rate is determined by the water potential gradient and by the resistance to water flow from vase to the petals. In the present study varieties and treatments were found to have significant influence on the water uptake by the flowers. Maximum uptake was recorded in variety Sunbird and the minimum in variety Presley, while among the treatments GA at 100 ppm was seen to be superior when compared with other treatments. In all the varieties treatment with GA 100 ppm tends to increase the water uptake by the flowers.

Present study showed that in all the varieties, flowers treated with 5 per cent sucrose + 20 ppm $AgNO_3$ lasted for the longest period in vase compared to all other treatments. This was on par with 5 per cent sucrose + 20 ppm $AgNO_3$ + 500 ppm HQC.

Flowers kept in water lasted on an average for one day where as in this combination (5% sucrose + 20 ppm $AgNO_3$) flowers remained fresh for 10 days. The best result obtained in 5 per cent sucrose + 20 ppm $AgNO_3$ may be because of the antimicrobial property of $AgNO_3$ (Aarts, 1957; Nichols, 1973) which in turn prevent the stem break.

Among the four varieties, Pritty registered the highest life in vase in all the treatments except in the treatment 5 per cent sucrose + 20 ppm $AgNO_3$ + 500 ppm HQC where the variety Sunbird had the maximum vase life. The two postulations supporting, this results are: the variety Presley produced the maximum number of flowers. This may perhaps reflected in decreasing the vase life of the flowers of variety Presley by the depletion of the amount of stored foods. At the same time, the variety Pritty which produced the least number of flowers had the maximum life in vase. The second thought is that the stem stability is a geneticaly determinent factor which differs among gerbera varieties and that is why varieties responded differently to different treatments.

Among the different field treatments, the flowers obtained from plants treated with GA 100 ppm had the longest vase life. At the same time CCC treated plants also had the equal effect. The increased life shown by these flowers in the vase may be due to the direct effect of the vase life treatment with 20 ppm $AgNO_3$ + 5 per cent sucrose which only showed a significant influence in the variety-treatment interaction studies.

When the effect of season was considered irrespective of the treatments, the performance of Gerbera was better during the first season (June planting) with respect to most of the selected characters than during the second season (October planting). June planting produced more leaf area, took minimum time to come to flower, lengthened the flowering period, increased the flower production, diameter of flower, stalk length, and stalk diameter.

Among the varieties Presley performed well under Vellanikkara condition compared to the other varieties namely, Eoliet, Pritty and Sunbird during the first season, mainly for the economic characters, namely, the number of flowers per plant and for early flowering. But for the flower diameter and longevity of flowers in the field, varieties Eoliet and Sunbird were superior compared to variety Presley. Variety Pritty registered highest life in vase.

Summary

SUMMARY

An experiment to determine the effect of time of planting and growth regulators on flowering and vase life of Gerbera jamesonii was conducted at the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara, during the year 1991-1993. Two growth regulators (GA and CCC), at two concentrations (GA 50 and GA 100 ppm; CCC 500 and CCC 750 ppm) and four varieties, Eoliet, Presley, Pritty and Sunbird were tried. The experiment was laid out in a factorial randomised block design, comprising five treatments and three replications. The experiment was repeated in two planting seasons. The results of the experiment are summarised below.

The varieties differed significantly with respect to plant height. Variety Presley had maximum height at 60, 90 and 120 days after planting (22.62 cm, 23.56 cm and 24.27 cm respectively) in the first season. During the second season after 90 days of planting variety Sunbird had maximum height (15.20 cm) while 120 days after planting the difference was not significant. The treatments did not have any significant influence on plant height in both the seasons.

Varietal influence on spread was significant only at 90 days after planting, with variety Presley exhibiting maximum spread (53.26 cm) during the first season. During the second season varietal influence was significant at 90 and 120 days after planting, with

variety Eoliet exhibiting maximum spread (36.57 cm) at 90 DAP and variety Pritty (42.63 cm) at 120 days after planting. The treatments did not have any effect on spread in both the seasons.

The difference between the varieties for leaf number was significant at 90 and 120 days after planting. In the first season, variety Presley had maximum number of leaves at 90 (11.00) and 120 days after planting (16.76). Variety Sunbird had maximum leaf number at 60 and 90 days (4.61 and 7.35, respectively) while Presley had maximum leaf number (9.47) at 120 days during the second season. The influence of treatments was not significant with respect to leaf number at 90 and 120 days after planting. Significant Varietal influence on leaf area was noticed. Area of the leaves was found to be maximum in Presley at 90 and 120 days after planting (737.09 cm^2 and 1479.22 cm^2, respectively). The treatment effect was not significant.

