EFFECTS OF PLANTING DATES AND FLORAL PRESERVATIVES ON SPIKE QUALITIES OF GLADIOLUS (*Gladiolus grandiflorus*)

By

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DECLARATION

I hereby declare that this thesis entitled Effects of planting dates and floral preservatives on spike qualities of gladiolus (*Gladiolus grandiflorus*) is a bonafide record of research worl done by me during the course of research and that the thesis has not previously formed the basis for the award of any degree diploma associateship fellowship or other similar title of any other University or Society

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CERTIFICATE

Certified that this thesis entitled Effects of planting dates and floral preservatives on spike qualities of gladiolus (*Gladiolus grandiflorus*) is a record of research work done independently by Miss SUNEETHA S 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

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INTRODUCTION

The horticultural products of commercial importance mainly consist of cut flowers and ornamental foliage plants The cut flowers constitute 45 per cent share of the total world trade in floricultural products The flowers which are important in cut flower trade are orchids roses carnations chrysanthemums and gladioli

In India the commercial production of cut flowers has registered a steady increase only in the recent past Most of these commercially important flowers can be grown in the open even during winter months in India and thus a great potential exists for their production for export Besides their demand in the export market in the recent times the requirement of cut flowers in the domestic markets has also been developed In spite of the favourable environment for growing many varieties of flowers in different regions India has practically no share in the world cut flower trade Ad hoc figures collected in a recent survey have indicated that an area of about 25000 ha only is devoted to flower cultivation in India (Mishra and Singh 1989)

Gladiolus is one of the most beautiful and fascinating cut flowers that is grown in many parts of the world It now ranks fourth in the international cut flower trade Gladiolus is by far the best suited bulbous cut flower plant for the tropical and subtropical regions of India But unfortunately this is not so commonly grown as tuberose or other flowers Gladiolus is popular for its attractive spikes having florets of huge form dazzling colours varying sizes and long vase life Its magnificent inflorescence with a variety of colours has made it attractive for use in herbaceous borders beddings rockeries pots and for cut flowers The exquisite cut flowers of gladiolus are preferred for bouquets and flower arrangements

Gladiolus (G <u>grandiflorus</u>) is a native of South Africa and belongs to Family Iridaceae The name gladiolus was originally coined by Pliny the Elder (A D 23 79) deriving from the Latin word Gladius meaning Sword on account of the sword like shape of its foliage (Mishra and Singh 1989) Sword lily and Corn flag are its common names because of the sword shaped leaves and its occurrance as a weed in corn fields There are around 200 species of gladiolus scattered through out the world Grandiflorus and Primulinus types look very attractive in mixed flower borders and beddings The Pixiolas (miniatures) are the daintiest and preferred for forcing under glass and / or for growing in pots and bowls

As in the case of any commercially important crop in gladiolus too flowering and yield are reflections of its growth during the pre flowering stage This pre flowering vegetative growth stage is under the profound influence of the environmental conditions prevailing during that period Thus the performance of the crop and successful crop production of gladiolus is determined by the environment during different growing seasons

Though many new developments in floricultural crop production have taken place in the last twentyfive years the process of postharvest growth opening and senescence of cut flowers in vase is not much understood even now To utilise the immense potential that exists in India for supporting an export trade in cut flowers as well as for meeting the ever increasing internal demand it is essential that more research be carried out on the postharvest physiology and senescence of cut flowers and methods for enhancing their postharvest shelf life and quality

The main objective of the study is to find out the effect of different dates of planting on growth flowering corms and cormel production of three varieties of gladiolus under Kerala conditions and standardising the optimum planting date The study also aims at finding out the effect of three floral preservative chemicals combined with sucrose on the postharvest life of cut gladiolus spikes in vase

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The literature available on this topic of study is reviewed and presented here under the following titles

2 1 Time of planting

There are reports from many countries on the effect of different planting times of gladioli on the growth flowering as well as corm and cormel production Environmental factors such as rainfall temperature humidity and sunshine were found to influence affect growth and flowering of the crop

2 1 1 Effect of different planting dates

Planting dates has been observed to influence flowering intensity and flower quality under both field and glass house conditions in many countries (Weinhart and Decker 1930 Post 1942 Kosugi 1962 and Shillo and Halevy 1975) Information available on the influence of planting dates on corm and cormel production in gladiolus are rather scanty But noteworthy response to daylight and light intensity have been reported (Borthwick and Parker 1949 Wassnik 1960 Kosugi 1962 and Nakayama 1967)

Experiments conducted on locations in the plains of North India revealed that good quality spikes can be produced during November to March by planting suitable cultivars from September to December (Swarup and Raghava 1972) Gladiolus is found to flower throughout the year under agroclimatic conditions prevailing in Bangalore (Mukhopadhyay and Bankar 1987) Ravidas (1991) found that under Kerala conditions November planting was better than April planting for production of good quality spikes corm and cormels

Trials conducted in Italy with cultivars Sans Souci and Snow Princess planted in open at fort-nightly intervals from July to October indicated that the plant failed to flower after mid September (Cocozza 1971) He also observed that early March planting under glass produced earlier flowering than simultaneous outdoor planting Varietal difference in flowering were seen with the planting time limit for cultivars Oscar and Firebrand around June whereas for cultivar Travela it was found till late June-July (Shimuzu and Uchibori 1976)

Studies on the performance of cormel planting of gladiolus at 18 days intervals revealed that the best flowering and corm yield were from early planting (Grabowska 1978) In 3 year studies with 18 gladiolus cultivars simultaneously planted in Leningrad and Krasnoder of Russia Tamberg and Chirva (1978) found that growth started sooner in Leningrad but longer spikes and greater number of florets were reported from Krasnoder

Growth and development studies on gladiolus conducted under greenhouse conditions in Egypt revealed that planting at monthly intervals form April to November resulted in longer growing periods from later plantings though there was little effect on corm size (Shoushan et al 1980a) Further studies on planting dates (Shoushan et al 1980b) observed that by monthly planting of cormlets of cultivar Aerovision from April to November greater number of cormels and corms were formed in plants from later planting dates

Mckay et al (1981a) in an experiment with 12 gladiolus cultivars planted at 3 to 4 weeks interval from February to September found that temperature was a major factor influencing the number of days taken for flowering Yield and quality of inflorescences from early planting were inferior to those from later planting though vase life deteriorated after mid April Later planting also tended to favour corm and cormlet production Vita (1981) from experiments conducted in Italy showed that gladiolus cultivars had more effect than planting dates on corm size and yield and that the best planting date differed for different cultivars

Studies on varietal responses with planting dates revealed that the time to harvest was reduced with delay in planting (Bondt 1982) From another experiment on planting dates Grabowska and Pankiewicz (1984) reported that the best way to delay flowering is by selecting the corm size and by delaying planting till mid May in Russia Groen (1984) studied the effect of planting time on flowering of cultivar Roselind under glass house conditions He observed that planting in mid August was too late for satisfactory flowering Planting on 25th July resulted in satisfactory flowering and corm size

Outdoor planting of gladiolus during summer caused low flowering in most cultivars mainly due to very high temperature during early growth period (Buschman and Groen 1989) When corms of cultivar Dibonar were planted on 3rd

September 18th September or 3rd October the best results were obtained from early planted corms (Dod *et al* 1989) In Korea the weight of corms produced from cormels tended to decrease with delay in planting time from March to May Delay in harvesting from September to October increased the corm weight irrespective of planting dates (Suh 1989)

Studies on the effect of planting time conducted in Punjab showed that October planting took longer time for spike emergence than August and September planting (Khanna and Gill 1983) This was attributed to the prevailing short day length and low temperature during night which slowed down plant growth September and October plantings were found to produce better spike length than August planting and cormel production was found to be high in August and October plantings

Arora and Khanna (1985) in an experiment on the evaluation of thirty gladiolus cultivars planted in the first fortnight of September found differential responses of the cultivars in terms of the period from spike emergence to colour break of basal floret This was observed to be due to the individual response to low temperature that prevailed during colour break period Correlation studies in gladiolus proved that the effect of environment on the expression of association between characters was not so strong as to alter it markedly (Lal et al 1985) Gill et al (1986) found that planting of cormels after October resulted in the production of poor grade corms because of delayed spike emergence due to lower temperature

