

**STUDIES ON CULTIVATION OF GLADIOLUS
IN OPEN AND PROTECTED CONDITIONS**

BY

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Date: June. 2010

Place: Hisar

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CERTIFICATE – I

This is to certify that this thesis entitled, “**Studies on cultivation of gladiolus in open and protected conditions**” submitted for the degree of **Master of Science** in the subject of **Horticulture** to CCS Haryana Agricultural University, Hisar, is a bonafide research work carried out by **Mr. Mohd. Saalim Saaie**, Admn. No. 2008A30M under my supervision and that no part of this thesis has been submitted for any other degree.

The assistance and help received during the course of investigation have been fully acknowledged.

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CERTIFICATE – II

This is to certify that this thesis entitled, “**Studies on cultivation of gladiolus in open and protected conditions**” submitted by **Mr. Mohd. Saalim Saaie**, Admn. No. 2008A30M to the CCS Haryana Agricultural University, Hisar in partial fulfilment of the requirement for the degree of **Master of Science** in the subject of **Horticulture** has been approved by the Student’s Advisory Committee after an oral examination on the same.

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LIST OF ABBREVIATIONS

| | | |
|------------------|---|-----------------------------|
| % | : | Per cent |
| / | : | Per |
| @ | : | At the rate of |
| CD | : | Critical Difference |
| cm | : | Centimetre |
| cm ² | : | Centimetre square |
| cv. | : | Cultivar |
| DAP | : | Days After Planting |
| EC | : | Electrical Conductivity |
| <i>et al.</i> | : | <i>et alii</i> (and others) |
| <i>etc.</i> | : | <i>Etcetra</i> |
| H ₂ O | : | Water |
| <i>i.e.</i> | : | <i>id. est.</i> (that is) |
| K | : | Potassium |
| M | : | Meter |
| m ² | : | Metre square |
| mm | : | Millimetre |
| MT | : | Metric Tonne |
| N | : | |
| NS | : | Nitrogen |
| | : | Non-significant |
| P | : | Phosphorus |
| ppm | : | Parts per million |

var. : Variety
Viz. : *videlicet* (namely)

CHAPTER – I

INTRODUCTION

Flowers are important mainly for aesthetic, social, and economic considerations. Flowers symbolize purity, beauty, peace, love and passion. Flowers provide excellent material for outdoor and indoor decoration and their presence brighten up the environment.

Floriculture is fast emerging as a major venture on world scenario. About 45 per cent of the world trade in floricultural products goes to cut flowers. The most important cut flowers are rose, chrysanthemum, carnation, orchids, tulip, lily and gladiolus. In floriculture industry, gladiolus occupies prime position and ranks next to tulip in European market and occupies fourth place in the international floriculture trade and is being cultivated in almost all countries of world (Cohat, 1993).

The area under flower cultivation in India during 2007-08 was 160720 ha, with a production of 870.37 MT (loose flower) and 43417.46 lakh (cut flower).

The contribution by various flower growing states to loose flower is Tamil Nadu (25%), Karnataka (19%), Andhra Pradesh (14%), whereas, in cut flower production is West Bengal comes the major share with (45%) flower, Karnataka (13%), and Maharashtra (13%). Tamil Nadu stands first in flower cultivation area with 26740 ha. Haryana has 6110 ha area under flower cultivation with production of cut flower 10.53 lakh (numbers) and loose flower 61.76 MT (Kumar, 2009).

The genus *Gladiolus* belongs to family *Iridaceae*. The word gladiolus was coined by Pliny the Elder (AD 23-79) and has been derived from a Latin word 'Gladius' meaning 'sword' because of sword like leaves of plant. Gladiolus is an important cut flower crop grown commercially in many parts of the world. It has gained popularity owing to its magnificent, unsurpassed beauty, attractive colours, various sizes and shapes of the flowers with their beautiful long lasting spikes. The modern cultivated gladiolus has a complex ancestry of natural and artificial hybridization involving at least a dozen species (Everett, 1981).

The cut flower industry is globally a fast growing industry, which has achieved significant growth during the past few decades. At present, cut flower production focus has moved from traditional growers, such as the Netherlands, Germany and France, to countries where the climates are better and production costs are low (Zhao and Wen., 2008). The best examples are of China, Kenya, and Ethiopia that have emerged as potential producers in booming world trade of high quality cut flowers and their planning policies

can be seen as a powerful demonstration of the role of floriculture industry in poverty alleviation.

Gladiolus, being a potential cut flower has great demand and is cultivated all over the world for its attractive spikes having florets of huge forms, dazzling colors, varying sizes and long vase life (Farid uddin *et al.*, 2002). The major gladiolus producing countries are the United States (Florida and California) Holland, Australia, Japan, Italy, France, Poland, Iran, India, Brazil, Poland, China, Malaysia and Singapore.

However mass production and quality cut flower spikes of gladiolus is still problem in many countries as its commercial cultivation is mainly restricted by rare production of corms and cormels (Singh and Doahre, 1994) and commercial cultivation is only possible through corms and cormels (Hartman et al, 1990).

Gladiolus needs sandy soils that drain well. The fertilizer requirements of gladiolus are highly dependent on soil type and climate. Maximum flower yield and quality are obtained with an adequate level of fertilization. Generally, neutral soils having a pH value of 6–7 are suitable for gladiolus production (Woltz, 1976 and Boodley, 1981). Magie (1976) suggested that gladiolus varieties less sensitive to light deficiency should be grown when winter flower production has been affected because of the short day length of winter. Gladiolus corms can be planted on beds or ridges of the furrows. Planting on the ridges in clay soils, and on the beds in sandy soils is recommended (Buschman, 1984). The Indian subcontinent is endowed with diverse agro climatic conditions and provides ample opportunities for the production of all the present day major cut flowers throughout the years in one or the other part of the country. During winter season when whole Europe is under snow cover and flower cultivation can only take place under controlled conditions, it is the best season for open field cultivation in India. Cheap labour is the next best advantage to compete in the international market due to low production cost. The gladiolus demand is elastic in nature in domestic and international markets, so production has to be regulated according to fluctuations in the market demand. It can be successfully grown in a wide variety of climatic conditions. The planting should be adjusted in such a way that gladiolus crop enjoys favourable weather conditions throughout its growing, flowering, corm and cormel production period. (Chadha.2006). Planting times varies from hills to plains. Generally middle of February to May in hills and September to November in plains is the optimum time for planting of corms (Bose *et al*, 1999).

In some parts of the country which have favourable climatic conditions, gladiolus is planted almost throughout the year. In Northern India, gladiolus is planted from September to November (Bose and Yadav, 1989). However, farmers take risk and go for

early and late planting. The use of polyhouse and greenhouse may be made growing of gladiolus, throughout the year. However the information is not available on the production of gladiolus flower under protected environment

Time of planting is one the most important factor which influences the performances and quality of flowers and other reproductive portions of gladiolus, so, the present study is aimed to explore the possibility of producing a high valued crop from greenhouse and open field and to standardize the time of planting.

Keeping this in view the above problems, the present studies were undertaken with the following objective.

1 – To standardize the time of planting of gladiolus under open, low cost and Hi-tech polyhouse conditions.

CHAPTER – II

REVIEW OF LITERATURE

In this chapter, an attempt has been made to review the available literature on various aspect of growth and flowering of gladiolus under open field and greenhouse conditions pertaining to the present investigation. The references from related flowering crops are also included where ever necessary to make the review more comprehensive and complete.

The variation in vegetative and reproductive growth parameters such as plant height, number of leaves, leaf area, size of flowers and corms, among different environments on gladiolus has reported by many research workers presented below.

The studies were conducted by Salvi *et al* (2003) to investigate the effects of planting dates on the growth, flowering and quality of gladiolus (*Gladiolus grandiflorus* cultivars American Beauty, Her-Majesty and Jester) grown under shade net. Planting dates were 30 September and 15 October. The results showed that cv. American Beauty, planted on 15 October, was the best among the cultivars in terms of the number of leaves per plant, vase life and flower quality. September planting produced greater plant height and higher number of cormels per plant compared to October planting. Her Majesty was recommended for early planting.

Shiva and Dadlani (2002) showed the advantage of growing gladiolus cv. American Beauty under low-cost greenhouse (polytunnel) environments compared to open field conditions. Greenhouse grown plants showed 20% reduction in time taken before sprouting of corms, spike emergence and flowering (10.17 days), compared to those in the field. Corm size and weight were 20.40 and 38% higher, respectively, in the greenhouse than in the field.

A field experiment was conducted by Nijiasure and Ranpise (2002), in Dapoli, Maharashtra, India, to evaluate the effects of planting dates (15 September, 1 October and 15 October) on the growth, flowering and flower yield of gladiolus (*Gladiolus grandiflorus* cv. American Beauty). Corms were planted at a distance of 30 x 20 cm in plots of 1.2 x 1.2 m² size. Observations were recorded for different growth parameters (days to sprouting of

corms, plant height, number of leaves, leaf length, leaf breadth, leaf area and leaf area index), days to flowering, flower quality parameters (spike length, number of flowers per spike, floret size, floret length and flower stalk diameter) and spike yield. Planting of corms on 15 October was found superior with respect to profuse growth, early flowering, better flower quality and higher spike yield under the agro climatic conditions of Maharashtra.

Suneetha and Vasantha Kumar (1997) planted three cultivars, Her Majesty, Vinks Glory and Oscar on six different planting dates at monthly intervals, i.e. mid-August, mid-September, mid-October, mid-November, mid-December and mid-January in South Kerala conditions. Planting of corms during September and October resulted in early sprouting, spike emergence and longest spikes with maximum number of florets per spike. Delay in planting also reduced the number of cormels produced per plant.

Similarly, Salvi *et al* (2004) worked on a field experiment Akola, Maharashtra, to investigate the effects of planting dates (30 September and 15 October 2002) on the performance of gladiolus cultivars American Beauty, Her Majesty and Jester under different environmental conditions. American Beauty planted on 15 October in open condition was found to be superior in terms of number of leaves per plant and quality of flower spike; however, 30 September planting produced more number of cormels per plant. Similarly, Her Majesty planted on 30 September in open condition was recommended for early flowering.

Nazir, *et al* (2005) reported about the path analysis studies in gladiolus carried out among 22 diverse genotypes of gladiolus for 20 characters related to growth and flowering at two locations, Baraut (Meerut, Uttar Pradesh) and Jammu (Jammu and Kashmir), India, during 1998-99 and 1999-2000. Results of pooled analysis for both years revealed that days to first floret colour showing and average weight of cormels per plant showed positive direct effects. These characters also showed positive significant correlation with number of florets per spike, so it is suggested that a single plant selection for these traits would be useful for the improvement in the number of florets per spike.