The treatments significantly influenced the fresh weight of leaves. GA 50 ppm had the maximum effect (5.31 g). The treatments as well as varieties had no significant effect on dry weight of leaves.

During the first season significant influence of varieties on petiole length was noticed. Variety Presley had the longest petiole at all the stages (60, 90 and 120 days) of growth (5.07 cm, 5.22 cm and 4.77 cm, respectively), while in the second season the varietal influence was not significant. Treatments failed to influence petiole length in both the seasons.

Variety had significant influence on the number of lobes during the first season at 90 and 120 days after planting. At 90 days Presley had the highest lobe number (5.66) while at 120 days Eoliet had the highest number (7.72). The treatments had no effect in both the seasons.

Number of days taken for the first flower bud emergence varied significantly among the varieties and the treatments had significant influence on the same. Presley was found to be the earliest (85 days) among the four varieties. Whereas Eoliet was found to require the longest time for initiation of flowering. GA 50 ppm was found to hasten (83.08 days) flowering.

During January and February varieties had significant influence on the period from bud emergence to opening. In both the months variety Pritty required minimum number of days (13.07 days and 13.87 days, respectively) for complete opening of the bud. Treatments exhibited an adverse effect on the time taken for the flower bud to open.

Longevity of flowers under field conditions was significantly influenced by variety and treatments. Variety Eoliet was found to have maximum (13.27 days) longevity of flowers. Among the treatments T_4 (CCC 750 ppm) had significant positive influence (13.25 days) on longevity.

Treatments had significant influence on number of flowers produced in the first season with CCC 750 ppm having the best

(18.75) effect. Among the varieties, Presley was found to produce maximum (22.40) number of flowers.

In the first season, during February, Eoliet produced flowers with maximum diameter (10.21 cm) while in March Sunbird had flowers with maximum diameter (9.97 cm). During the second season Presley had flowers with largest diameter (9.77 cm) in February. CCC 750 ppm had the best influence on the (10.47 cm) diameter of flower in the first season.

Variety Sunbird was found to have the longest stalk during January, February and March (37.56 cm, 32.50 cm, 36.51 cm, respectively). Among treatments only CCC 750 ppm had significant influence during January (34.60 cm) in the first season. Both treatment and varietal influence were not significant during second season.

During first season, significant varietal influence on stalk girth was noticed in January and March. During these months Sunbird had stalks with maximum girth (2.32 cm and 2.16 cm, respectively). Treatments were not significantly different with respect to stalk girth. During the second season variety as well as treatments did not have any influence on stalk girth.

In vase life studies all the varieties recorded the maximum vase life in the holding solution containing 5 per cent sucrose and 20 ppm $AgNO_3$ (12.66 days). This was on par with 5 per cent sucrose + 20 ppm $AgNO_3$ + 500 ppm HQC. Vase life was maximum

in variety Pritty (10.95 days) and T_2 (GA 100 ppm) had a positive influence in extending vase life (11.42 days). This was on par with CCC 750 ppm and CCC 500 ppm.

Fresh weight of flowers was increased by GA 100 ppm in Eoliet (21.28 g), Sunbird (19.80 g), Pritty (19.75 g) and CCC 500 ppm in Presley (18.76 g).

Treatments and varieties significantly influenced the water uptake of flowers. Variety Sunbird was found to have maximum (67.08 cc) water uptake and treatment with GA 100 ppm resulted in maximum water uptake (71.92 cc).

In correlation studies plant height was found to be significantly and positively correlated with flower number. Highly significant negative correlation of leaf area with petiole length and flower number was noticed but this character had positive significant correlation with stalk length and flower number.

Petiole length showed a high positive correlation with flower diameter and leaf number, while it had highly significant negative correlation with stalk length and leaf area. Number of lobes had positive correlation with plant height, flower number and leaf area. Highly significant negative correlation of stalk girth with stalk length and significant positive correlation with flower diameter was also seen.

The correlation of vase life with three characters namely fresh weight of flowers, stalk length and water uptake was considered and only fresh weight of flowers had positive correlation with vase life which was significant at one per cent level. Other factors had no significant correlation with vase life.