Misra et al (1987) in an experiment on varietal response of gladiolus found that late blooming varieties produced bigger cormels in most cases since they get ample time for development In another experiment in Punjab involving 15 cultivars planted on 3rd September or 1st November Arora and Sandhu (1987) found that September planting took longer period for sprouting but lesser time to flower than November planting Better floral characters were given by November planting whereas the early plantings gave improved corm and cormel quality

In an experiment with six gladiolus cultivars planted on 25th October 10th November 25th November and 10th December in Haryana Saini et al (1988) found that days taken to sprouting increased with delay in planting Delayed planting decreased the number of spikes per plant but did not affect spike length and number of florets Best corm yield was reported from planting during 10th November

2 1 2 Effect of environmental factors

Flowering in gladiolus has been reported to be dependent on the interaction between environmental factors (Post 1942 Apte 1960 and Kosugi 1962)

2 1 2 1 Light intensity

Remerlable response of gladiolus crop to day length and light intensity have been reported by several authors (Borthwick and Parker 1949 Wassnik 1960 Kosugi 1962 and Nakayama 1967) Shillo and Halevy (1975) found that the time of inflorescence differentiation in gladiolus was dependent on the temperature and light conditions and that the 4 to 6 leaf stage which was the period of rapid elongation of inflorescence and flower stalk was most sensitive to unfavourable environmental conditions

Later Shillo and Halevy (1976a) found that low light intensity during 4 to 6 leaf stage decreased both flowering and number of florets per spike Failure of flower production in gladiolus during winter was mainly attributed to a low percentage of irradiance falling on plants at their 2 to 6 leaf stage which is especially sensitive to illumination (Shillo and Halevy 1976d)

Though flower initiation in gladiolus occur independently of environmental factors further development of inflorescence is definitely influenced by environment Unfavourable environmental conditions may cause blasting of whole inflorescences or individual florets (Kosugi 1962 Shillo and Halevy 1975) Mckay et al (1982) found that the inflorescence yield in gladiolus was increased by increasing illumination levels of day length to 144 lux

Talia et al (1988) demonstrated that the extension of day length to 16 22 hr at 2000 to 4000 lux in green house increased the production of marketable spikes and improved the flower quality Imanishi and Imae (1990) found that gladiolus cv Traveler plants were most sensitive to low light intensity (75 per cent) at 4 to 5 leaf stage which resulted in a decrease in flowering and number of florets per spike But low light intensity at 6 to 7 leaf stage reduced the number of florets per spile only

2 1 2 2 **Photo period**

Pioneering reports on photoperiodic responses of gladiolus (Borthwick and Parker 1949) indicated that flowering was delayed in long days but flowering percentage number of florets per spike and length of flower stalks were enhanced Similar results were obtained by several other scientists (Kosugi 1962 Shillo and Halevy 1976b and Shillo and Halevy 1981 Shillo et al 1981 Mckay et al 1981a and b and Halevy et al 1984) experimenting with different cultivars of standard gladioli Practical methods of promoting flowering by supplementary illumination under field conditions have been described in Isreal (Shillo and Halevy 1976b and 1981 and Shillo et al 1981) and Australia (Mckay et al 1981a and b)

Asahira et al (1968) observed that short day treatments after flowering increased the yield of cormels while long day treatments reduced it The weight of corms and cormels was little affected by day length Vega (1970) reported that wide fluctuations in temperature conditions and duration of photoperiod played a significant role in spike development A short day treatment during and after flowering enhanced the cormel formation of gladiolus cultivars Professor Goudrian Snow Princess Valeria and Spot Light and the short day requirement varied according to cultivars (Imanishi et al 1970) According to Cocozza (1971) reducing the day length to 8 hours affected the flower yields under glass but not in the open Cohat (1974) demonstrated that provision of short days following shoot emergence produced shorter plants and induced earlier production of cormels and replacement corms than did long days

Shillo and Halevy (1976b) reported that shortening of day length caused a decrease in flowering during the 1st leaf stage to 8th leaf stage and the number of florets from 4th leaf to anthesis stage and affected both these parameters during the stage from 4th leaf to spike emergence They also found that delay in flowering is a specific photoperiodic response This is in accordance with the findings of Borthwick and Parker (1949) and Kosugi (1962) It is inferred that the photoperiodic effect by increasing day length has an improvement in flowering which might be due to an increment in total light energy which the plant absorbs

Flower parameters as affected by long day treatments are delayed flowering increase in the number of florets per spike flowering percentage and length of flower stalk Number of secondary inflorescences produced also increased in long days (Shillo and Halevy 1976b)

Robinson et al (1980) found two competing sinks in gladiolus the inflorescence which constitute the main sink until anthesis and the corm which is the main sink after blooming Studies by Shillo and Halevy (1981) confirmed these results and showed that long day conditions promoted dry matter distribution towards the flower and away from the corm Short day conditions on the contrary promoted the growth and sink activity of corms thus increasing the competition for assimilates between the flower and the corm

Mclay (1979) reported that in cases where assimilate supply is limited under short day conditions the effect of long days on the partitioning of assimilates in such cases was at the expense of the corm and its size was reduced Mckay *et al* (1981b) studied the application of continuous light on gladiolus cultivars Oscar and Professor Gourdriaan and noticed substantially greater inflorescence yield and improvement in flower quality and reduced corm yield These results therefore suggested that floral and corm or cormlet development are competitive for photosynthates and that continuous light favours floral development at the expense of corm development

Halevy *et al* (1984) found that 10 cultivars of miniature gladiolus responded to photoperiod almost similarly to that of large flowered *Gladiolus grandiflorus* The response to long days was more apparent under green house than under field conditions They also found that the cultivars of miniatures of G *colvilei* and G *nanus* hybrids generally were not sensitive to photoperiod and mostly did not respond to supplemental lighting

Mckay *et al* (1982) also reported that inflorescence yields of gladiolus were increased by increasing illumination level of day length extension But the weight of cormlets per plot and per new corm was higher from plants which required no day length extension

Talia *et al* (1988) observed that extension of day length to 16 22 hours in green house proportionately increased the production of marketable spikes and improved the flower quality but there was difference in the varietal response Imanishi and Imae (1990) also found that artificial long days of 16 hrs during period of low temperature was very effective in preventing a decrease in the percentage of flowering and the number of florets per spike

2 1 2 3 Temperature

The specific effect of temperature on winter flowering of gladiolus was studied by Post (1942) and Apte (1960) They observed that flower failure in glasshouse grown gladioli during winter was mainly due to a combination of low light intensities short days and high temperatures Shillo and Halevy (1968) found that night temperature of 2°C during winter caused blasting of whole inflorescences and reduced the number of florets per spike in inflorescences However the same temperature during day time through inhibited stalk elongation but did not cause blasting They also found that plants at 2 5 leaf stage were particularly sensitive to these temperature effects

Asahira *et al* (1968) reported that a constant temperature of 20^{o}C after flowering increased cormel yield as compared with alternating temperatures of 25^{o}C and 30^{o}C The weight of cormels and corms was greatest with a temperature treatment at 20^{o}C There are also reports that wide growing temperature conditions during growth period played a significant role in spike development (Vega 1970) In an experiment under glass Cocozza (1971) found that flowering began a week earlier in a temperature range of 15-25^{o}C than in a minimum temperature of 15^{o}C

Aoba (1975) found that the formation of daughter corms in cultivar Red Radiance was enhanced at 15^{o}C and 25^{o}c and delayed at 10^{o}C and no new corms were formed at 5^{o}C Shillo and Halevy (1975) reported that the exact time of differentiation of flower buds which ranged form 3 8 weeks after planting depends on temperature and light conditions

Shillo and Halevy (1976c) found that gladiolus is extremely tolerant high temperature upto 50^{o}C and that direct damage due to high temperature is from planting to first leaf stage They reported that temperature of 1 4^{o}C caused chilling damage at two developmental stage viz immediately after planting and during spile emergence Subsequently Shillo and Halevy (1976d) attributed flower failure in winter to direct damage caused by high soil temperature from planting to first leaf stage and by water deficit in plants They reported that the rate of development in gladiolus is primarily affected by prevailing temperatures which caused differences in the rate of plant development in gladioli planted on different dates

Shimuzu and Uchibori (1976) found that the summation of temperature required from planting to flowering was 1800 2200°C for cormlets 1500 1700°C for cormels and 1400 1500°C for corms respectively Early cultivars had a temperature sum requirement of 1500 1700°C for induction of flowering whereas the late cultivars required 2000-2500°C (Tamberg and Chirva 1978)