Similarly, Muhammad *et al* (2006) studied the effects of planting date on the yield and quality of gladiolus corms and cormels in Peshawar, Pakistan, during 2003-05. Cultivars Deciso, Hong Kong, Jessica, Jester Ruffled, Madonna, Peters Pears, Rose Supreme, and White Friendship were used in the experiment. The corms of these cultivars were planted on 1 November, 1 December or 1 January 2003-04 and 2004-05. Rose Supreme produced the highest number of cormels per mother corm (104.5), followed by White Friendship and Deciso (21.1 and 14.8, respectively). Daughter corms with the greatest diameter (6.8 and 6.2 cm) were produced by Rose Supreme and Peters Pears,

whereas cormels with the greatest diameter (1.6, 1.5 and 1.4 cm) were produced by Rose Supreme, Hong Kong and Peters Pears. Jessica had the highest number of daughter corms (1.7) per mother corm, followed by Rose Supreme (1.4), Peters Pears (1.4) and White Friendship (1.2). The delay in planting date (1 November, 1 December and 1 January) reduced the number of daughter corms per mother corm (1.2, 1.2 and 1.0), number of cormels per mother corm (24.8, 20.9 and 19.5), and sizes of daughter corm (6.3, 5.6 and 5.1 cm) and cormels (1.5, 1.3 and 1.2 cm). Rose Supreme and Peters Pears planted on 1 November produced the largest daughter corms. Rose Supreme planted on 1 January in 2004-05 had the highest number of cormels per mother corm (205.3).

A field experiment was conducted by Swaroop, *et al* (2005) to evaluate the performance of 23 gladiolus cultivars in New Delhi, observations were recorded for vegetative growth as well as floral and corm production parameters. Six cultivars (Dhanvantari, Anjali, Chandani, Gold Dust, Hunting Song and African Star) were superior over the others for various parameters studied. On the basis of flowering, 5 cultivars (Vink's Glory, Suchitra, Rose Spire, Gold Dust and Hunting Song) were grouped as early flowering, 2 cultivars (Dhanvantari and Neelum) as late flowering, and 16 cultivars as mid-season flowering. Dhanvantari was considered special grade, Gold Dust and Synayana were standard grade, and the remaining cultivars were utility grade according to length of spik.

Field trials were conducted by Sharma, and Talukdar (2002) during 1999/2000 and 2000/01, at Jorhat, Assam, India, to evaluate the effects of time, spacing and depth of planting on the growth and flowering of gladiolus cv. Sylvia. The treatments comprised 4 dates of planting (15 October, 5 November, 25 November and 15 December), 3 spacings (30×15, 45×20 and 60×25 cm) and 2 depths (2.5 and 5.0 cm). Earlier plantings (15 October and 5 November) resulted in earlier shoot emergence, spike emergence and first flower opening, and gave the highest values for all other parameters studied, i.e. sprouts per corm, plant height, leaf length, number of leaves, florets per spike, spike length, floret size and shelf life of spike. Similarly, wider spacings (45×20 and 60×25 cm) were found to be superior over the closer spacing in terms of all parameters studied. Depth of planting had no significant effect on any parameter, except for shoot emergence.

Arora *et al.* (2002) studied in performance of carnation in poly house and observed that maximum plant height was recorded in cv. Laurella followed by Galatte. Dwivedi and Kareem (2004) observed significant variation in 15 varieties of carnation with respect to plant height the average plant height varied from 47.68cm to 57.66cm in New Espana and

Author Sim respectively. Whereas, Gurav *et al.* (2004) recorded the maximum plant height (60.16cm) in cv. Sunrise.

Jhon and Khan (2003) worked on evaluation of tulips under polyhouse condition and observed that the cv. Pink Supreme recorded significantly the maximum plant height (53.26cm) whereas the minimum plant height (8.42cm) was recorded in cv. Double Yellow. Sherry and Goldsberry (1980) grew carnation cultivars in green houses covered with new corrugated fiberglass reinforced plastic panels (New FRP), single layer UV-resistant polyethylene (Sgl Poly), air inflated double layer polyethylene (Dbl Poly) and 8-year-old weathered corrugated fiberglass reinforced plastic panels (old FRP). Total flower production in the New FRP, Dbl Poly and Old FRP cover treatments was 1.9, 21.8 and 56.5% less, respectively than in the Sgl Poly treatment. Significant interactions were noted between cultivar fresh weights stem lengths, grades and cover treatment. Increase of irradiance in the cover treatments reduced return crop times while increasing stem length, fresh weight and grade.

Grassotti *et al.* (1983) compared different planting dates for carnation under greenhouse conditions at Italy and reported that flower production was early and better from autumn planting.

Kumar *et al.* (1999) studied the effect of growing environments on carnation flowering. The rooted carnation cuttings of cultivars Red Corso and Cabaret were planted in a greenhouse (fitted with an evaporative cooling system) or in the open field. Effects of the environments on flowering parameters and photosynthetic activity were assessed. In both cultivars, the greenhouse gave better performance with regard to most characters. Flowering was advanced by 10- 15 days in the greenhouse, flower stems were longer and number of flowers/plant was higher

Shinde *et al.* (2005) studied to investigate the effect of pinching treatments (no pinching; single pinching at 20 days after planting, DAP; and double pinching at 50 days after treatment) under polyhouse conditions on the flowering, flower yield, flower quality and vase life of carnation cultivars Domingo, Master, Paolo, Solar and Yellow Solar. Master produced the highest number of shoots/plant (8.86), highest flower yield (6.92 flowers/plant and 249.12 flowers/m²), the longest flower stalk (76.17 cm) and the longest vase life (7.84 days), and showed the earliest flowering (106.54 days).

Jhon *et al.* (1996) studied the performance of 41 *Gladiolus* cultivars in Kashmir. They reported that cultivars Classic, Red Majesty, Rose Supreme, Oscar, Sunny Boy and White Prosperity were the most suitable cultivars for cut flower production, with spike ranging in length from 106.06 cm for Oscar to 120.13 cm for White Prosperity.

Jhon and Khan (2003) studied in evaluation of tulip and observed the earliest flowering varieties recorded was Show Winner (120.9 days) and maximum diameter of flower (11.27cm) was recorded in Inzell.

Kandpal *et al.* (2003) worked on evaluation of gerbera and found that the cultivar having earlier flower bearing habit was Diablo (64.2 days).

Kumar and Yadav (2003) studied on evaluation of gerbera at Sikkim for NEH region and found that the cultivar Evening Bell and Salman Spray were earliest to initiate flower bud (123.00 days) while the Popular took the maximum number of days (135.50). The mean number of days for bud burst from bud emergence was found from 11.20 in G.S. Lal to 14.39 in Popular while, for full bloom from bud burst, from 4.80 (pride of sikkim) to 5.72 (Indu Kumari).

Naik *et al.* (2006) reported that yield and quality characters of gerbera in 11 cultivars such as number of flower per plant, diameter of flower, length of flower stalk, vase life were significant different among the cultivars. The significant highest number (38.83) of flower recorded in Lexus and was statistically at par with Alberino (37.20) and Scilla (36.95). There was significant variation in flower size among the different varieties studied.

Paraneetha (2006) evaluated the cut flower cultivars of gerbera at Shervory hills of Tamil Nadu and observed that among the ten cut flower cultivars evaluated, the highest number of flowers per plant per year were the maximum in Rosalin (23.35) and next in Tiffany (21.97).

Singh (2006) conducted an experiment in nine exotic cultivars of the gerbera and observed that the flower yield showed positive correlation with leaves per plant, suckers per plant, plant spread and plant height.

CHAPTER – III

MATERIALS AND METHODS

The present investigations entitled, “Studies on cultivation of gladiolus in open and protected conditions” were carried out at precision farming development center of Department of Horticulture, CCS Haryana Agricultural University, Hisar during the year 2009-2010.

3.1 CLIMATE AND WEATHER CONDITIONS:

Hisar(Haryana) is the situated at 29°10” North Latitude and 75°46” East longitude at an elevation of 215.2 m above mean sea level. This region has semi-arid climate with severe cold winter and hot dry summer, with no specific pattern of rainfall during growing season. The average annual rainfall is about 420 mm mostly from mid April to mid October which is unevenly distributed with peak rainfall occurring during month of July and August.

3.2 SOIL:

The soil of the experimental site was analyzed for various physico-chemical attributes and the data are presented in Table 1 and Table 2. On the basis of soil analysis and the mean values, the soil was found to be sandy loam in texture, medium in organic carbon, low in available nitrogen, medium in phosphorus and high with respect to available potassium.

Table 1: - Physico-chemical analysis of the experimental field soil.

| Character | Contents | Method of determination |
|--------------------|------------|--|
| Texture | Sandy loam | International Pipette method (Piper, 1950) |
| Organic carbon (%) | 0.60 | Walkley and Black rapid titration method (Piper, 1966) |

| | | |
|---|-------|--|
| pH | 8.1 | 1:2 soil water suspension (Jackson, 1967) |
| EC (dS m ⁻¹) | 0.80 | 1:2 soil water suspension (Jackson, 1967) |
| Available nitrogen (kg ha ⁻¹) | 129.5 | Alkaline permanganate method (Subbiah and Asija, 1956) |
| Available phosphorus (kg P ₂ O ₅ ha ⁻¹) | 27.5 | Olsen's method (Olsen <i>et al.</i> 1954) |
| Available potassium (kg K ₂ O ha ⁻¹) | 422.1 | Flame photometric method (Jackson, 1973) |

Table 2: - Physico-chemical analysis of the experimental polyhouse soil.

| Character | Contents | Method of determination |
|---|------------|--|
| Texture | Sandy loam | International Pipette method (Piper, 1950) |
| Organic carbon (%) | 0.63 | Walkley and Black rapid titration method (Piper, 1966) |
| pH | 8.4 | 1:2 soil water suspension (Jackson, 1967) |
| EC (dS m ⁻¹) | 0.82 | 1:2 soil water suspension (Jackson, 1967) |
| Available nitrogen (kg ha ⁻¹) | 133.5 | Alkaline permanganate method (Subbiah and Asija, 1956) |
| Available phosphorus (kg P ₂ O ₅ ha ⁻¹) | 28.7 | Olsen's method (Olsen <i>et al.</i> 1954) |
| Available potassium (kg K ₂ O ha ⁻¹) | 432.6 | Flame photometric method (Jackson, 1973) |

3.3 LAND PREPARATION

The land was brought to a fine tilth by repeating ploughing and leveled properly. Manure was applied in ratio of 54 g per m² in 3 treatments in 3 stages of life of plant. The bed for planting of gladiolus corms was prepared by maintaining bed size 100 cm x 100cm.