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* Originals not seen

Appendices

APPENDIX-I

Meteorological parameters of the experimental site at the College of Horticulture, Vellanikkara for the period from June 1992 - June 1993

Month		Mean temperature (%)		Mean relative humidity (%)	Rainfall (mm)	Number of rainy days	Mean sunshine (hours)
		Maximum	Minimum				
1992	May	33.8	24.8	73	90.6	6	7.4
	June	30.1	23.7	84	976.8	22	3.3
	July	28.8	22.7	87	874.5	26	2.1
	August	28.9	23.3	88	562.9	25	2.7
	September	30.1	23.1	82	302.9	17	4.1
	October	30.1	22.9	82	386.7	14	4.6
	November	31.0	23.1	77	376.7	12	5.5
	December	31.1	22.3	61	2.0	0	8.9
1993	January	32.6	20.7	53	0	0	8.1
	February	34.1	22.0	62	6.6	2	9.4
	March	35.4	23.7	63	0	0	9.0
	April	34.5	25.0	69	32.1	2	9.1
	May	34.4	24.8	74	13.1	6	6.5
	June	30.1	23.9	86	700.3	22	3.3

APPENDIX-II

Abstract of analysis of variance for varietal treatment and interaction effects

Sl. No.	Character	Factor A MSS	Factor B MSS	AB MSS	Error MSS
1	2	3	4	5	6
A	First season				
1	Vegetative characters				
a	Plant height				
	60 days after planting	121.615**	18.576	3.352	8.706
	90 ,,	112.850**	2.749	7.577	5.075
	120 ,,	65.665**	9.168	12.482	10.307
b	Spread				
	60 days after planting	294.704	97.836	77.284	177.483
	90 ,,	830.215*	129.825	170.294	205.091
	120 ,,	94.839	129.677	217.167	286.237
c	Leaf number				
	60 days after planting	5.649	0.931	1.639	2.808
	90 ,,	18.625*	1.211	3.731	4.644
	120 ,,	95.858**	5.419	7.085	12.846
d	Leaf area				
	60 days after planting	74611.614	4246.531	8899.890	29889.248
	90 ,,	190840.126	8224.542**	31976.103	43610.431
	120 ,,	1505948.999**	80676.367	70249.155	190696.769
e	Fresh weight	1.753	6.522	1.143	1.779
f	Dry weight	0.041	0.048	0.159	0.154
g	Petiole length				
	60 days after planting	16.655**	0.760	0.447	0.631
	90 ,,	23.156**	0.889	0.491	0.536
	120 ,,	15.427**	0.569	0.759	0.487

Conto

Appendix-II. Continued

1	2	3	4	5	6
h	Number of lobes				
	60 days after planting	0.785	0.431	0.485	0.373
	90 ,,	0.728	0.320	0.540	0.606
	120 ,,	2.553*	0.239	0.540	0.705
2	Floral characters				
	a) Time taken for first flower bud emergence	342.906**	479.142**	128.364**	53.655
	b) Longivity of flowers	16.417**	12.025*	9.958*	3.568
	c) Number of flowers	504.417**	58.775**	9.431	6.422
	d) Bud emergence to opening				
	December	278.333**	69.733**	18.000**	14.678
	January	21.622*	11.808	8.608	5.442
	February	17.844**	23.125**	2.914	2.716
	March	10.194	15.233*	6.833	5.046
	e) Flower diameter				
	December	137.799**	39.987**	57.271**	3.679
	January	1.156	2.469*	0.475	0.587
	February	3.537**	0.453	0.610*	0.288
	March	2.710**	0.508	0.615*	0.282
	f) Stalk length				
	December	1439.950**	429.576**	634.103**	40.910
	January	414.979**	43.917*	12.156	16.056
	February	55.548*	35.261	21.023	17.852
	March	261.841**	16.528	14.666	9.289
	g) Stalk diameter				
	December	6.384**	1.925**	2.789**	0.190
	January	0.250*	0.129	0.121	0.081
	February	0.070	0.049	0.118*	0.030
	March	0.159**	0.044	0.071*	0.034