Mckay et al (1981a) demonstrated that temperature during crop development and/or postharvest life are important in determining vase life of gladiolus The unfavourable environmental conditions during floral initiation and development of plants from March to May planting possibly involved both day length and temperature Iziro and Hori (1983) found that day night temperature of $30^{o}/24^{o}c$ markedly promoted growth of above ground parts of gladiolus and that low temperature of $17/12^{o}C$ however depressed the growth The formation and thickening growth of daughter corms however was decreased by higher temperatures

Khanna and Gill (1983) observed that the time taken by cultivars for attaining colour break on October plantings in Punjab was comparatively long which was attributed to the shortening of day length and prevailing low temperatures that directly slowed down plant growth Production of poor grade corms from cormels planted after October is found to be due to the delayed emergence under the low temperature conditions that prevailed during the period (Gill _et al_ 1986)

Noto and Romano (1986) suggested that the thermal unit methods were more satisfactory than calendar days method for predicting flowering and that a simple temperature time scale could adequately predict the date of flowering Imanishi and Imae (1990) found that the most sensitive stage to low temperature was the six leaf stage and that low irradiance together with low temperature during this period reduced the flowering percentage

2 2 Post harvest life of cut flowers

Relatively little work has been done to prolong the vase life of gladiolus Hence literature pertaining to the effect of floral preservatives on the postharvest physiology of gladiolus along with other cut flower crops like rose carnation orchid tuberose etc have been reviewed here

Works on the post harvest physiology and senescence of cut flowers have been reviewed by Rogers (1973) and Halevy and Mayak (1979 and 1981) Two factors which play an important role in regulating the life of flowers are carbohydrate supply (Aarts 1957) and water balance (Rogers 1973) The most widely accepted theories on extending the vase life of cut flowers are based on the improvement in water relations within the stem Reduced water uptake and a decrease in water potential of the tissues are found to cause wilting in Chrysanthemum flowers (Singh and Moore 1992)

A major factor contributing to rapid deterioration of cut flowers is vascular blockage which begins at the cut end and moves upward in the stem with time (Durkin and Kuc 1966) Presence of microorganisms in the solution may directly cause physical plugging by clustering of microbial cells around the stem base or indirectly by release of plugging substances into the water Stem plugging and reduced water uptake and transport capacity have been related to the presence of microorganisms in the holding solution (Burdett 1970 Zagory and Reid 1986 and Put and Jansen 1989)

In addition to the microbial stem plugging there has also been described a Physiological stem plugging which occurs even under aseptic conditions The presence of lignins tannins and tyloses in the vascular plugging material has been suggested by Durkin and Kuc (1966) Burdett (1970) is of the opinion that pecteolytic enzymes secreted by microorganisms degrade the cell wall materials into stem plugging substances Experiments conducted by Singh and Moore (1992) however could not demonstrate the presence of lignins tannins and tyloses in the vascular plugging materials

Durkin (1967) opined that air blockage in cut rose stems could also reduce the rate of water uptake Ethylene induced clogging due to wounding of stem tissue is also believed to be a major factor limiting post harvest life by inducing water stress and senescence (Paull and Goo 1985)

2 2 1 Effect of Sucrose on cut flower longevity

Floret opening and development is a growth process Two of the basic requirements for maintaining growth are carbohydrate supply and fully turgid tissues Sucrose fulfills these two requirements the first by supplying the tissues with carbohydrates and the second by improving the water uptake of the stem (Kofranek and Halevy 1976)

Many earlier research workers have reported the use of sucrose and various chemical preservatives for extending the vase life and improving the quality of cut flowers (Marousky 1968 1969 and 1973 Bravdo et al 1974 and Kofranek and Halevy 1976) Sucrose at high concentrations form the major ingredient in the preservative solutions in which cut flowers are kept to study the post harvest development of immature flowers (Kofranek and Halevy 1972 and Rao and Ram 1981) The importance of sucrose on improving the vase life and quality of cut gladiolus flowers have been demonstrated by Marousky 1970 Mayak *et al* 1973 Woltz and Marouksk 1973 Bravdo *et al* 1974 Choi and Roh 1980 Rao and Ram 1981 Wang and Gu 1985 and Garibaldi and Deambrogio 1989

Aarts (1957) demonstrated that sucrose limited transpiration and water uptake and promoted the closure of stomata of *Mathiola incana* leaves He attributed the reduced water uptake to the high osmotic potential of the sucrose solution Marousky (1969) found that though cut roses placed in sucrose solution initially supressed water absorption it subsequently gained and sustained more fresh weight than roses which were held in water He attributed this increase in fresh weight to stomatal closure

Durkin and Kuc (1966) emphasized that cut flower longevity might be enhanced by overcoming vascular blockage and using anti dessicants which reduce water stress within the flower Marousky (1969) suggested that sucrose acts not only as a respiratory substrate but also as an anti dessicant The rate of water loss in sucrose treatments possibly fell short of the rate of water uptake and thus more favourable water balance existed its the spikes for a longer period (Deswal and Patil 1983)

Sucrose or preservatives containing carbohydrates substitute for naturally depleting carbohydrates in cut flowers Blueing in cut roses which is essentially a proteolytic phenomenon was also prevented by holding them in sucrose solutions (Bruszewski 1968) Acock and Nichols (1979) pointed out that addition of sucrose to the vase solution increased the endogenous sucrose content there by contributing to an enhanced proportion of total osmatic energy Sucrose in the preservative solution is the ultimate sugar accumulating in the petals (Paulin and Jamian 1982) The predominant form of sugar found in petal tissues were fructose and glucose and addition of sucrose to the vase solution increased the levels of glucose and fructore in the tissues (Kaltaler and Steponkus 1974 and Khattab et al 1987)

Sucrose undoubtedly served as an energy source for the developing buds in cut flowers Good flower opening and increased longevity of immature but cut flowers placed in sucrose solutions has been reported by several workers in in gladiolus (Mayak et al 1973 Bravdo et al 1974 and Rao and Ram 1981) carnations (Amariutei et al 1982) Chrysanthemums (Marousky 1973 Lukaszewska 1980a) roses (Marousky 1969) and Gosczynska and Reid 1985) Freesias (Woodson 1987) and Liliums (Nowak and Mynett 1985)

Marousky (1968) demonstrated that in gladiolus sucrose was responsible for increase in size and number of open florets and that florets of spikes held in sucrose solutions contained more carbohydrates than those held in water A poor sugar content of gladiolus spikes is a major factor leading to the poor ornamental quality of cut flowers and treatment with sucrose markedly improved the spike quality (Jiang et al 1989)

Evidences are there on the increase in petal sucrose and reducing sugar content in cut flowers when treated with sucrose solutions (Acock and Nichols 1979 Lukaszewska 1980 a and 1986 Chung et al 1986 and Khattab et al 1987) This increase in endogenous sugar content undoubtedly help in the growth and development of immature bud cut flowers

Merwe *et al* (1986) reported that sucrose uptake from the vase solution replenished the intracellular respirable carbohydrates thus allowing a sustained high respiration rate and a prolonged vase life Ferriera *et al* (1986) found that the accumulation of ^{14}C sucrose absorbed from the vase was much higher in the terminal florets which do not have sufficient carbohydrate reserves initially when compared to the basal florets

Anatomical studies by Steinitz (1982) revealed a strong post harvest cell wall thickening and lignification of phloem cells in sucrose treated flowers resulting in irreversible changes in the cell wall structure and composition rather than a temporary sugar dependent increase in turgor Lulaszewska (1986) reported that the prescence of sugars in the holding solution prevented undesirable accumulation of free amino acids in the cut flowers

Kaltaler and Steponkus (1976) noted that exogenous sugars maintained mitochondrial structure and function thus controlling the decline in the respiratory control of mitochondria Lukaszewska (1980a) found lower amount of free aminoacids and low acid phosphates and RNA ase activities in cut carnations held in 5 per cent sucrose solutions Fibre and lignin content of Gerbera flowers was found to double when placed in sucrose solutions (Stenitz 1983) An increase in anthocyanin content and therefore the colour intensity of flowers kept in sucrose solutions was reported by Belynskaya _et al_ (1985) Choi and Sang (1989) and Gao and Wu (1990)

Sugar may also serve as building blocks needed for the growth processes associated with flower opening Gilman and Steponkus (1972) found that roses held in 2 per cent sucrose solution showed a very high rate of metabolism and that the tissues in the presence of sucrose had a high reductive capacity partly due to the increased metabolism