3.4 EXPERIMENTAL PLAN, PLANT MATERIAL AND PLANTING:

The corms of gladiolus cv. American Beauty used in experiment were procured from Department of Horticulture, CCS Haryana Agricultural University, Hisar. The uniform sized corms were planted at depth of 7 cm and 20 cm apart, with a row to row

distance of 30 cm on 18th August, 16th September, 20th October, 16th November, 15th December and 15th January with three replications in every months planting in open ,low-cost polyhouse (Naturally ventilated) and Hi-tech polyhouse (Hi-tech greenhouse) conditions.

3.5 CULTURAL PRACTICES:

Regular weeding was done to check the growth of weeds. Irrigation was given on the basis of increase in temperature and plant requirements during the growing period. Recommended plant protection measures were taken to control the pest and diseases. The combinations of NPK in ratio 6:6:6 g per meter square were applied three times: before planting, 3 to 6 leaf stage and during spike initiation.

3.6 EXPERIMENTAL DETAILS:

The present studies were carried out to find out the effects of time of planting on growth and flowering of gladiolus under different planting conditions. Details of experiments are given below:

| | | |
|------------------------------|---|---|
| Cultivar | - | American Beauty |
| Experimental design | - | RBD |
| Plot size | - | 1 m x 1m |
| Planting distance | - | 30 cm x 20 cm |
| Replications | - | 3 |
| No. of corms per replication | - | 15 |
| Times of planting | - | 18 th August, 16 th September, 20 th October, 16 th November, 15 th December and 15 th January. |





Fig. 1: Gladiolus plants under open field condition.

Fig. 2: Gladiolus plants under Hi-tech greenhouse condition.

3.7 OBSERVATIONS RECORDED:

The following observations were recorded from five randomly selected plants from each treatment plot leaving the border plants at different intervals.

3.7.1 Number of days required for sprouting of corms

Days required for sprouting of corm were recorded from date of planting to date of appearance of sprout. Average of sprouted corms per plot was worked out.

3.7.2 Percentage sprouting

Percentage sprouting of corms was worked out based on the number of corms sprouted out of the total corms sown in each plot.

3.7.3 Plant height (cm)

Height of the all plants in plots was measured from the ground level to the tip of spike with the help of a meter rod and average was calculated.

3.7.4 Number of leaves

Total numbers of leaves from all plants in plots were counted at flowering stage and average was calculated.

3.7.5 Leaf area (cm²)

For average leaf area, sampling was done at flowering stage. Three sprouts, out of 15 marked plants in each plot were selected randomly and all leaves from plants were taken and pressed. Total area of these leaves was determined with the help of leaf area meter. The average leaf area per plant was determined using the following formula:

$$\text{Average leaf area/plant} = \frac{\text{Total area of leaves of 9 plants from 3 plots}}{9}$$

3.7.6 Number of days required for spike initiation

The total numbers of days taken for spike emergence were counted in all replications and average was calculated.

3.7.7 Number of days to opening of basal floret

Days to opening of basal floret were counted from the date of corm planting to the appearance of basal floret.

3.7.8 Number of days to opening of last floret

Days to opening of last floret were counted from the date of corm planting to the appearance of last floret.

3.7.9 Total number of florets per spike

Total numbers of florets on each spike were counted for all replications and average was calculated.

3.7.10 Length of spike (cm)

The length of each spike, starting from the point where the stalk emerged from the compressed node leaves to the top most bud of the spike was measured and then mean of all spikes produced by all replications were calculated.

3.7.11 Length of rachis (cm)

The length of rachis was measured from basal floret to the apical floret in each spike produced by all replications were calculated and averaged.

3.7.12 Diameter of floret

With the help of a scale, the minimum and maximum diameter of basal 1st floret in each spike was measured in case of all replications and the mean were calculated.

3.7.13 Number of corms per plant

The total number of daughter corms produced by a plant were counted and averaged for all replications.

3.7.14 Size of corm (cm)

The size of each corm was measured with the help of venire caliper and the mean of five corms per replications was taken.

3.7.15 Weight of corm (g)

Weight of individual corm was measured with the help of physical balance and average of five corms per replication was calculated.

3.7.16 Number of cormels per plant

The total numbers of cormel produced by a plant were counted and the mean of all replications were taken.

3.7.17 Weight of cormels per plant (g)

The total weight of cormels produced by per replication was taken and average was calculated.

3.8 STATISTICAL ANALYSIS

The statistical method described by Panse and Sukhatme (1978) was followed for analysis and interpretation of the experimental results and the technique of analysis of variance described by Fisher (1958) was used. To judge the significance of the difference between two results, critical difference (CD) was worked out by following formula:

$$\text{C.D. at 5 \% } = \frac{2 \times \text{error mean square}}{n} \times t \text{ (value at 5 \%)}$$

Where,

- C.D. = critical difference
 n = no. of observations
 t = value of t-distribution at 5 % level of error degree of freedom.

The data were analysed with the help of a windows based computer package OPSTAT (Sheoran, 2004), which calculates standard error of means (SE_M), standard error of difference in mean (SE_d) and critical difference between the treatments (CD).

CHAPTER – IV

EXPERIMENTAL RESULTS

The findings of present investigations entitled, “Studies on cultivation of Gladiolus in open and protected conditions” are presented in this chapter under various heads: The observations recorded at the successive stages of the crop growth were analyzed statistically and are presented in tables. It is evident from the analysis of the data (Table) that vegetative growth, flowering, corm production and vase life were significantly influenced by different times of plantings and environment.

4.1 Vegetative characters:

4.1.1 Number of days required for sprouting of corms: It is evident from the data given in Table.3 that numbers of days for sprouting were significantly affected by date of planting. Minimum numbers of days were taken for sprouting where planting was done on 20th October and maximum numbers of days were recorded when planting was done on 15th December which was as par with 15th January.

Number of days for sprouting decreased with the advancement of planting up to October and by late planting it increased. Number of days for sprouting was affected significantly by various growing conditions. Minimum numbers of days were recorded in greenhouse and maximum in low-cost polyhouse.

Interaction between planting date and growing conditions was found significant. Minimum number of days were recorded on 20th October in open field whereas maximum in low-cost polyhouse.

4.1.2 Percentage of sprouting: The data regarding effects of planting dates on percentage of sprouting is given in Table.4. The data showed that percentage of sprouting was significantly affected by planting dates. Cent per cent of sprouting was recorded in corms planted on 18th August, 16th September and 20th October, and decreased later on with late planting times, the minimum percentage of sprouting was recorded on 15th January planting.

Interaction was found to be insignificant for percentage of sprouting of corms.

Table 3: Number of days for sprouting of gladiolus corms cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Conditions | | | Overall Mean |
|---------------------|--------------------|--------------|----------------------|--------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 21.5 | 16.7 | 19.3 | 19.2 |
| 16th Sep | 12.0 | 10.7 | 15.3 | 12.7 |
| 20th Oct | 9.0 | 9.7 | 13.0 | 10.5 |
| 16th Nov | 13.7 | 13.3 | 24.3 | 17.1 |
| 15th Dec | 31.3 | 35.3 | 39.7 | 35.4 |
| 15th Jan | 43.7 | 27.0 | 29.7 | 33.4 |
| Overall Mean | 21.86 | 18.78 | 23.55 | |

C.D at 5% Planting Date = 1.50 Growing Condition = 2.12

Date × Condition = 3.67

Table 4: Percentage of sprouting of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Condition | | | Overall Mean |
|---------------------|-------------------|--------------|----------------------|--------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 100.0 | 100.0 | 100.0 | 100.0 |
| | (89.39) | (89.39) | (89.39) | (89.391) |
| 16th Sep | 100.0 | 100.0 | 100.0 | 100.0 |
| | (89.39) | (89.39) | (89.39) | (89.39) |
| 20th Oct | 100.0 | 100.0 | 100.0 | 100.0 |
| | (89.39) | (89.39) | (89.39) | (89.39) |
| 16th Nov | 84.4 | 88.9 | 77.8 | 83.7 |
| | (67.26) | (74.40) | (61.89) | (67.85) |
| 15th Dec | 71.1 | 63.9 | 75.5 | 70.2 |
| | (57.67) | (53.81) | (60.38) | (57.29) |
| 15th Jan | 71.1 | 55.5 | 33.3 | 53.3 |
| | (49.80) | (48.16) | (35.23) | (44.4) |
| Overall Mean | 87.77 | 84.71 | 81.10 | |
| | (73.82) | (74.09) | (70.94) | |

Figures in parentheses are the arc-sine transformed values.

C.D at 5%

Planting Date = 5.93

Growing Condition = N.S.

Date × Condition = N.S.



Sprouting of corm

Sprouted plants in 4-6 leaves stage.

Fig. 3: Sprouting of corms and 4-6 leaves stage of plant under greenhouse.

4.1.3 Number of leaves per plant: The data regarding the number of leaves per plant of gladiolus are presented in Table.5 indicated that planting dates affected number of leaves of plants. Maximum numbers of leaves were recorded in plants grown on 16th November and minimum in 15th January planting.

Number of leaves was found in variation according to growing conditions, maximum number of leaves per plant was noted in open field and minimum in polyhouse. Interaction was significant maximum number of leaves was recorded in plants grown inside of greenhouse on 16th November and minimum in polyhouse on 15th January.

4.1.4 Leaf area per plant: The data on leaf area are presented in Table.6, it is apparent from data that this parameter was significantly affected by planting conditions. Maximum leaf area per plant was noted in plants grown on 18th August followed by 16th November and minimum on 15th January. Leaf area was also affected by growing conditions. Maximum leaf area was noted in open field and minimum in naturally ventilated.

Interaction among planting date and growing conditions was significant, maximum leaf area was noted in plants grown on 18th August and 16th November in open field followed by greenhouse on 16th November and minimum in polyhouse on 15th December.

4.1.5 Plant height: The perusal of the data presented in Table.7 regarding on effects of planting dates on plant height of gladiolus indicated that dates of planting significantly

affected plant height. Maximum height of plant was recorded when planting was done on 18th August followed by 16th November and minimum in 15th January.