Cor

Appendix-II. Continued

1	2	3	4	5	6
3	Vase life character				
	a) Water	5.525	70.211	9.164*	4.391
	b) 5% sucrose	9.133**	4.567	2.133	1.932
	c) 5% sucrose + $AgNO_3$	9.402*	13.849**	2.707	2.225
	d) 5% sucrose + 20 ppm $AgNO_3$ + HQC	21.378**	0.100	6.933*	2.946
	e) Fresh weight of	5.525	70.211	9.164*	4.391
	f) Water uptake	575.679*	477.002*	235.124	183.122
B	Second season				
1	Vegetative characters				
a	Plant height				
	30 days after planting	4.997	4.954	2.687	2.455
	60 ,,	30.406**	10.531	2.497	4.453
	90 ,,	6.7	4.67	3.86	4.492
b	Spread				
	30 days after planting	11.066	29.735*	12.995	8.179
	60 ,,	50.214*	9.380	15.834	15.766
	90 ,,	94.245**	82.485**	32.473	16.921
c	Leaf number				
	30 days after planting	2.91*	0.35	0.44	0.73
	60 ,,	5.866*	2.58	0.961	2.021
	90 ,,	17.046**	2.496	1.239	3.572
d	Petiole length				
	30 days after planting	2.294	0.236	1.744	1.355
	60 ,,	0.817	0.276	1.244	1.058
	90 ,,	0.245	0.202	0.449	0.068
e	Number of lobes				
	30 days after planting	0.60	0.373	0.265	0.297
	60 ,,	0.56	0.992	0.277	0.471
	90 ,,	2.423*	0.212	0.7326	0.821

Co

Appendix-II. Continued

1	2	3	4	5	6
2	Floral characters				
	a) Longevity of flowers	9.84	8.64	3.60	4.452
	b) Number of flowers	3.61	3.69	1.69	2.41
	c) Flower diameter				
	February	5.704*	1.965	0.199	1.356
	March	1.773	0.615	1.384	1.266
	d) Stalk length				
	February	56.40	3.91	29.91	25.69
	March	0.56	1.01	21.32	1.188
	e) Stalk diameter				
	February	0.096	0.092	0.043	0.060
	March	0.13	0.046	0.037	0.049

** Significant at 1%

* Significant at 5%

Plate 1 & 2. Variety Eoliet

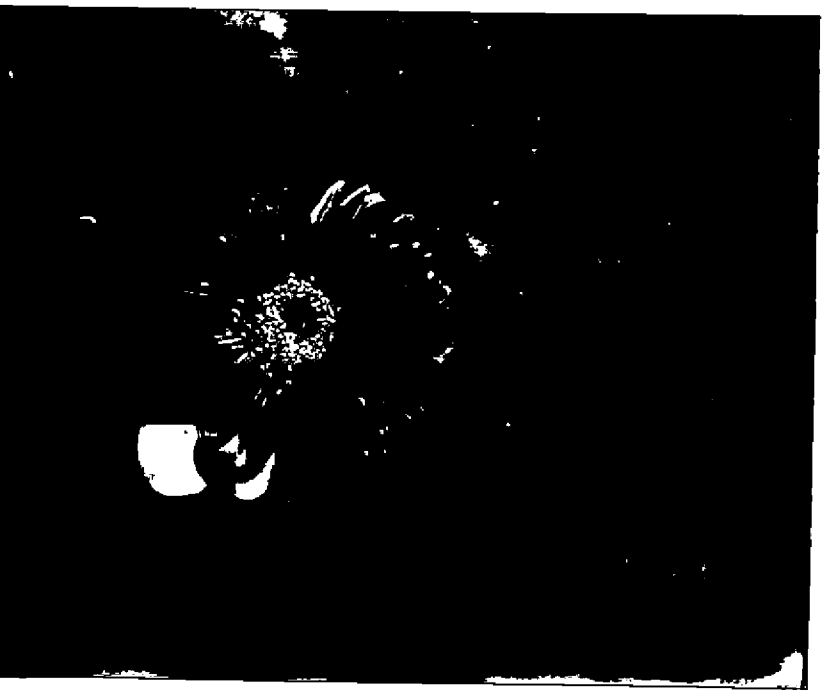
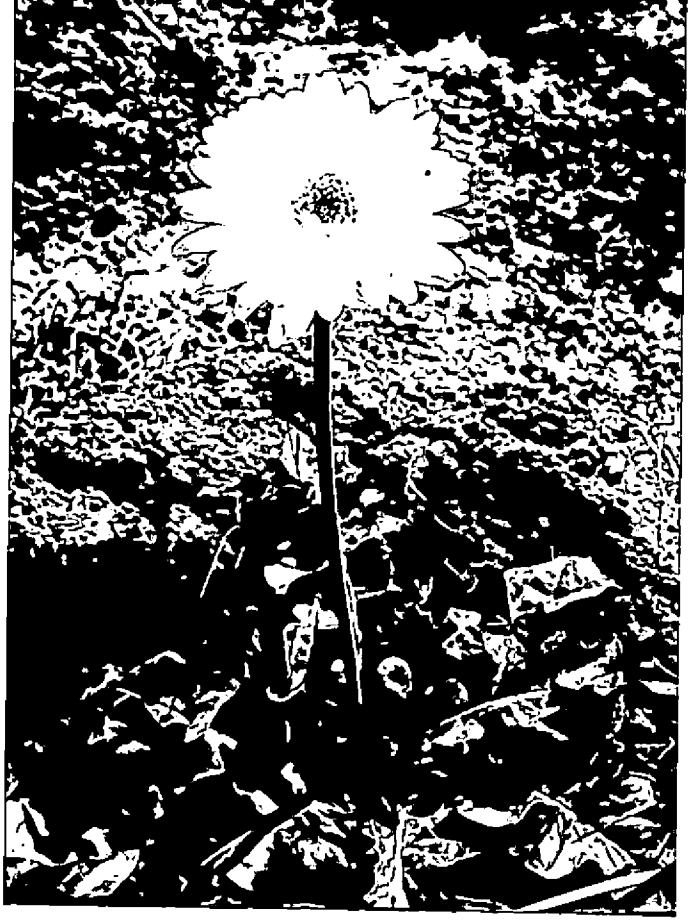