Studies have also shown that pulsing treatments (treating with high sugar concentrations before shipment or sale) of cut flowers with high concentrations of sucrose resulted in improved opening and increased longevity in the vase This has been reported in gladiolus (Mayak _et al_ 1973 Halevy and Mayak 1974 Kofranek and Halevy 1976 Rao and Ram 1981) and in carnations roses and gerberas (Nowak and Rudnicki 1978)

2 2 2 Effect of Chemical preservatives on cut flowers longevity

The usual components of commercial floral preservatives which increase vase life of cut flowers are sugars acidifiers and a mild fungicide The flowers depend on externally applied sugars for their metabolic requirements (Kofranek and Halevy 1976) Even dilute solutions of sugars provide ideal media for microbial growth which may enter the vascular bundles and may block water uptake and reduce vase life (Zagory and Reid 1986 and Put and Jansen 1989)

Certain nontoxic mineral salts notably silver thiosulphate silver nitrate aluminium sulphate boron cobalt nickel etc can improve the water balance of cut flowers there by extending the vase life Other chemicals like 8-hydroxyquinoline salts with germicidal action are also commonly used in the preservative solutions to extend the vase life of many cut flowers (Halevy and Mayak 1981) Literature pertaining to the effects of three chemicals viz 8 hydroxyquinoline silver nitrate and aluminium sulphate only are reviewed here

Effect of 8-hydroxyquinoline

A number of workers have reported extension of vase life and improved quality of cut flowers using mixtures of quinoline salts and sucrose (Coorts _et al_ 1965 Larsen and Scholes 1965 and 1966 Larsen and Cromarty 1967 and Larsen and Frolich 1969)

Larsen and Scholes (1965) recognized 8 hydroxy quinoline citrate (8 HQC) as a stomatal closing agent but concluded that prolonged cut flower life was due to the bactericidal properties of quinoline compounds Larsen and Cromarty (1967) proved that quinoline compounds primarily act as bactericidal agents and that extended vase life of flowers in 8-HQC was principally due to redu tion of microbial growth Recently Doorn _et al_ (1990) found that the prescence of 8 HQC in vase water decreased the number of bacteria in cut rose stems

Coorts _et al_ (1965) found that in a vase solution containing sucrose and HQC cut roses transpired at 10-15 per cent higher rate than in tap water whereas in sucrose solutions roses transpired at a 30 per cent lower rate They postulated that 8 HQC may have a beneficial effect on water uptake by reducing physiological plugging They also demonstrated that 200 ppm 8 HQS combined with 4 per cent sucrose increased respiration by 50 percent over control and concluded that the keeping quality of roses was enhanced by preservatives which increased respiration rather than inhibited it

Subsequent sutdies by Larsen and Scholes (1966) made it clear that 8 HQC acidified the keeping solutions of cut snap dragons to pH 4 and that cut flowers last longer in such a low pH Marously (1969) found that 8 HQC prolonged vase life in rose by decreasing vascular blockage in stems and increasing water absorption and stomatal closure and that 8 HQC did not affect respiration He also found that roses held in sterile 8 HQC solution had less blockage and greater absorption than roses held in sterile water indicating an additional role of 8 HQC He therefore suggested that the presence of 8 HQC influenced the activity of peroxidase enzyme thus controlling the physiological plugging

The role of quinoline compounds as a chelating agent which reduces physiological plugging has been reported by Coorts <u>et al</u> (1965) Camprubi and Aquila (1974) were of the opinion that vascular blockage might be an enzymatic process which could be inhibited by removing the micro elements of the coenzyme by chelation

Low pH has been reported to increase flower longevity (Aarts 1957) Marousky (1968) suggested that the role of 8 HQC in prolonging the longevity of cut gladiolus flowers might be by reducing the pH of the holding solution

A preservative solution containing 4 percent sucrose and 600 ppm 8 HQC increased the fresh weight and sustained the flower quality of cut chrysanthemums gladioli and roses (Marousky 1972) Pre conditioning treatments with sucrose and 8-HQC have also been proved successful in gladiolus (Marousky 1970 and Mayak <u>et al</u> 1973) Subsequently Marousky and Woltz(1975) found that 8 HQC solutions caused more water uptake than did water alone as the vase medium

Post harvest studies conducted on roses by Gilman and Steponkus (1972) gave the indications that 8 HQC acted through impairment of the general metabolic capacity of the stem which led to active stem blockage Gay and Nichols (1977) reported that 8 HQC increased vase life by affecting the physiology of the cut flower stem and microbial growth rather than by the stomatal physiology of the leaf

The effect of 8-HQC plus sucrose on vase life of Orchids was studied by Nowak and Vachoratayan (1980) They found that Dendrobium Oncidium Vanda Vandopsis Aranthera and Arachnis flowers were positively affected Ong and Lee (1983) and Hew <u>et al</u> (1987) reported that 8-HQS in the presence of sugar significantly improved the vase life of Oncidium Ketza and Boonrote (1990) also found increased bud opening and vase life of Dendrobium inflorescences in sucrose plus 8 HQS and $AgNO_3$ solution

Wang and Gu (1985) found that addition of 8 HQS to 5 per cent sucrose in the presence of $AgNO_3$ gave the highest percentage of open flowers maximum fresh weight and vase life in gladiolus Experiments on tuberose by Khondaikar and Mazumdar (1985) revealed delayed petal senescence retarded abscission rate of petals and neck bending when held in sucrose plus 8 HQS

Several authors have reported on the improved performance and longevity of cut carnations by use of floral preservatives (Choi and Roh 1980 Goszczynska and Nowak 1980 Lee et al 1980 Belynskaya et al 1985 and Chung et al 1986) Vase life studies on roses conducted by Ketza and Treeturuyananlha (1988) revealed that 8 HQC in combination with 5 per cent sucrose reduced blueing bent neck and stem blockage and increased vase life water uptake and fresh weight

Substantial improvement in the vase life and quality of cut roses has also been observed by other workers by the use of 8 HQ in sucrose medium (Stighter 1981 Goszczynska and Reid 1985 and Gao and Wu 1990) The combination of 8-HQ and sucrose has also been found to improve the vase life of several cut flowers including chrysanthemums (Marously 1973 and Ketza 1989) gerberas (Amariutei et al 1986) liliums (Nowak and Mynett 1985) freesias (Woodson 1987) and carnations (Nowak and Rudnicki 1978)

2 2 3 Effect of silver

The role of silver as a bactericide and as an ethylene antagonist in cut flower senescence has recently been reviewed (Halevy and Mayak 1981) Silver ions has been used for many years for increasing in longevity of cut flowers (Aarts 1957) Silver salts usually at 20 50 ppm are included in several formulation of floral preservatives (Kofranek and Halevy 1972 Mayak et al 1973 Rogers 1973 Bravdo et al 1974 and Halevy and Mayak 1974) or at high concentrations of 1000 1200 ppm for very short term (seconds to minutes) stem basal dips (Kofranek and Paul 1975 Kofranek and Halevy 1976 and Goszczynska and Nowak 1980) Since silver ion is a potent bactericide its floral preservative properties were attributed to reduced bacterial contamination of the flower stems (Aarts 1957 and Rogers 1973)

The application of silver ion as a potent antiethylene agent in several plant process has been reported by Beyer (1976) Halevy and Kofranek (1977) reported that coating of cut carnation flowers with silver ions nullified the effect of externally applied ethylene and also delayed senescence Ho ever such silver sprays had limited practical use since it caused spotting of petals Th y als suggested that basal treatment of cut flower stems with silver extended flower longevity by bactericidal action only and not by its antiethylene effect

Impregnation of cut carnation stems with silver extended the flowers life by significantly reducing the water deficit of the petals (Mayak et al 1977) They postulated that the main beneficial effect of stem base treatment with silver is by counter acting the toxic materials released by the bacteria and not by its direct bactericidal action

Mayak et al (1973) Bravdo et al (1974) Kofranek and Halevy (1976) and Deswal and Patil (1983) have reported the use of 50 ppm $AgNo_3$ in the sucrose solutions used for keeping gladiolus spikes to reduce the microbial growth in the solution This compound is an active bactericide which almost completely eliminated the development of any bacteria in the flowers stems and thus prevented the plugging of conducting tissues (Deswal and Patil 1983)