Plant height was also affected by growing conditions, maximum plant height was recorded in greenhouse and minimum in low-cost polyhouse and interaction was found to be insignificant.



Fig.4: Increasing of number of leaves and beginning of spike initiation in 16th September planting under open field condition.

Table 5: Number of leaves per plant of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Conditions | | | Overall Mean |
|---------------------|--------------------|-------------|----------------------|--------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 10.00 | 7.27 | 8.20 | 8.49 |
| 16th Sep | 8.73 | 6.40 | 6.00 | 7.04 |
| 20th Oct | 8.70 | 8.13 | 6.97 | 7.93 |
| 16th Nov | 9.50 | 10.70 | 6.97 | 9.05 |
| 15th Dec | 7.87 | 7.60 | 5.33 | 6.93 |
| 15th Jan | 4.67 | 6.97 | 4.33 | 5.32 |
| Overall Mean | 8.24 | 7.84 | 6.30 | |

C.D at 5% Planting Date = 0.75 Growing Condition = 0.53

Date × Condition = 1.30

Table 6: Leaf area (cm²) per plant of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Conditions | | | Overall Mean |
|---------------------|----------------------------------|---------------|----------------------------------|--------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 768.73 | 532.70 | 442.67 | 581.37 |
| 16th Sep | 463.20 | 402.00 | 264.37 | 376.52 |
| 20th Oct | 474.03 | 409.50 | 367.43 | 416.98 |
| 16th Nov | 596.23 | 586.20 | 424.60 | 535.69 |
| 15th Dec | 424.83 | 467.60 | 179.43 | 357.28 |
| 15th Jan | 218.80 | 469.70 | 181.20 | 289.91 |
| Overall Mean | 490.97 | 477.95 | 309.95 | |
| C.D at 5% | Planting Date = 77.91 | | Growing Condition = 55.09 | |
| | Date × Condition = 134.95 | | | |

Table 7: Plant height (cm) of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Conditions | | | Overall Mean |
|---------------------|--------------------------------|--------------|---------------------------------|--------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 81.33 | 95.73 | 76.10 | 84.39 |
| 16th Sep | 65.97 | 84.17 | 52.90 | 67.68 |
| 20th Oct | 57.87 | 76.43 | 54.47 | 62.92 |
| 16th Nov | 63.83 | 98.03 | 49.13 | 70.33 |
| 15th Dec | 54.10 | 72.80 | 43.77 | 56.89 |
| 15th Jan | 29.90 | 70.70 | 31.67 | 44.09 |
| Overall Mean | 58.83 | 82.97 | 51.34 | |
| C.D at 5% | Planting Date = 8.80 | | Growing Condition = 6.22 | |
| | Date × Condition = N.S. | | | |

4.2 Flowering parameters:

4.2.1 Number of days for spike initiation: The data in Table.8 showed the effects of planting dates on number of days for spike initiation. Minimum numbers of days were recorded in planting of 16th September which was at par with 18th August and maximum in 15th January. Under various growing conditions days taken for spike emergences were affected. Minimum numbers of days were recorded in greenhouse condition and maximum in open field. Interaction was found to be significant. Minimum number of days were recorded in plants grown in open field on 16th September and maximum in planting date of 15th December under low-cost polyhouse.

4.2.2 Number of days to opening of basal floret: The perusal of data presented in Table.9 regarding effects of the planting date on number of days for opening of basal floret indicated that time taken was affected significantly by date of planting. Minimum number of days was recorded in plants grown on 16th September at par with 18th August and later on increased significantly and maximum noted on 20th October. Under various growing condition time taken was different, minimum number of days were recorded under low-cost polyhouse and maximum in open field. Interaction was found to be significant. Minimum number of days were recorded when planting was done on 16th November in greenhouse and maximum was recorded when planting was done on 20th October also in greenhouse.

4.2.3 Number of days to opening of last floret: The perusal of data presented in Table.10 regarding effects of the planting date on number of days to opening of last floret indicated that time taken was affected significantly by date of planting. Minimum number of days was recorded in plants grown on 16th September and maximum on 20th October. Under various growing condition time taken was different, minimum number of days was recorded under low-cost polyhouse and maximum in open field. Interaction was significant, minimum number of days were recorded when planting was done on 16th September in open field and maximum was recorded when planting was done on 20th October also in open field.

Table 8: Number of days for spike initiation of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Conditions | | | Overall Mean |
|---------------------|--------------------|---------------|----------------------|---------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 80.5 | – | – | 26.82 |
| | (9.03) | (1.00) | (1.00) | (3.68) |
| 16th Sep | 74.8 | – | – | 24.93 |
| | (8.7) | (1.00) | (1.00) | (3.57) |
| 20th Oct | 104.6 | 96.00 | 85.0 | 95.19 |
| | (10.28) | (6.89) | (6.49) | (7.89) |
| 16th Nov | 111.7 | 91.93 | 112.2 | 105.30 |
| | (10.61) | (9.63) | (10.62) | (10.29) |
| 15th Dec | 129.2 | 128.30 | 130.8 | 129.40 |
| | (11.41) | (11.37) | (11.49) | (11.42) |
| 15th Jan | – | – | – | – |
| | (1.00) | (1.00) | (1.00) | (1.00) |
| Overall Mean | 83.46 | 52.70 | 54.67 | |
| | (8.5) | (5.15) | (5.27) | |

Figures in parentheses are the squared root transformed values.

C.D at 5% Planting Date = 1.62 Growing Condition = 1.14

Date × Condition = 2.81

Table 9: Number of days to opening of basal floret of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Conditions | | | Overall Mean |
|---------------------|--------------------|---------------|----------------------|---------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 98.33 | – | – | 32.78 |
| | (9.87) | (1.00) | (1.00) | (3.99) |
| 16th Sep | 94.63 | – | – | 31.54 |
| | (9.78) | (1.00) | (1.00) | (3.92) |
| 20th Oct | 123.00 | 118.50 | 100 | 113.80 |
| | (11.13) | (7.62) | (7.01) | (8.59) |
| 16th Nov | 117.90 | 94.07 | 125 | 112.30 |
| | (10.9) | (9.75) | (7.81) | (9.49) |
| 15th Dec | 103.00 | 103.00 | – | 68.67 |
| | (10.2) | (10.2) | (1.00) | (7.13) |
| 15th Jan | – | – | – | – |
| | (1.00) | (1.00) | (1.00) | (1.00) |
| Overall Mean | 89.47 | 52.59 | 37.50 | |
| | (8.82) | (5.09) | (3.13) | |

Figures in parentheses are the squared root transformed values.

C.D at 5% Planting Date = 2.20 Growing Condition = 1.57

Date × Condition = 3.82

Table 10: Number of days to opening of last floret of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Conditions | | | Overall Mean |
|---------------------|--------------------|--------------|----------------------|---------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 114.0 | – | – | 38.01 |
| | (10.72) | (1.00) | (1.00) | (4.24) |
| 16th Sep | 100.0 | – | – | 33.34 |
| | (10.05) | (1.00) | (1.00) | (4.01) |
| 20th Oct | 129.5 | 124.0 | 109.5 | 121.00 |
| | (11.42) | (7.28) | (7.32) | (8.67) |
| 16th Nov | 126.5 | 103.9 | 127.0 | 119.30 |
| | (11.29) | (10.24) | (10.43) | (8.65) |
| 15th Dec | – | 117.0 | – | 39.00 |
| | (1.00) | (8.34) | (1.00) | (3.44) |
| 15th Jan | – | – | – | – |
| | (1.00) | (1.00) | (1.00) | (1.00) |
| Overall Mean | 78.33 | 57.49 | 39.41 | |
| | (7.59) | (4.81) | (2.62) | |

Figures in parentheses are the squared root transformed values.

C.D at 5% Planting Date = 2.41

Growing Condition = 1.70

Date × Condition = 4.18

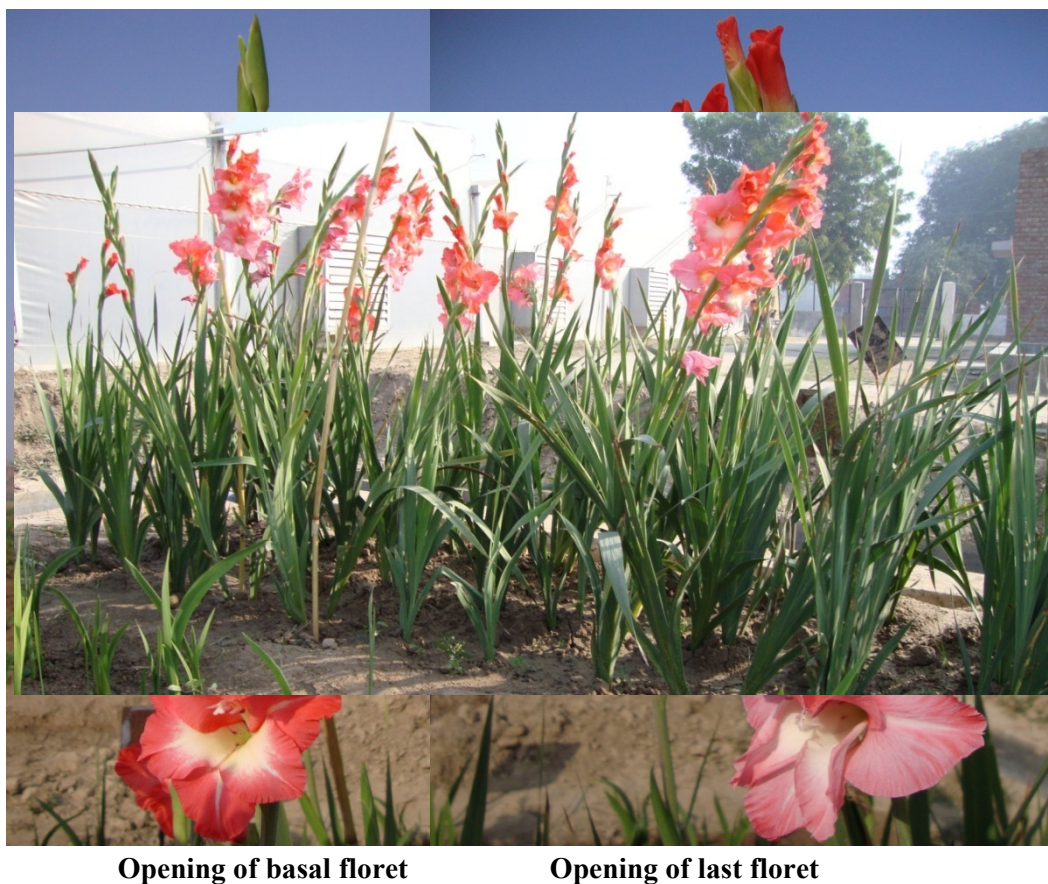


Fig.5: Opening of florets of 18th August planting in open field condition.