Plate 3 & 4. Variety Presley



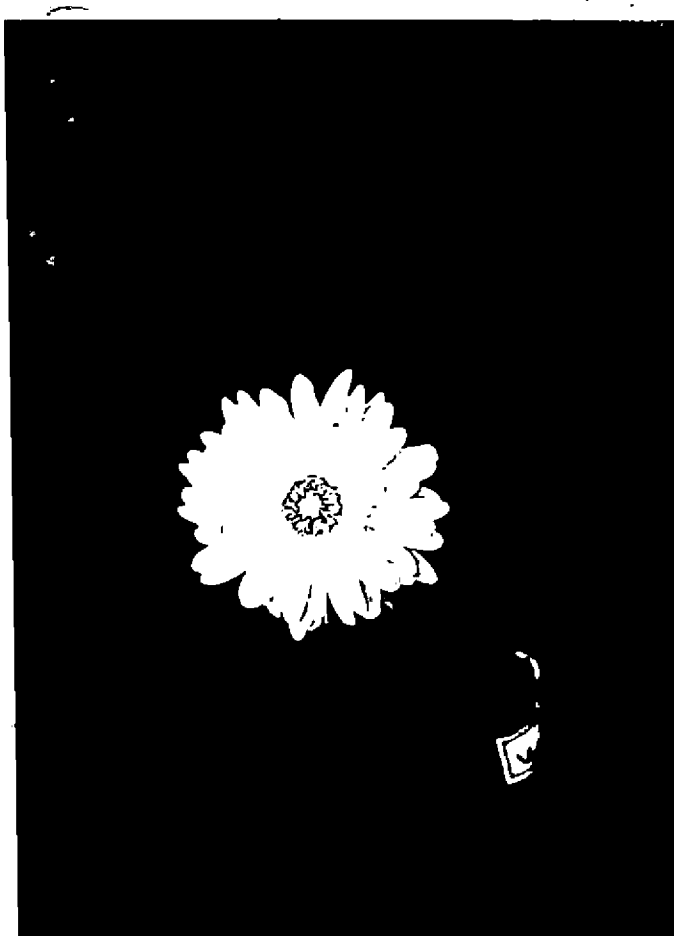
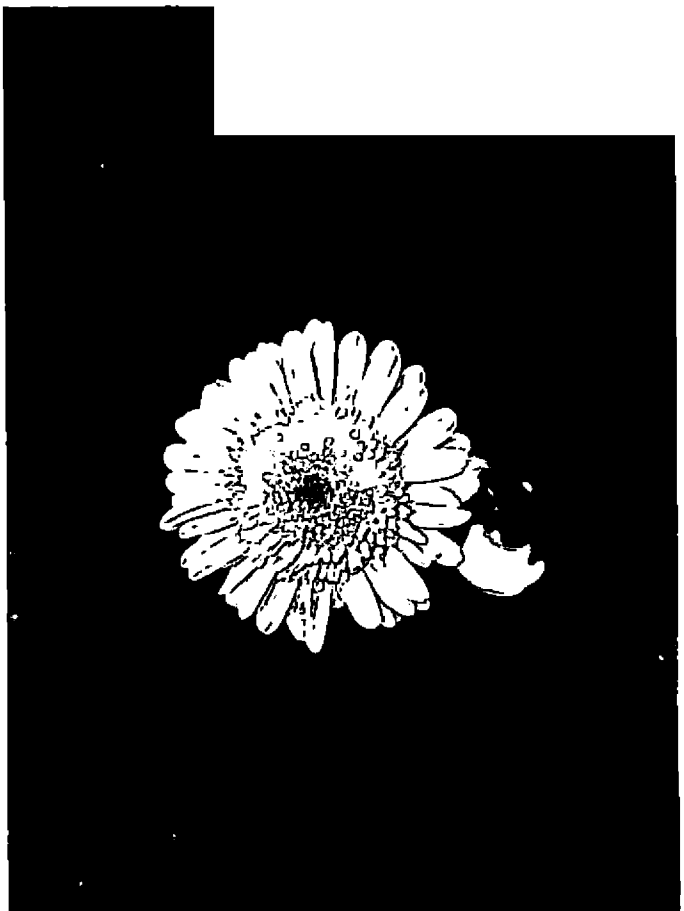