A relatively high level of endog nous ytokinins in the developing gynoecia of carnation flowers created a strong sink which enhanced the senescence of petals (Staden and Dimalla 1980) Application of silver as silver thiosulphate was found not to cause an increase in the levels of endogenous cytokinins Thus in silver treated cut flowers the preservative prevented gynoecia enlargement and apparently ensured a continuous transport and utilization of nutrients in the petals (Dimalla and Staden 1980)

A study on silver pulsing of anthurium flower stems (Paull et al 1988) proved that the senescence process was modified by regulating the respiration rate which substantially reduced the amount of stem plugging Murali (1990) found that silver ions with sucrose in the vase solution maintained the integrity of petal membranes and markedly reduced lipid peroxidation and ethylene evolution

Lee et al (1980) and Belynskaya (1985) reported a favourable response in bud opening of cut carnations in a sucrose plus preservative solution containing silver nitrate The beneficial effect of $AgNO_3$ in the vase solution on prolonging the vase life of carnations was subsequently reported by Chung *et al* (1986)

The effects of low concentrations of ethylene in cut roses could be inhibited by anionic silver thiosulphate complex (Goszczynska and Reid 1985) Silver containing preservatives also reduced the amino acid content and pH value of petals (Gao and Wu 1990) Treatment of cut roses with $AgNo_3$ markedly increased the water uptake and acted as a bactericide which proved to be affective in reducing wilting Its action as an inhibitor of ethylene biosynthesis also promoted longevity of flowers (Reddy and Nagarajaiah 1988 and Rath *et al* 1991)

Choi and Roh (1980) reported increased vase life in gladiolus by dipping the stem bases in silver nitrate 1000 2000 ppm for 5 15 minutes Gladiolus spikes showed better floret opening and increased vase life in solutions of 5 per cent sucrose and 50 ppm $AgNO_3$ (Wang and Gu 1985) Murali (1988) demonstrated that silver thiosulphate improved the floret opening and vase life in gladiolus $AgNO_3$ (0 005-0 01 per cent) in combination with sucrose and 8 HQC was found to be effective in delaying senescence of tuberose cut flowers and retarded the absussion rate of petals and neck bending (Khondarkar and Mazumdar 1985)

Nowak and Rudnicki (1978) found that 100 ppm $AgNO_3$ with 10 per cent sucrose markedly improved the post harvest life of cut carnations roses and gerberas Pre treatment with 4 mM STS and sucrose 100 g/l for 24 hours improved the quality of cut lilium flowers (Nowak and Mynett 1985) The presence of $AgNO_3$ in pulsing solutions of gerbera flowers (Amariutei et al 1986) and chrysanthemums (Ketza 1989) was found to delay senescence and increased the fresh weight of cut flowers

2 2 4 Effect of aluminium

Aluminium sulphate has also been used in many preservative solutions for many cut flowers (Mayak et al 1973 Rameshwar 1974 Schnabl 1976 and Mukhopadhyay 1980) Weinstein (1957) found that colour form and longevity of aluminium rose cut flowers was superior The effect of aluminium was attributed to the lowering of petal pH and stabilising of anthocyanins of flowers there by increasing the vase life (Halevy and Mayak 1979) Aluminium sulphate also acidifies the holding solution thus reducing bacterial growth and improving water uptake (Halevy and Mayak 1981)

Studies conducted on chrysanthemum flowers revealed that aluminium when used in pulsing solutions and bud opening solutions promoted foliage wilting (Kofranek and Halevy 1972) Aluminium was also effective when applied as foliar spray in reducing transpiration and increasing the longevity of roses and carnations But spray applications were not effective in the case of tulips iris and gladiolus (Schnabl 1976)

Rameshwar (1974) found that aluminium sulphate 0 1 per cent was an adequate substitute for 8 HQ salts in prolonging the vase life of gladiolus probably by reducing the pH of the vase solution $Al_2(SO_4)_3$ reduced the number of bacteria in the vase solutions of gladiolus below that of water control (Bravdo et al 1974 and Deswal and Patil 1983) Recently Murali (1990) reported that aluminium also helped in maintaining petal membrane integrity of cut gladiolus spikes

Mayak et al (1973) Kofranek and Halevy (1976) and Deswal and Patil (1983) have reported the presence of 50 ppm $Al_2(SO_4)_3$ in the preservative solutions used for enhancing the longevity of cut gladiolus spikes $Al_2(SO_4)_3$ also proved effective in promoting greater blooming and vase life in cut tuberoses (Mukhopadhyay 1980 and Balakrishna 1987) Murali (1988) found that aluminium individually or in combination with sucrose increased the number of fully open flowers water uptake fresh weight and vase life of gladiolus spikes

Aluminium sulphate in combination with 2 per cent glucose also proved an ideal vase solution for cut roses (Stighter 1981) Reddy and Nagarajaiah (1988) found that aluminium in the form of potassium aluminium sulphate was effective in checking vascular blockage and inducing higher water uptake in cut roses Doorn et al (1990) reported that the presence of aluminium sulphate in the vase solution reduced the number of bacteria in the stems of cut roses

A vase solution containing 4 per cent sucrose 0 1 per cent potassium aluminium sulphate and 0 02 per cent potassium chloride extended the vase life of cut carnations(Amariutei et al 1982) and cut roses (Gherghi et al

1983) Mugge (1983) demonstrated that a preservative solution containing $Al_2(SO_4)_3$ at 0 08 per cent along with KCl and NaCl at 0 2 per cent and sucrose (1 5 per cent) gave better vase life of antirrhinum and aster flowers Mantur and Nalawadi (1989) obtained maximum vase life of cut aster flowers in a solution of 0 2 per cent $(Al_2(SO_4)_3$

MATERIALS AND METHODS

MATERIALS AND METHODS

The investigation on the effect of planting dates and floral preservatives on spike qualities of gladiolus was conducted at the Department of Horticulture College of Agriculture Vellayani during 1992 1993 and it comprised of two experiments The first experiment was on the effect of different planting dates on the performance of three gladiolus cultivars under open field conditions The second experiment was a post harvest study on the effect of different floral preservatives on the improvement of the vase life of cut gladiolus spikes

3 1 Experiment No 1

Effect of planting dates on the performance of three gladiolus cultivars

3 1 1 Experimental design

The experiment was laid out in a factorial randomised block design with three varieties and six planting dates with three replications Each replication had 15 plants from which five plants were randomly selected for recording observations

3 1 2 Treatments

3 1 2 1 Planting dates

Six plantings were done at monthly intervals from mid August 1992 to mid January 1993 as detailed below

T_1 mid August 1992

T_2 - mid-September 1992

T_3 mid October 1992

T_4 mid November 1992

T_5 mid December 1992

T_6 mid January 1993

3 1 2 2 Cultivars

The following cultivars of gladiolus procured from M/s Model Nursery Calcutta were used for the experiment

V_1 - Her Majesty

V_2 - Vinks Glory

V_3 - Oscar

3 1 3 Cultural practices

The cultural practices followed were application of manures and fertilizers irrigation weeding and plant protection These practices are briefly described here

3 1 3 1 Land preparation

The land was prepared to fine tilth and mixed with dried cowdung powder at the rate of 25 tonnes per hectare and raised beds of 1 5 x 2m size were prepared

3 1 3 2 Planting

Uniform sized corms of 35-40g were selected for planting These corms were given a pre planting dip in Carbendazim (0 2 per cent) for an hour Planting was done at a spacing of 40 cm between rows and 30 cm between plants Fertilizers were applied at the rate of 10g N 40 g P_2O_5 and

40 g K_2O per m^2 (Raghava et al 1981) Of the above recommendation half the dose of N and full dose of P and K were applied as basal dressing The second dose of N was applied 45 days after sprouting of corms

3 1 3 3 After care

Irrigation was given every day and hand weeding was practiced every fortnight Plants were staked at the time of spike emergence and earthing up was also done Spraying with Quinalphos (0 03 per cent) was done as a prophylatic measure against pests Soil drenching with Carbendazim (0 2 per cent) or Emisan (0 1 per cent) was also done at monthly intervals against Fusarium wilt

3 1 4 Harvesting

3 1 4 1 Spikes

Harvesting of spikes were done for the post harvest studies from each treatment when the florets showed colour breaking and the first floret started to open