4.2.4 Total number of florets per spike: The data in Table.11 indicated average number of florets per spike of gladiolus was affected significantly by planting dates; maximum numbers of florets were recorded in plants grown on 16th Nov and minimum in 16th September planting. The numbers of florets per spike under various growing conditions were different, maximum numbers of florets were recorded in open field and minimum at low-cost polyhouse. Interaction between planting dates and growing conditions was found to be significant. Maximum number of florets were recorded where the planting was done on 16th November in open field and greenhouse and minimum in low-cost polyhouse on 20th October planting.

4.2.5 Length of spike: The data presented in Table.12 indicated that the length of spike was affected significantly by planting dates. Maximum length of spike was recorded in 16th November and minimum in 16th September. The spike length under various growing conditions was significantly different, maximum spike length was recorded in open field and minimum in low-cost polyhouse.

Interaction between planting dates and growing condition was found to be significant, maximum length of spike was recorded when the planting was done on 16th November in greenhouse and minimum length of spike on 20th October planting in plants grown under low-cost polyhouse.

4.2.6 Length of rachis: The data presented in Table.13 indicated that the length of rachis which was affected significantly by planting dates. Maximum length of rachis was recorded on 16th November and minimum in 16th September planting. The rachis length under various growing conditions was significantly different. Maximum rachis length was recorded in open field and minimum in low-cost polyhouse.

Interaction between planting dates and growing condition was found to be significant, maximum length of rachis was recorded where the planting done on 16th November in greenhouse and minimum length of rachis on 20th October planting when plants were grown under low-cost polyhouse.

4.2.7 Diameter of floret: The perusal of data presented in Table.14 regarding effects of the planting date on diameter of floret indicated that size of floret was affected significantly by date of planting. Maximum size of floret was recorded in plants grown on 16th November and minimum on 16th September. Under various growing condition size of florets was found different. Maximum size was recorded under open field and minimum in low-cost polyhouse. Interaction was significant. Maximum size of floret was recorded when planting was done on 16th November in greenhouse and open field and minimum was recorded when planting was done on 20th October also in low-cost polyhouse.

Table 11: Total number of floret per spike of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Conditions | | | Overall Mean |
|----------------|--------------------|------------|----------------------|--------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 9.57 | – | – | 3.19 |

| | | | | |
|---------------------|--------------|--------------|-------------|--------------|
| | (3.25) | (1.00) | (1.00) | (1.75) |
| 16th Sep | 9.30 | – | – | 3.10 |
| | (3.2) | (1.00) | (1.00) | (1.73) |
| 20th Oct | 10.20 | 8.75 | 8.5 | 9.14 |
| | (3.32) | (2.41) | (2.39) | (2.7) |
| 16th Nov | 12.60 | 12.80 | 9.1 | 11.50 |
| | (3.69) | (3.71) | (2.45) | (3.28) |
| 15th Dec | 11.30 | 8.83 | – | 6.72 |
| | (3.5) | (3.12) | (1.00) | (2.54) |
| 15th Jan | – | – | – | – |
| | (1.00) | (1.00) | (1.00) | (1.00) |
| Overall Mean | 8.83 | 5.06 | 2.93 | |
| | (2.99) | (2.04) | (1.47) | |

Figures in parentheses are the squared root transformed values.

C.D at 5% Planting Date = 0.51 Growing Condition = 0.36

Date × Condition = 0.88

Table 12: Length of spike (cm) of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Conditions | | | Overall Mean |
|---------------------|--------------------|---------------|----------------------|--------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 89.77 | – | – | 29.92 |
| | (9.52) | (1.00) | (1.00) | (3.84) |
| 16th Sep | 79.40 | – | – | 26.47 |
| | (8.97) | (1.00) | (1.00) | (3.65) |
| 20th Oct | 68.00 | 59.50 | 41.67 | 56.39 |
| | (8.29) | (6.64) | (5.63) | (6.85) |
| 16th Nov | 78.87 | 111.50 | 66.77 | 85.71 |
| | (8.93) | (10.6) | (8.22) | (9.25) |
| 15th Dec | 79.33 | 73.67 | – | 51.00 |
| | (8.94) | (7.36) | (1.00) | (5.77) |
| 15th Jan | – | – | – | – |
| | (1.00) | (1.00) | (1.00) | (1.00) |
| Overall Mean | 65.89 | 40.78 | 18.07 | |
| | (7.6) | (4.6) | (2.98) | |

Figures in parentheses are the squared root transformed values.

C.D at 5% Planting Date = 1.93 Growing Condition = 1.37

Date × Condition = 3.36

Table 13: Length of rachis (cm) of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Conditions | | | Overall Mean |
|---------------------|--------------------|--------------|----------------------|--------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 29.17 | – | – | 9.72 |
| | (5.48) | (1.00) | (1.00) | (2.49) |
| 16th Sep | 27.47 | – | – | 9.16 |
| | (5.33) | (1.00) | (1.00) | (2.44) |
| 20th Oct | 26.70 | 19.33 | 12.30 | 19.46 |
| | (5.25) | (3.97) | (3.28) | (4.17) |
| 16th Nov | 37.03 | 38.47 | 14.70 | 30.06 |
| | (6.17) | (6.27) | (3.85) | (5.42) |
| 15th Dec | 22.00 | 22.67 | – | 14.89 |
| | (4.79) | (4.27) | (1.00) | (3.34) |
| 15th Jan | – | – | – | – |
| | (1.00) | (1.00) | (1.00) | (1.00) |
| Overall Mean | 23.73 | 13.41 | 4.50 | |
| | (4.67) | (2.92) | (1.85) | |

Figures in parentheses are the squared root transformed values.

C.D at 5% Planting Date = 1.05 Growing Condition = 0.74

Date × Condition = 1.83

Table 14: Diameter of florets (cm) of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Conditions | | | Overall Mean |
|---------------------|--------------------|--------------|----------------------|--------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 9.31 | – | – | 3.10 |
| | (3.21) | (1.00) | (1.00) | (1.73) |
| 16th Sep | 8.52 | – | – | 2.84 |
| | (5.33) | (1.00) | (1.00) | (2.44) |
| 20th Oct | 7.72 | 5.33 | 4.67 | 5.90 |
| | (2.94) | (2.33) | (2.22) | (2.5) |
| 16th Nov | 10.00 | 10.40 | 4.83 | 8.40 |
| | (3.32) | (3.37) | (2.25) | (2.98) |
| 15th Dec | 8.83 | 9.17 | – | 6.00 |
| | (3.13) | (3.19) | (1.00) | (2.44) |
| 15th Jan | – | – | – | – |
| | (1.00) | (1.00) | (1.00) | (1.00) |
| Overall Mean | 7.39 | 4.14 | 1.58 | |
| | (3.16) | (1.98) | (1.41) | |

Figures in parentheses are the squared root transformed values.

C.D at 5% Planting Date = 0.44 Growing Condition = 0.31

Date × Condition = 0.76



Length of rachis in Greenhouse

Length of rachis in open field



Fig.6: Strong spike and rachis from 20th October planting in open field.

4.3 Corms and Cormels production:

4.3.1 Size of corm: The data presented in Table.15 regarding the size of corm indicated that planting dates significantly affected the size of corm. It was observed that the corms obtained from the plants planted early were bigger in size. Delayed in planting dates decreased size of the corms and also plants planted on 15th December and 15th January failed to produce corm. Maximum size of the corm was recorded on 16th November and minimum size was on 15th December.

The size of corm was different under various growing conditions; maximum size of corm was recorded in open field followed by greenhouse and minimum in low-cost polyhouse.

Interaction between planting dates and growing conditions was significant, maximum size of corm was obtained when plants were grown on 16th November inside greenhouse and minimum on 15th December planting in open field.

4.3.2 Weight of corm (g): The data presented in Table.16 regarding the weight of corm indicated that planting dates and growing conditions both affected weight of corm. Maximum weight of corm was noted on 18th August and minimum on 15th December plants. Under various conditions maximum weight of corm was obtained in open field and minimum in low-cost polyhouse.

Interaction was found significant, maximum weight was noted where plants grown on 16th November under greenhouse and minimum on 15th December in open field.

4.3.3 Number of cormels per plant: The data presented in Table.17 showed planting date and growing conditions were not affective for number of cormels produced per plant of gladiolus. Maximum numbers of cormels were recorded on 18th August planting and minimum on 15th December. Accordingly growing conditions open field produced maximum number of cormels per plant and minimum in low-cost poly. Plants grown on 16th September in open field were recorded with maximum number of cormels, and minimum in low-cost polyhouse on planting of 16th September and 20th October.

4.3.4 Weight of cormels (g): The data in Table.18 show weight of cormels was not affected by planting dates and various growing conditions. The corms which were planted in 16th November produced higher weight of cormels (0.14g), under greenhouse condition weight of cormels were increased when plants were grown on 16th November.

| Planting Dates | Growing Conditions | | | Overall Mean |
|---------------------|--------------------|-------------|----------------------|--------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 5.43 | 3.43 | 3.63 | 4.17 |
| | (2.53) | (2.1) | (2.15) | (2.26) |
| 16th Sep | 5.67 | 3.83 | 3.00 | 4.17 |
| | (2.58) | (2.19) | (2.00) | (2.26) |
| 20th Oct | 4.93 | 3.83 | 2.90 | 3.89 |
| | (2.43) | (2.20) | (1.97) | (2.20) |
| 16th Nov | 4.73 | 6.40 | 2.87 | 4.67 |
| | (2.39) | (2.71) | (1.96) | (2.36) |
| 15th Dec | 2.77 | – | – | 0.92 |
| | (1.94) | (1.00) | (1.00) | (1.31) |
| 15th Jan | – | – | – | – |
| | (1.00) | (1.00) | (1.00) | (1.00) |
| Overall Mean | 3.92 | 2.92 | 2.07 | |
| | (2.15) | (1.87) | (1.68) | |

Table 15: Size of corm (cm) of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

Figures in parentheses are the squared root transformed values.