Plate 5 & 6 Variety Pritty


V4 T5



EFFECT OF TIME OF PLANTING AND GROWTH REGULATORS ON FLOWERING AND VASE LIFE OF *Gerbera jamesonii*

By

P. SUMA

ABSTRACT OF A THESIS

Submitted in partial fulfilment of the
requirement for the degree of

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Kerala Agricultural University

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(Pomology & Floriculture and Landscaping)
COLLEGE OF HORTICULTURE
Vellanikkara, Thrissur

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ABSTRACT

Studies were carried out at the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara, Thrissur, during 1991-93 to examine the effect of time of planting and growth regulators on flowering and vase life of gerbera. Four varieties, namely, Eoliet, Presley, Pritty and Sunbird and five treatments, viz., GA 50 ppm, GA 100 ppm, CCC 500 ppm, CCC 750 ppm and control, were tried.

Varieties were found to have significant influence on both vegetative as well as the floral characters whereas the treatments did not have any significant effect on vegetative characters of the Gerbera cultivars in general, when evaluated in the first season. In the second season both varietal and treatment effects were not consistent.

Variety Presley was found to be early flowering while Eoliet was late flowering. GA 50 ppm and GA 100 ppm hastened flowering whereas CCC 500 ppm and CCC 750 ppm delayed it.

In general the longevity of flowers was maximum in varieties Eoliet and Sunbird. Variety Presley had the least longevity. Among the treatments, CCC 750 ppm and GA 50 ppm increased the longevity of flowers in field.

Maximum number of blooms was produced by Presley and the minimum by Eoliet. In general GA 100 ppm and CCC 750 ppm increased the number of blooms.

In general CCC 750 ppm, GA 50 ppm and GA 100 ppm had a significant positive influence on flower diameter.

In general variety Sunbird had the maximum stalk length and diameter, while Pritty produced the shortest stalks. CCC 500 ppm and CCC 750 ppm had the best effect on stalk length.

Vase life was found to be significantly increased by GA 100 ppm and CCC 750 ppm treatments given to the plants. Five per cent sucrose + 20 ppm $AgNO_3$ significantly increased the longevity of flowers in vase.

Planting in June was found to be better than October planting with respect to vegetative as well as floral characters, especially for number of flowers and flower diameter.

Among the varieties, with respect to growth and number of flowers, Presley was found to be superior.

In the correlation studies flower number was found to have positive and highly significant correlation with plant height and leaf area whereas flower diameter had significant negative correlation with leaf area and stalk length. Petiole length, stalk diameter and leaf number had positive correlation with this character. Vase life had significantly positive correlation with fresh weight of flowers.