Plate 1 & 2

General view of the experimental plots

P A E

P 2

3 1 4 2 Corms

After harvesting the flowers plants were left undisturbed until the leaves started yellowing Corms were then lifted and the cormels were also collected After taking observations they were treated with Carbendazim (0 2 per cent) for half an hour dried under shade and stored

3 1 5 Observations

Five plants were selected at random from each plot for recording biometric observations The following observations were recorded

3 1 5 1 Days to 50 and 100 per cent sprouting of corms

Number of days taken from planting to 50 per cent and 100 per cent sprouting of corms was recorded

3 1 5 2 Days to 50 and 100 per cent spike emergence

Number of days taken from the planting of corms to 50 per cent and 100 per cent emergence of spikes in each plot was recorded

3 1 5 3 **Number of leaves per plant**

The total number of leaves borne on the plant was counted and recorded at the time of harvest

3 1 5 4 **Leaf area**

The leaf area was measured using a leaf area meter and recorded in square centimeters

3 1 5 5 **Plant height**

The height of the plants were measured from the collar region to the top of the topmost leaf and expressed in centimeters

3 1 5 6 **Number of shoots per plant**

The total number of shoots produced from each corm was counted and recorded at the time of harvest

3 1 5 7 Spike length

Length of the spike was measured from the base to the tip of the spike and expressed in centimeters

3 1 5 8 Length of rachis

Length of the rachis was measured from the first basal floret to the last floret in a spike and recorded in centimeters

3 1 5 9 Number of florets per spike

The total number of florets per spike was counted and recorded

3 1 5 10 Girth of the spike stalk

Girth of the spike just below the basal floret was measured and expressed in centimeters

3 1 5 11 Colour of the florets

Colour of the florets of each variety was observed visually and recorded

3 1 5 12 Size of florets

Diameter of the second floret of each spike was measured and expressed in centimeters

3 1 5 13 Days from spike emergence to opening of florets

Number of days taken from the appearance of the spike to the opening of the first floret was recorded

3 1 5 14 Blooming period

Number of days taken from opening of the first floret to the last floret was recorded

3 1 5 15 Vase life of spikes

Number of days taken from opening of the first floret in vase to the drying of the last floret was recorded

3 1 5 16 Volume and weight of corms produced

Weight of the corms was measured and recorded in grams Volume was recorded by water displacement method and expressed in milli litre

3 1 5 17 Number and weight of cormels produced

Number and weight of cormels produced per plant was counted and expressed in grams

3 1 5 18 Scoring for incidence of Fusarium wilt

Number of plants affected with Fusarium wilt per plot was also recorded

Experiment No 2

Post harvest study for finding out optimum concentration of floral preservatives for enhancing the vase life of gladiolus

Studies were conducted on the effect of three different chemicals at two concentrations each in combination with 5 per cent sucrose on the post harvest life of cut gladiolus

3 2 1 Treatment

The three different chemicals tried and their concentrations are given below

i) 8 Hydroxy quinoline (8 HQ)
Concentrations 300 ppm 600 ppm

ii) Aluminium sulphate ($Al_2(SO_4)_3$)
Concentrations 100 ppm 300 ppm

iii) Silver nitrate ($Ag NO_3$)
Concentrations 100 ppm 200 ppm

The seven treatments imposed are as follows

T_1 - Control (distilled water)

T_2 Sucrose 5 per cent + 8 HQ 300 ppm

T_3 Sucrose 5 per cent + 8-HQ 600 ppm

T_4 Sucrose 5 per cent + $Al_2(SO_4)_3$ 100 ppm

T_5 Sucrose 5 per cent + $Al_2(SO_4)_3$ 300 ppm

T_6 - Sucrose 5 per cent + $Ag NO_3$ 100 ppm

T_7 - Sucrose 5 per cent + $Ag NO_3$ 200 ppm

3 2 2 Experimental details

Spikes of all the three varieties of gladioli from each of the six planting dates were harvested when the lower most floret started unfolding The stems were cut to an uniform length below the uppermost bract-like leaf Each spike was immediately placed in a 250 ml conical flask containing 100 ml distilled water or the aqueous solution of glucose plus the chemicals All the solutions were prepared with distilled water and only fresh solutions were used for the experiment Each treatment was tested with three spikes from each of the three cultivars and from all the six planting dates

3 2 3 Observations

The following observations were recorded from the experiments

3 2 3 1 Days to full bloom

Number of days taken from the harvesting to full blooming of all the florets in a spike was recorded

3 2 3 2 Vase life

Number of days from opening of the first floret to the drying of the last fully opened floret was recorded

3 2 3 3 Size of florets

Size of the florets was measured as the diameter of the second floret from the base and expressed in centimeters

3 2 3 4 Nature of bending

Days taken under vase conditions for bending or breaking of the floral stem was recorded Position of breakage was also recorded and expressed as the number of florets below the point of the break

3 2 3 5 Colour and colour fading

Visual observations on the change occuring in the colour of petals with advancement of flower senescence was recorded

3 2 3 6 Number of florets open at a time

Number of open florets present at a time in spikes kept in different preservative solutions were recorded

3 2 3 7 Estimation of colour pigments - anthocyanins

Analysis of pigments was done as per the method described by Ranganna (1977) The initial step was alcoholic extraction of the plant material (petals) One gram of the sample was extracted with ethanolic HCl filtered through a Buchner funnel using Whatman No 1 filter paper and the volume was made upto 100 ml A small quantity (5 ml) of the filtrate was then diluted with ethanolic HCl to 50 ml to yield the optical density measurements within the optimum range of the spectrophoto meter (535 nm) The anthocyanin content was then calculated using the following relationship and quantity was expressed as mg per 100 g of the sample

$$\text{Total OD per 100 g sample (x)} = \frac{\text{Absorbance at 535 nm} \times \text{Volume made up of the extract used for colour measurement} \times \text{Total Volume} \times 100}{\text{Volume (ml of the extract) used} \times \text{Weight of the sample taken}}$$

The absorbance of a solution containing 1 mg per ml is equal to 98 2

Therefore

$$\text{Total anthocyanin in mg per 100 g of the sample} = \frac{\lambda}{98\ 2}$$

3 3 Interpretation of data

The data generated from the study was subjected to analysis of variance using the methods suggested by Panse and Sukhatme (1985) Correlation of selected characters were also worked out with the weather parameters like temperature sunshine hours relative humidity and rainfall

RESULTS

RESULTS

The salient results obtained from the study are presented in this chapter

4 1 Effect of planting dates and cultivars on the performance of gladiolus

The experimental data collected from the present study were statistically analysed to bring out the effect of time of planting on the growth and flowering of three gladiolus cultivars viz Her Majesty Vinks Glory and Oscar The results obtained under the present investigation are included in this chapter

4 1 1 Effect of planting date on growth parameters of gladiolus

The results of analysis of variance are given in Appendix II and mean values in Table 1

4 1 1 1 Days to 50 per cent corm sprouting

The analysis of variance indicated that the effect of planting date on days to 50 per cent corm sprouting is highly significant (Table 1 and Appendix II) Corms planted in October (T_3) took the shortest duration (15 56 days) to attain 50 per cent sprouting which significantly differed from November (18 56 days) and December plantings (19 22 days) which were on par August planting took the maximum time to record 50 per cent sprouting (50 44 days)

The three cultivars tested also showed significant differences in the time taken for 50 per cent sprouting of corms Oscar (V_3) was the earliest (24 44 days) and significantly superior to Her Majesty (26 78 days) and Vinks Glory (28 50 days) The varieties Her Majesty (V_1) and Vinks Glory (V_2) were on par

The planting date x cultivar interaction effects were also found to be significant with the time taken for 50 per cent corm sprouting ranging from 13 00 days in t_3V_2 (Vinks Glory planted in October) to 58 67 days in t_1V_2 (Vinks

Glory planted in August) Vinks Glory planted in October was significantly superior compared to the other combinations

4 1 1 2 Days to 100 per cent corm sprouting

The days taken for 100 per cent sprouting of corms followed a trend similar to that of days taken for 50 per cent sprouting (Table 1 and Appendix II) The planting dates cultivars and their combinations exerted significant influence on this character

October planting (T_3) was the earliest to attain 100 per cent sprouting (32 67 days) and August planting (T_1) showed maximum delay (73 00 days) November and December plantings (36 22 days and 37 11 days respectively) were found to be on par

Among the cultivars Oscar (V_3) was the earliest (42 56 days) to show 100 per cent sprouting and which on par with Her Majesty (V_1) The latter took 46 67 days for 100 per cent corm sprouting as while Vinks Glory took 49 67 days the two varieties being on par