C.D at 5%

Planting Date = 0.08

Growing Condition = 0.06

Date × Condition = 0.15

Table 16: Weight of corm (g) of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Conditions | | | Overall Mean |
|---------------------|--------------------|--------------|----------------------|--------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 53.67 | 37.17 | 29.17 | 40.0 |
| | (7.39) | (6.15) | (5.49) | (6.34) |
| 16th Sep | 42.10 | 26.37 | 20.33 | 29.6 |
| | (6.56) | (5.23) | (4.62) | (5.47) |
| 20th Oct | 46.67 | 37.00 | 18.83 | 34.2 |
| | (6.90) | (6.16) | (4.45) | (5.84) |
| 16th Nov | 34.60 | 62.27 | 15.33 | 37.4 |
| | (5.90) | (7.95) | (4.00) | (5.95) |
| 15th Dec | 23.33 | – | – | 7.8 |
| | (4.93) | (1.00) | (1.00) | (2.31) |
| 15th Jan | – | – | – | – |
| | (1.00) | (1.00) | (1.00) | (1.00) |
| Overall Mean | 33.39 | 27.13 | 13.94 | |
| | (5.45) | (4.58) | (3.42) | |

Figures in parentheses are the squared root transformed values.

C.D at 5% Planting Date = 0.38

Growing Condition = 0.27

Date × Condition = 0.65

Table 17: Number of cormels per plant of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Conditions | | | Overall Mean |
|---------------------|--------------------|-------------|----------------------|--------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 8.23 | 3.33 | 9.67 | 7.08 |
| | (3.02) | (2.06) | (3.19) | (2.76) |
| 16th Sep | 10.70 | 1.33 | 1.00 | 4.33 |
| | (3.41) | (1.52) | (1.41) | (2.11) |
| 20th Oct | 7.67 | 8.00 | 1.00 | 5.55 |
| | (2.70) | (2.95) | (1.41) | (2.35) |
| 16th Nov | 5.00 | 9.67 | 1.67 | 5.44 |
| | (2.43) | (3.18) | (1.63) | (2.41) |
| 15th Dec | 6.00 | – | – | 2.00 |
| | (2.58) | (1.00) | (1.00) | (1.52) |
| 15th Jan | – | – | – | – |
| | (1.00) | (1.00) | (1.00) | (1.00) |
| Overall Mean | 6.26 | 3.72 | 2.22 | |
| | (2.52) | (1.95) | (1.61) | |

Figures in parentheses are the squared root transformed values.

CD at 5% Planting Date = 0.49 Growing Condition = 0.45

Date × Condition = .085

Table 18: Weight of cormels (g) of gladiolus cv. American Beauty as affected by planting dates and growing conditions.

| Planting Dates | Growing Conditions | | | Overall Mean |
|---------------------|--------------------|-------------|----------------------|--------------|
| | Open Field | Greenhouse | Naturally Ventilated | |
| 18th Aug | 0.05 | 0.03 | 0.03 | 0.04 |
| | (1.02) | (1.01) | (1.02) | (1.02) |
| 16th Sep | 0.05 | 0.03 | 0.03 | 0.03 |
| | (1.02) | (1.02) | (1.01) | (1.02) |
| 20th Oct | 0.05 | 0.03 | 0.02 | 0.03 |
| | (1.02) | (1.01) | (1.01) | (1.02) |
| 16th Nov | 0.05 | 0.35 | 0.02 | 0.14 |
| | (1.03) | (1.1) | (1.01) | (1.06) |
| 15th Dec | 0.05 | – | – | 0.01 |
| | (1.02) | (1.00) | (1.00) | (1.00) |
| 15th Jan | – | – | – | – |
| | (1.00) | (1.00) | (1.00) | (1.00) |
| Overall Mean | 0.04 | 0.07 | 0.02 | |
| | (1.02) | (1.03) | (1.01) | |

Figures in parentheses are the squared root transformed values.

C.D at 5% Planting Date = N.S Growing Condition = N.S

Date × Condition = N.S



Variation in size of corms



Variation in size of cormels



CHAPTER – V

DISCUSSION

Yield of a crop is a result of interaction between the various factors that influence the plant growth and development. Agro-technology and climate factors play an important role in the performance of flower crops. A flower shows its yield potential under the optimum environmental and agronomical factors for growth and yield. Times of planting and growing condition are the important factors which decide the flowering, flower quality and yield of gladiolus. Results emanating from the present studies are discussed in this chapter.

5.1 Vegetative characters:

5.1.1 Days taken for sprouting:

The gladiolus corms planted on 20th October took minimum number of days for sprouting under all growing conditions and increased with late planting 16th November to 15th January. The reason for late sprouting under late sown condition might be due to downfall in temperature which started decreasing from beginning of November. Days taken for sprouting by greenhouse were less than open field and naturally ventilated which might be due to more humidity and cooling under pad system with controlled condition. Nijasure and Ranpise (2005) in gladiolus cv. American Beauty in Maharashtra condition obtained same result minimum days were taken for sprouting from October planting.

5.1.2 Percentage of sprouting:

It was observed that percentage of sprouting was not affected by growing conditions. Time of planting was affected significantly the percentage of sprouting of corms and 100% sprouting was recorded on 18th August, 16th September and 20th October and late planting after October it decreased. This might be attributed to the fact that during early planting the day and night temperature was very favourable for sprouting of corms. It clearly showed that decreased in temperature has affected the percentage of sprouting particularly the corms which were planted on 15th December and 15th January. Similar results were reported by Bhat and Zahoor Ahmad (2007) in gladiolus planting under Kashmir condition.

5.1.3 Number of leaves per plant and leaf area:

Numbers of leaves per plant and leaf area were more in plants where planting was made on 16th November followed by 18th August and 16th September and decreased significantly on 15th December followed by 15th January. Plants grown in greenhouse on 16th November produced more number of leaves and leaf areas increased which might due to effect of better growing conditions. Variations in number of leaves were also recorded in cv. Friendship (Sujatha and Singh, 1991) in gladiolus. Variation in number of leaves and leaf area due to different planting dates and growing conditions was observed significantly in naturally ventilated polyhouse. Similar variation in production of leaves due to varieties has been reported previously in gerbera (Bhattacharjee, 1981), chrysanthemum (Jayaprakash, 1998), gladiolus (Kalasaraddi, 1996) and carnation (Patil, 2001).

5.1.4 Plant height (cm):

There were significant differences in plants height due to effects of planting dates and growing conditions. Maximum plant height (84.39cm) was recorded on 18th August planting and it reduced with delay in planting dates and minimum height of plant (44.09) was noted on 15th December planting. Plants grown in greenhouse produced maximum height followed by open field and minimum in low-cost polyhouse. Increase in height of plants might be due to presence of more soil structure greenhouse and also due to controlled temperature and humidity.

The results of present investigations are in conformity with research results of Nijasure and Ranpise (2002) carried out on three times of planting *i.e.* September, October and November in Maharashtra condition.

5.2 Flowering parameters:

5.2.1 Days taken for spike initiation:

Numbers of days for spike initiation were affected by planting dates and growing conditions. Plants grown on 18th August and 16th September took minimum number of days for spike emergence and it increased with delay in planting dates whereas the maximum numbers of days (125.43 days) were recorded on 15th December. Plants grown on 15th January failed to produce flower which might be due to decrease in temperature during growing season. Greenhouse and naturally ventilated polyhouse failed to produce flower on 18th December and 16th September which might be due to poor of light which is most required for gladiolus. Significance of light during growing period of gladiolus was also reported by Mckay *et al.* (1981).

Shiva and Dadlani (2002) reported early spike initiation of gladiolus grown under greenhouse conditions in November planting in comparison to open field in Delhi condition. Similarly Laurie *et al* (1979) suggested that earliness in flowering inside the greenhouse could be because of rise in soil temperature as indicated by higher temperature inside greenhouse conditions as compared to open field.

5.2.2 Days taken for opening of basal and last floret:

Basal floret and last floret opening were found to be affected by time of planting and growing condition. Earliest opening of basal and last floret was found in 16th September planting which was at par with 18th August planting. Maximum numbers of days were taken on 20th October which was at par with 16th November planting. Plants grown in greenhouse on 16th November took minimum number of days for opening of basal and last florets to comparison to open field. This might be due to the fact that

environmental conditions were suitable under September for open field and November for greenhouse growing of gladiolus. These results are similar to findings of Shiragur *et al* (2004) in carnation cultivars. Gaikward and Patil (2001) have also observed similar results in chrysanthemum varieties under open and polyhouse conditions.

5.2.3 Total number of florets per spike:

Number of florets per spike showed the significance of planting dates and growing conditions which affected the floral parts of plants planted in different dates under protected and open field conditions. Maximum numbers of florets per spike were counted from the spikes of plants which were planted on 16th November and 20th October, in 16th November date of planting the maximum florets per spike were counted in greenhouse (12.8) followed by open field (12.6) and naturally ventilated polyhouse (9.1). The number of florets obtained from open field on 18th August and 16th September were at par. The results of experiment are in agreement with Arora and Sandhu (1984) reported about two times of planting performances in months of October and November in Punjab condition. Open conditions produced more numbers of florets per spike which might be due to more light required by gladiolus.

5.2.4 Length of Spike and Rachis:

There were significant differences in spike length and rachis length due to different timing of planting and growing conditions. Maximum spike length (111.5cm) in greenhouse was recorded in November planting and open field (89.77cm) in August planting.

In November planting the maximum rachis length (38.47cm) was recorded in greenhouse followed by open field (37.03cm) and low-cost polyhouse (14.77cm). Increase in spike and rachis length of gladiolus inside the greenhouse might be due to availability of more fertilizers and suitability of environmental factors mainly the light and temperature in greenhouse. The results of the present investigation is in conformity with results of Nijasure and Ranpise (2002). Improved in gladiolus flowers quality inside the greenhouse was also reported by Mckay *et al.* (1981).

5.2.5 Diameter of floret:

Diameters of florets of gladiolus were noted differently in size within planting dates and growing conditions. Plants grown on 16th November gave the largest size of florets, (10.37cm) in greenhouse followed by open field (10cm) and low-cost polyhouse produced the smallest size of floret in all planting dates. Florets produced in open field on 18th August were at par with florets of 16th September. Increase in size of florets on

November might be due to normality of temperature and light during growth of plants. Shiragur *et al* (2004) reported the variation in carnation flower diameter due to their genetic characters of particular genotypes. Similar variations in flower diameter among the cultivars were also observed previously in carnation by Kumar *et al* (1999), Patil (2001) and Singh *et al* (2001). Variation on flower diameter of different cultivars may be due to their genetical character (Halevy and Mayak, 1981).