Planting of Vinks Glory during October (t_3V_2) was found to be the best combination resulting in the shortest duration from planting to complete sprouting (31 33 days) However days taken for 100 per cent sprouting by October November and December planting of Her Majesty (33 00 35 67 and 38 67 days respectively) and Oscar (33 67 35 33 and 33 33 days respectively) and November planting of Vinks Glory (37 67 days) were not significantly different from t_3V_2 The maximum duration was recorded by Vinks Glory planted during August (83 67 days)

4 1 1 3 Plant Height

The results of analysis of variance showed significant effects of planting dates cultivars and planting date x cultivar interaction on plant height (Appendix II) The data presented in Table 1 revealed that October planting (T_3) registered the tallest plants (77 27 cm) whereas the shortest plants were produced in January plantings (67 58 cm) November (T_4) and September (T_2) plantings produced plants with heights 75 17 cm and 74 16 cm respectively which were on par with October plantings

The varietal effect on plant height was also found to be significant with Vinks Glory (V_2) producing the tallest plants (78 15 cm) followed by Oscar (74 29 cm) The shortest plants were observed in the cultivar Her Majesty (66 71 cm)

The plant height was also significantly influenced by the interaction effect of planting dates with cultivars The plant height recorded ranged from 62 10 cm in t_2V_1 (Her Majesty planted in September) to 83 37 cm in t_2V_2 (Vinks Glory in September) Plant heights attained by t_1V_2 t_3V_2 t_1V_3 t_3V_3 and t_4V_3 (80 33 79 13 73 53 78 73 and 78 40 cm respectively) were on par with t_2V_2

4 1 1 4 Number of shoots per plant

The data on the number of shoots produced per plant (Table 1 and Appendix II) revealed no significant difference response to planting dates The interaction effect of planting time and cultivar was also not statistically significant

However the number of shoots per plant was significantly influenced by the cultivars Vinks Glory recorded the maximal tillering (1 18 tiller/plant) and was significantly superior to the other two varieties Her Majesty recorded the lowest number (1 01) of tillers per plant

4 1 1 5 Number of leaves per plant

The planting dates and varieties exerted significant influence on the number of leaves produced per plant (Table 1 and Appendix II) The average number of leaves per plant ranged between 7 96 in January planting and 9 52 in November planting The difference in the number of leaves recorded for the other four planting dates were found to be not significant

Vinks Glory (V_2) recorded the maximum number of leaves per plant (9 76) and Her Majesty (V_1) the minimum (7 38) The interaction effect also exerted significant influence with the maximum and minimum number of leaves per plant recorded in Vinks Glory planted in November (11 33) and Her Majesty planted in January (6 07) respectively

Table 1 Effect of planting dates and cultivars on growth parameters of gladiolus

Treatments	Days to 50% corm sporut ng	Days to 100% corm sporuting	Plant height (cm)	No of shoots per plant	No of leaves per plant	Leaf area (cm^2)	Days to 50% spike emergence	Days to 100% spike emergence	Fusarium incidence (infected plants per plot)
Planting dates									
T_1 Mid Aug	50 44	73 00	73 36	1 07	8 52	576 58	104 89	121 33	3 56(1 97)
T_2 Mid Sept	27 67	55 78	74 16	1 12	8 17	641 20	89 33	115 11	1 78(1 51)
T_3 Mid Oct	15 56	32 67	77 27	1 09	8 62	578 57	81 22	102 44	2 33(1 79)
T_4 Mid Nov	18 56	36 22	75 17	1 11	9 52	608 38	70 89	92 44	4 33(2 13)
T_5 Mid Dec	19 22	37 11	70 77	1 04	8 50	525 68	81 67	103 22	3 00(1 93)
T_6 Mid Jan	28 00	43 00	67 58	1 02	7 96	451 41	95 44	111 33	4 00(2 15)
CD (0 05)	2 786	4 250	3 607	NS	0 593	94 020	6 351	6 588	NS
Cultivars									
V_1 Her Majesty	26 78	46 67	66 71	1 01	7 38	396 85	80 72	96 67	6 50(2 65)
V_2 Vinks Glory	28 50	49 67	78 15	1 18	9 76	674 39	95 28	119 22	1 11(1 40)
V_3 Oscar	24 44	42 56	74 29	1 03	8 51	619 67	85 72	107 06	1 89(1 68)
CD (0 05)	1 970	3 005	2 551	0 072	0 419	66 482	4 491	4 659	0 287
Interact ons									
T_1V_1	46 67	70 00	66 20	1 00	7 57	374 37	102 67	113 67	8 67(3 11)
T_1V_2	58 67	83 67	80 33	1 20	9 07	750 67	109 67	129 67	0 67(1 24)
T_1V_3	46 00	65 33	73 53	1 00	8 93	604 70	182 33	120 67	1 33(1 52)

contd

Treatments	Days to 50% corm sporuting	Days to 100% corm sporuting	Plant height (cm)	No of shoots per plant	No of leaves per plant	Leaf area (cm^2)	Days to 50% spike emergence	Days to 100% sp ke emergence	Fusar um incidence (infected plant per plot)
T_2V_1	30 00	59 00	62 10	1 00	8 20	426 13	85 67	102 67	4 00(2 02)
T_2V_2	30 33	58 67	83 37	1 37	9 33	793 40	98 67	127 00	0 00(1 00)
T_2V_3	22 67	49 67	77 00	1 00	6 97	704 07	83 67	115 67	1 33(1 52)
T_3V_1	16 33	33 00	73 93	1 07	8 07	421 70	77 00	93 67	3 00(2 00)
T_3V_2	13 00	31 33	79 13	1 13	9 13	625 90	85 67	114 67	1 67(1 55)
T_3V_3	17 33	33 67	78 73	1 07	8 67	688 10	81 00	99 00	2 33(1 82)
T_4V_1	17 33	35 67	70 39	1 00	7 75	507 80	63 33	82 3	10 00(3 31)
T_4V_2	18 00	37 67	76 73	1 27	11 33	656 00	78 67	101 67	0 67(1 28)
T_4V_3	20 33	35 33	78 40	1 0	9 47	661 33	70 67	93 33	2 33(1 80)
T_5V_1	17 67	38 7	64 37	1 00	6 63	358 47	70 33	89 67	5 67(2 55)
T_5V_2	20 33	39 33	76 27	1 07	10 20	625 30	92 33	116 67	1 67(1 63)
T_5V_3	19 67	33 33	71 67	1 07	8 67	593 27	82 33	103 33	1 67(1 63)
T_6V_1	32 67	43 67	63 27	1 00	6 07	292 60	85 33	98 00	7 67(2 94)
T_6V_2	30 67	47 33	73 07	1 07	9 48	595 10	106 67	125 67	2 00(1 72)
T_6V_3	20 67	38 00	66 42	1 00	8 33	466 53	94 33	110 33	2 33(1 79)
CD (0 05)	4 827	7 361	6 248	NS	1 027	NS	NS	NS	(0 704)

Note Figures in paranthes s denote transformed ($\sqrt{x+1}$) values

NS Not s gn ficant

4 1 1 6 Leaf Area

Planting time as well as varieties exerted significant influence on leaf area However their interaction effect was not significant (Table 1 and Appendix II)

Leaf area recorded by the first four planting dates viz 576 58cm^2 for August 641 20cm for September 578 57 cm for October and 608 38 cm for November were on par The last two planting dates (December and January) registered lesser leaf area(525 68 cm^2 and 451 41 cm^2 respectively) and were on par

Vinks Glory recorded the maximum leaf area of 674 39 cm^2 which was on par with variety Oscar (619 67 cm^2) Her Majesty had plants with significantly lesser leaf area (396 85 cm^2) compared to the other two varieties

4 1 7 Days to 50 per cent Spike emergence

The planting dates as well as varieties exhibited highly significant difference in days taken for 50 per cent spike emergence (Table 1 and Appendix II) November planting (T_4) took the least number of days (70 89) for 50 per cent spike emergence The time taken by October planting (81 22 days) and December planting (81 67 days) were on pai and were delayed compared to November planting August planting (T_1) took the longest time to record 50 per cent spike emergence (104 89 days)