5.3 Corm and cormel characters:

5.3.1 Size of corm:

Early planting resulted in production of large sized corms, size of corms decreased as the planting was delayed. This might be due to the fact that maximum plant growth occurred in early planting and so large number of photosynthesis were available for the production of large sized corm, in open field the large corms sized (5.67cm) was obtained on 16th September date of planting and it was reduced by late planting. Talia and Traversa (1986) were reported about variation in size of corms obtained by different methods of planting of gladiolus.

5.3.2 Weight of corm:

Weight of corms was affected by planting dates and growing conditions, early planting produced near to equal in weight of corms in open field and it was reduced by delayed in planting. Greenhouse plants which produced the highest weight of corms only on 16th November planting and low-cost polyhouse gave the low weight of corms among them.

The results of this experiment are in agreement with Arora and Sandhu (1987) reported about times of planting performances in months of October and November in Punjab condition.

5.3.3 Number of cormels per plant:

Numbers of cormels per plant were affected by date of planting and also planting conditions. Maximum number of cormels per plant were obtained from corms sown on 18th August (7.08) followed by 20th October (5.55) and 16th September was at par with 20th October planting. Cormels obtained from corms planted in open field were noted with maximum numbers per plant and greenhouse was at par with low-cost polyhouse. Interaction was found to be significant where maximum number of cormels (10.67) in open field were recorded when corms were sown on 16th September followed by greenhouse

(9.67) on 16th November which was at par with low-cost polyhouse on 18th September and minimum in low-cost poly house.

5.3.4 Weight of cormels:

The data regarding weight of cormels showed that cormels weight was not affected by planting dates and growing conditions.

CHAPTER – VI

SUMMARY AND CONCLUSION

1. The gladiolus corms planted on 20th October took minimum number of days for sprouting under all growing conditions and increased with late planting after November.
2. August, September and October found to be best time of planting to obtain more percentage of corms sprouting.
3. Numbers of leaves per plant and leaf area increased with planting in August and November.
4. Maximum growth in terms of plant height was recorded on 18th August planting and greenhouse produced the tallest plants.
5. Minimum numbers of days for spike emergence were taken on 18th August and 16th September planting.
6. Earliest opening of basal and last floret were found in planting of 16th September and 18th August planting.
7. Maximum numbers of florets per spike were counted from the spikes of 16th November and 20th October plantings.
8. Maximum spike length and rachis were recorded in 16th November planting.
9. The largest sizes of florets were produced in 16th November planting.
10. The largest sizes of the corms were obtained on 16th November date of planting.
11. Early planting produced near to equal corms in weight with open field and it was reduced by delayed in planting.
12. Maximum numbers of cormels per plant were obtained from corms which were sown on 18th August and 20th October.
13. Cormels weights were not affected by planting dates and growing conditions.

Conclusion

From the present investigations it may be concluded that the planting during August to November is the best time of planting of gladiolus under open field conditions.

Greenhouse planting during November gave satisfactory result and it needs further investigations.

Naturally ventilated polyhouse did not give good response. Gladiolus corms which were sown under open field conditions produced better quality of corms and cormels.

CHAPTER – VII

BIBLIOGRAPHY

- Arora, J.S., and Sandhu, G.S. (1987). Effect of two planting dates on the performance of fifteen Gladiolus cultivars. *Punjab.J. Hort.* **27**: 243-249.
- Arora, J.S., Kaur, A. and Sidhu, G.S. (2002). Performance of carnation in polyhouse. *J. Orn. Hort.* **5**(2): 58.
- Bhattacharjee, S.K. (1981). Studies on the performance of different varieties of *Gerbera jamesonii hybrida* under Bangalore condition. Lal Bagh. **26**: 16-23.
- Bhat and Zahoor Ahmad. (2007). Growth, flowering and production of gladiolus as influenced by plant density, corm size and time of sowing under temperate conditions of Kashmir, *KrishPrabha Database*, <http://www.hau.ernet.in/>.
- Boodley. J. W (1981). The Commercial Greenhouse, Delmar Publishers Inc., Albany, New York, p. 568.
- Bose, T.K., Dhua. R.S, Das. P. and Maiti (1999), *Floriculture and Landscaping*, Naya Prokash, Culcutta: 477-478.
- Bose, T.K and Yadav. L.P. (1989). *Commercial Flowers*, Naya Prokash, Culcutta: 305-307.
- Buschman, (1984) Gladiolus as Cut flower in Subtropical and Tropical Regions, International Flower bulb Centre, Hillegom, Holland p. 31.
- Chadha.K.L (2006) *Handbook of Horticulture*, ICAR, New Delhi: 562-566.
- Cohat, J. (1993). Gladiolus In: *The physiology of flower bulbs* (eds A.A. Dehertogh and M. LeNard) Elsevier Science Publ., Amsterdam, p. 297-320.
- Dwivedi, S.K. and Kareem, A. (2004). Introduction and evaluation of carnation (*Dianthes caryophyllus Linn.*) varieties cold arid region of India. *J. Orn. Hort.* **7**(2): 207-209.
- Everett, T.H. (1981). New York Botanical Garden Illustrated Encyclopedia of Hort. 5 Gar.land N. Y.:1485-1490.
- Farid uddin, M., M.M. Rahman, M.G. Rabbani and M.A. Mannan. (2002). Effect of corm size and depth of planting on the growth and flowering of gladiolus. *Pak. J. Biol. Sci.* **5**(5): 553–555.
- Fisher, R.A. 1958. *Statistical methods for research workers*. Ed. **10**, Oliver and Boyd. Edinburgh and London.
- Gaikwad, A.M. and Patil, S.S.D. (2001). Evaluation of chrysanthemum varieties under open and polyhouse conditions. *J. Orn. Hort.* **4**(2): 95-97.

- Grassotti, A., Raneiri, M.D.E. and Pergula, G. (1983). Extending the summer harvesting period of carnation with assistance of protective structure. *Colture Protette*. **12**(10): 45-51.
- Gurav, S.B., Nagare, P.K., Katwate, S.M., Sabale, R.N., Singh, B.R. and Dhane, A.V. (2004). Standardization of package of practices for carnation under partially modified greenhouse condition. *J. Orn. Hort.* **7**(3-4): 221-225.
- Halevy, A.H. and Mayak, S. (1981). Senescence and post harvest physiology of cut flowers. *Horticulture Reviews Part II*. **3**: 59-143.
- Hartman, H.T., D.E. Kester and F.T. Davis. 1990. Plant propagation: Principles and practices. 5th ed. Prentice-Hall, International Inc. Englewood Cliffs, New Jersey. p. 443-445.
- Jackson, M.L. (1967). *Soil Chemical Analysis*. Asia Publishing House, Bombay.
- Jackson, M.L. (1973). *Soil Chemical Analysis*. Prentice Hall of India Pvt. Ltd., New Delhi, India. pp.498.
- Jayaprakash, A. (1998). Evaluation of chrysanthemum (*Chrysanthemum morifolium* Romat.) cultivars under greenhouse. *M.Sc. Thesis*. University of Agricultural Sciences, Bangalore.
- Jhon, A.Q. and Khan, F.U. (2003). Evaluation of tulips under polyhouse and open conditions. *J. Orn. Hort.* **6**(1): 42-45.
- Jhon, A.Q., Bichoo, G.A. and Siddique, M.A.A. (1996). Performance of gladiolus cultivars in Kashmir. *Flora and Fauna Jhansi*. **2**(1): 75-77.
- Kalasaraddi, P.T. (1996). Effect of time of planting and corm size on growth, flowering and flower quality of gladiolus (*Gladiolus hybrida* Hort.). *M.Sc. Thesis*. University of Agricultural Sciences, Dharwad.
- Kandpal, K., Kumar, S., Srivastava, R., and Chandra, R. (2003). Evaluation of gerbera (*Gerbera jamesonii*) cultivars under tarai conditions. *J. Orn. Hort.* **6**(3): 252-255.
- Kumar, B. (2009). Indian Horticulture database 2008. National Horticulture Board, Gurgaon. p. 12-13.
- Kumar, P.N., Singh, B., Sindhu, S.S. and Voleti, S.R. (1999). Effect of growing environments on carnation flowering. *J. Orn. Hort.* **2**(2): 137-138.
- Kumar, R. and Yadav, D.S. (2003). Evaluation of gerbera for NEH region. *J. Orn. Hort.*, **6** (1).
- Laurie, A., D.C. Kiplinger and K.S. Nelson. (1979). Cut flower production. In Commercial flower forcing (ed.) Laurie, A., McGraw Hill Inc. New York.
- Magie, R.O. (1976). Growing gladiolus flowers commercially during the winter season. Gladio Grams. In: Magie, R.O. (Ed.), Bulletin No.: 22. Commercial Growers Division of the North American, Gladiolus Council, p. 1-4.
- Mckay, M.E., D.E. Byth and J.A. Tommerup (1981a). Environmental responses of gladiolus in South-east Queensland. *Scientia Hort.* **14**: 77-92.

- Mckay, M.E., D.E. Byth and J.A. Tommerup (1981b). The influence of photoperiod and plant density on yield on winter-grown gladiolus in Queensland. *Scientia Hort.*, **17**: 277-288.
- Muhammad-Zubair; Wazir, F.K., Gohar, Ayub., Sohail, Akhter, (2006). Planting dates affect production and quality of gladiolus corms and cormels. *Sarhad-Journal-of-Agriculture*. **22**(2): 249-258.
- Naik, B.H., Chauhan, N., Patil, A.A., Patil, V.S. and Patil, B.C. (2006). Comparative performance of gerbera (*Gerbera jamesonii* Bolusex Hooker F.) cultivar under naturally ventilated polyhouse. *J. Orn. Hort.* **9**(3): 204-207.
- Nazir, M., Dwivedi, V.K., Bhat, K.L. (2005). Path analysis studies in gladiolus over different environments. *Karnataka-Journal-of-Horticulture*. **1**(4): 24-28.
- Nijiasure, S. N and Ranpise. S. A. (2005). Effect of date of planting on growth, flowering and spike yield on Gladiolus. *Haryana J.Hort*: **34**(1-2): 73-74.
- Olsen, S.R., Cole, C.V., Watanable, F.S. and Dean, T.A. (1954). Estimation of available phosphorus in soil by extraction with sodium bicarbonate. *Circular U. S. Deptt. Agric.* Pp. 939
- Panse, V.G. and P.R. Sukhatme 1978. *Statistical Methods for Agricultural Workers*. ICAR, New Delhi.
- Paraneetha, S. (2006). Performance of gerbera (*Gerbera jaesoni* Bolusex Hooker F.) genotypes at shervaroy hills of Tamilnadu. *J. Orn.Hort.* **9**(1): 55-57.
- Patil, R.T. (2001). Evaluation of standard carnation (*Dianthus caryophyllus*) cultivars under protected cultivation. M.Sc. Thesis, University of Agricultural Sciences, Dharwad.
- Piper, C.S. (1950). Soil and Plant Analysis. *The University of Adelaide Monograph Adelaide,Australia*.
- Piper, C.S. (1966). Soil and plant analysis. Hans Publication, Bombay. pp.368.
- Salvi, J.S., Dalal, S.R., Anjali,Mohariya., Renuka,Deshpande ,(2003). Effect of planting dates on growth, flowering and quality of gladiolus under shade net, *Annals-of-Plant-Physiology*. **17**(1): 88-91.
- Salvi, J. S; Dalal, S. R., Jogdande, N. D., Anjali, Mohariya., Anuje, A.A (2004) Effect of planting dates on the performance of gladiolus varieties under different environmental conditions, *Crop-Research-Hisar*; **27**(2/3): 227-230.
- Sharma ,Sanjib, and Talukdar, M. C (2002). Effect of time, spacing and depth of planting on gladiolus. Deptt. Of Horticulture, Assam Agricultural University, Jorhat -785013, India.
- Sheoran, O.P. (2004). *Statistical Package for Agricultural Research Workers*. CCS HAU, Hisar. <http://hau.ernet.in>.
- Sherry, W.J. and Goldsberry, K.L. (1980). Carnation production responses to solar radiation transmitted through plastic greenhouse covers. *J. Am. Soc. Hort. Sci.* **105** (4): 579-582.
- Shiragur, M., Shirol, A.M., Gorabal, K., Reddy, B.S. and Kulkarni, B.S. (2004). Evaluation of standard carnation cultivars for their flowering, flower quality and yield parameters under protected cultivation. *J. Orn. Hort.* **7**(3-4): 206-211.

- Shinde, R.D., Dalal, S.R., Shinde, S.D., Deshmukh, R.P. (2005). Effect of pinching on performance of carnation varieties under polyhouse condition. *Advances in Plant-Sci.* **18**(2): 731-733.
- Shiva. K. N and Dadlani, N. K ,(2002). Effect of growing environments on growth, flowering and corm production of gladiolus, *South-Indian-Horticulture.* **50**(4/6): 635-640.
- Shiva, K. N and Dadlani, N. K, (2002). Floriculture-research-trend-in-India-Proceedings-of-the-national-symposium-Indian-floriculture-in-the-new-millennium,-Lal-Bagh,-Bangalore,-25-27 February, 2002. 251-252.
- Singh, A.P. and S.R. Dohare. 1994. Maximization of corm and cormel production in gladiolus. In: J. Prakash and K.R. Bhandary (Eds.). Floriculture- Technology, trades and trends. Oxford & IBH Pub. Co. Pvt. Ltd., India, 205–208.
- Singh, D., Gill, A.P.S. and Kumar, R. (1994). Effect of summer shading on the plant growth and flower production of standard carnation (*Dianthus caryophyllus* L.) cv. Espana under subtropical conditions of Punjab, *J. Orn. Hort.* **2**(1-2): 51-53.
- Singh, K.P. and Singh, M.C. (2006). Association analysis in gerbera (*Gerbera jamesonii* Bolusex Hooker F.) grown under naturally ventilated greenhouse. *Prog. Hort.* **38**(2): 199-204.
- Singh, K.P., Sangama and Mandhar, S.C. (2001). Evaluation of post harvest qualities of standard carnation flowers grown under natural ventilated greenhouse. *J. Orn. Hort.* **4**(1): 53-54.
- Subbiah, B.V. and Asija,G.L.(1956). A rapid procedure for the determination of available nitrogen in soils. *Cuurr. Sci.* **25**: 259-260.
- Sujatha, K., Singh, K.P (1991). Effect of different planting densities on growth, flowering and corm production in gladiolus. *Indian J. Hort.* **48**(3); 273-276.
- Suneetha, S, and Vasantha Kumar, K. (1997). Influence of planting dates and cultivars on the performance of gladiolus under Kerala conditions. *South Indian J.Hort.* **45**:139-142.
- Swaroop,Kishan, Singh,K.P., Singh, K.P, (2005). Performance of gladiolus under Delhi conditions. *J. Orn.Hort-New-Series.* **8**(1): 32-35.
- Talia, M.C. and E. Traversa (1986). First result from the study of the effect of the planting density on increasing the size of gladiolus corms. *Culture Protette* **15**(11): 45-49.
- Woltz, S.S. (1976). Fertilization of gladiolus. Gladio Grams. In: Magie, R.D. (Ed.), Bulletin No.: 21. *Commercial Growers Division of the North America Gladiolus Council*, p. 1–5.
- Zhao, J, Y, and Y. Wen. (2008). Development and countermeasures of flower industry in Yunnan, China. *Ecol. Econ.* **4**: 151-160.

APPENDIX

Weekly meteorological data recorded during crop growing season (2009-10)

| Standard weeks | Mean temperature (°C) | | Mean relative humidity (%) | | Mean sunshine (hours) | Mean pan evaporation (mm) | Rainfall (mm) |
|----------------|-----------------------|------|----------------------------|--------|-----------------------|---------------------------|---------------|
| | Max. | Min. | (Morn.) | (Eve.) | | | |
| 42 | 33.7 | 18.0 | 81 | 39 | 8.1 | 5.6 | 0.0 |
| 43 | 30.2 | 15.0 | 90 | 44 | 5.3 | 4.0 | 0.0 |
| 44 | 30.7 | 13.9 | 95 | 38 | 4.0 | 3.1 | 0.0 |
| 45 | 32.3 | 13.0 | 83 | 32 | 7.5 | 2.7 | 0.0 |
| 46 | 29.4 | 12.8 | 92 | 53 | 5.7 | 2.5 | 0.0 |
| 47 | 25.7 | 9.7 | 96 | 72 | 6.8 | 2.5 | 0.0 |
| 48 | 24.4 | 4.8 | 92 | 50 | 8.3 | 2.8 | 0.0 |
| 49 | 22.3 | 7.8 | 91 | 49 | 5.6 | 2.1 | 2.2 |

| | | | | | | | |
|----|------|------|----|----|------|-----|------|
| 50 | 20.8 | 4.3 | 96 | 46 | 5.8 | 1.4 | 0.0 |
| 51 | 23.3 | 6.4 | 95 | 39 | 7.1 | 2.1 | 0.0 |
| 52 | 20.5 | 4.2 | 98 | 53 | 7.0 | 1.5 | 3.8 |
| 1 | 17.0 | 1.9 | 97 | 48 | 5.4 | 1.4 | 0.0 |
| 2 | 18.0 | 0.7 | 93 | 41 | 6.9 | 1.3 | 0.0 |
| 3 | 20.4 | 3.2 | 94 | 34 | 7.0 | 1.8 | 0.0 |
| 4 | 22.8 | 4.5 | 90 | 39 | 8.2 | 2.1 | 0.0 |
| 5 | 25.4 | 7.6 | 97 | 69 | 5.9 | 2.0 | 0.0 |
| 6 | 22.0 | 10.2 | 95 | 80 | 2.7 | 1.5 | 59.3 |
| 7 | 20.8 | 8.8 | 97 | 83 | 6.5 | 1.6 | 16.0 |
| 8 | 23.2 | 8.4 | 94 | 55 | 8.4 | 2.8 | 0.0 |
| 9 | 23.2 | 9.6 | 97 | 60 | 6.7 | 2.6 | 4.1 |
| 10 | 26.0 | 9.8 | 83 | 36 | 9.2 | 3.9 | 0.0 |
| 11 | 23.4 | 10.5 | 97 | 57 | 6.8 | 2.2 | 40.2 |
| 12 | 29.5 | 13.0 | 91 | 45 | 8.5 | 4.2 | 0.0 |
| 13 | 33.8 | 13.8 | 80 | 35 | 9.9 | 5.1 | 0.0 |
| 14 | 34.1 | 14.0 | 84 | 28 | 9.6 | 5.3 | 2.0 |
| 15 | 37.9 | 16.4 | 66 | 18 | 10.1 | 7.2 | 0.0 |

ABSTRACT

| | | |
|--------------------------------------|---|---|
| Title of thesis | : | Studies on cultivation of gladiolus in open and protected conditions |
| Name of degree holder | : | Mohd. Saalim Saaie |
| Title of degree | : | Master of Science |
| Name and address of Major advisor | : | Prof. V.P. Ahlawat Head of the Department of Horticulture CCS Haryana Agricultural University, Hisar- 125004 |
| Degree awarding University/Institute | : | Chaudhary Charan Singh Haryana Agricultural University, Hisar-125004, Haryana (India) |
| Year of award of degree | : | 2010 |

Major subject : Horticulture
 Total number of pages in the thesis : 45 + iv
 Number of words in the abstract : 190 Approx.
 Keywords : Gladiolus, Cultivation, Open and Greenhouse.

A field experiment entitled "Studies on cultivation of gladiolus in open and protected conditions" was carried out during the year 2009-10 in the Department of Horticulture, CCS Haryana Agricultural University, Hisar with a view to standardize the time of planting of gladiolus under open, low-cost polyhouse and Hi-tech greenhouse. Studies on the effect of different growing conditions and sowing dates on growth and yield attributes of gladiolus revealed that the planting during August to November recorded with minimum number of days and significantly highest percentage of sprouting, leaf area and number of leaves per plant, plant height, number of days taken to emergence, number of days taken opening of basal and last floret, number of florets/spike, diameter florets, number of cormels per plant, weight of corms and cormels and size of corms during studies in comparison to six planting dates in all growing conditions. Among the various growing conditions (open field, low-cost polyhouse and Hi-tech greenhouse) tested, the open field exhibited significantly highest performances till November planting, low-cost polyhouse was low in all objectives particularly in floral parts and greenhouse gave best result during November planting.

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