The cultivar Her Majesty (V_1) registered the shortest duration from planting to spike emergence (80 72 days) and Vinks Glory (V_2) the longest duration (95 28 days) Oscar (V_3) took intermediate duration (85 72 days) from planting to 50 per cent spike emergence The interaction effect of cultivars and planting dates were found to be not significant

4 1 1 8 Days to 100 per cent Spike emergence

The data presented in Table 1 and Appendix II revealed that both planting dates cultivars influenced the time taken for 100 per cent spike emergence The interaction effects did not exert significant influence on days to 100 per cent spike emergence

November planting (T_4) was the earliest to register 100 per cent spike emergence (92 44 days) followed by October (102 44 days) and December (103 22 days) plantings which were on par August planting (T_1) took the maximum time to record 100 per cent spike emergence (121 33 days)

The time taken for 100 per cent spike emergence by the three cultivars followed a pattern similar to that of the time taken for 50 per cent spike emergence The time taken by the three cultivars Her Majesty (V_1) Oscar (V_3) and Vinks Glory (V_2) were 96 67 107 06 and 119 22 days respectively which were significantly different from each other

4 1 1 9 Incidence of Fusarium wilt

The data on the number of infected plants per plot were transformed to the corresponding square root of (value + 1) prior to the analysis of variance The results (Table 1 and Appendix II) showed that planting dates did not significantly influence the extent of Fusarium wilt incidence

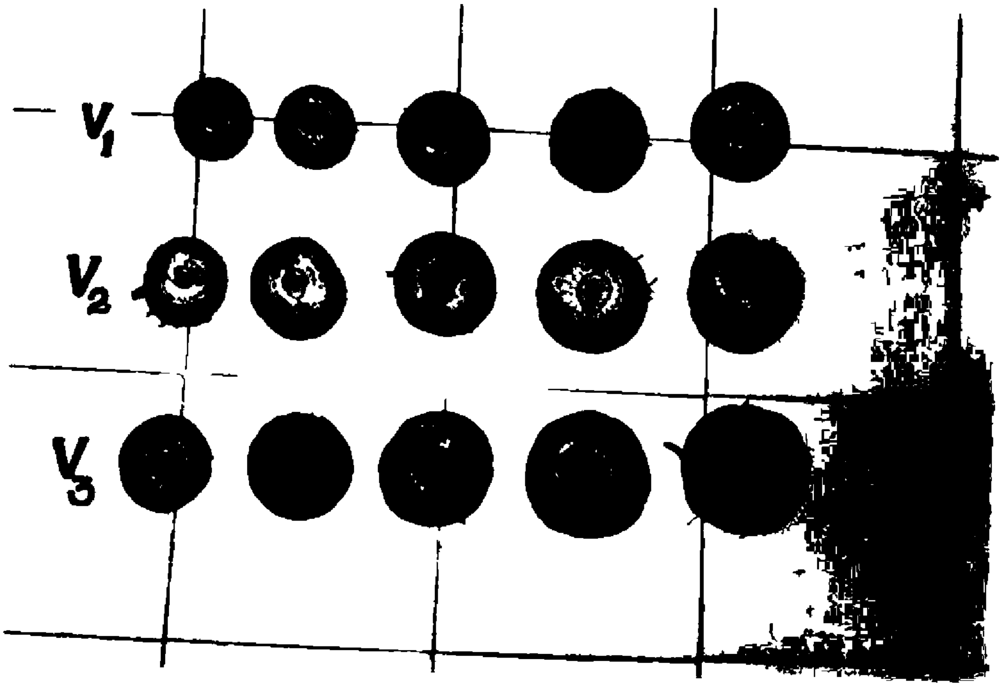
Plate 3

View of plots with severe incidence of Fusarium wilt

Plate 4

Corms of Her Majesty (V_1) Vinks Glory (V_2) and Oscar (V_3)

P 3



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However the varietal difference was highly significant Vinks Glory (V_2) registered the least degree of incidence (a mean of 1 11 infected plants per plot) among the three varieties Oscar (V_3) recorded medium incidence (1 89) while Her Majesty (V_1) showed the maximum susceptibility (a mean of 6 50 infected plants per plot)

Significant influence was exerted by the interaction effects Vinks Glory planted in September (t_2V_2) did not have even a single diseased plant The maximum disease incidence was noticed in Her Majesty planted in November (10 out of the 15 plants/plot)

4 1 2 Effect of planting dates on spike characteristics of gladiolus

The results of analysis of variance are given in Appendix II and the mean values in Table 2

4 1 2 1 Spike length

Planting dates and cultivars significantly influenced the spike lengths However their interaction effects were not significant (Table 2 and Appendix II)

The longest spikes were produced by September plantings (61 16 cm) which was significantly longer than August (57 50 cm) and October (55 64 cm) plantings which were on par Further delay in planting was found to significantly reduce the spike lengths (50 08 cm and 43 70 cm in December (T_5) and January (T_6) plantings respectively)

The longest spikes were produced by Oscar (59 57 cm) which was significantly superior to Vinks Glory (54 18 cm) Her Majesty produced significantly shorter spike of 47 19 cm length

4 1 2 2 Rachis length

Length of rachis of inflorescences were found to be significantly influenced by planting dates and varieties and their combination effects (Table 2 and Appendix II)

The maximum rachis length was recorded by September plantings (47 83 cm) followed by August plantings (44 18 cm) which were significantly superior to other planting dates October (41 27 cm) and November (40 41 cm) plantings were on par The minimum rachis length was recorded by January plantings (31 40 cm)

Oscar which recorded the maximum spike length also registered the maximum rachis length (46 77 cm) The rachis length of Vinks Glory (39 83 cm) was significantly lower than that of Oscar Her Majesty recorded the shortest rachis length of 34 92 cm

The longest rachis was recorded in the inflorescence of Oscar planted in September (56 57 cm) and was significantly superior to other combinations The shortest rachis was produced by Her Majesty planted in January (26 93 cm)

4 1 2 3 **Number of florets per spike**

The data (Table 2 and Appendix II) indicated that significant influence was exerted by the different planting dates and cultivars and their interaction effect

The average number of florets per spike ranged from 8 27 (January planting) to 13 02 (August planting) September plantings (12 34) were on par with August plantings Delayed plantings after November (11 17 cm) resulted in significant reduction in the number of florets per spike (9 36 in December plantings and 8 27 in January plantings)

Oscar produced the maximum number of florets per spike (12 31) followed by Her Majesty (10 56) and these two varieties differed significantly from one another Her Majesty and Vinks Glory (10 08) were on par with regard to the number of florets

Oscar planted during September and October produced the maximum number of florets (14 43 each) The combinations t_1V_3 (14 13) and t_1V_2 (13 10) were not significantly different from the best combination

4 1 2 4 Size of florets

Floret diameter was found to be significantly influenced dates of planting and varietal differences However the combination effect of planting date x variety failed to influence the size of floret (Table 2 and Appendix II)

Table 2 Effect of planting dates and cultivars on spike character st cs of gladiolus

Treatment	Spike length (cm)	Rachis length (cm)	No of florets per spike	Size of florets (cm)	Girth of spike stalk (cm)	Days from spike emergence to opening	Blooming period (days)	Vase life (days)
Planting dates								
T_1 Mid Aug	57 50	44 18	13 02	11 57	3 00	6 46	8 22	9 34
T_2 Mid Sept	61 16	47 83	12 34	11 46	3 03	6 63	7 33	8 33
T_3 Mid Oct	55 64	41 27	11 74	10 89	2 97	6 83	7 00	8 33
T_4 Mid Nov	53 80	40 41	11 17	10 88	3 26	6 88	6 89	8 11
T_5 Mid Dec	50 08	37 96	9 36	10 50	3 12	6 34	6 22	7 22
T_6 Mid Jan	43 70	31 40	8 27	10 01	3 02	5 97	5 11	6 00
CD (0 05)	3 278	2 853	0 960	0 712	0 170	0 328	1 146	1 196
Cultivars								
V_1 Her Majesty	47 19	34 92	10 56	9 77	2 87	6 02	6 44	7 67
V_2 Vinks Glory	54 18	39 83	10 08	10 98	3 05	7 32	7 50	8 61
V_3 Oscar	59 57	46 77	12 31	11 91	3 28	6 22	6 45	7 39
CD (0 05)	2 320	2 017	0 679	0 503	0 120	0 232	0 814	0 846
Interactions								
T_1V_1	53 43	40 37	11 83	10 97	2 83	6 00	8 33	9 70
T_1V_2	57 97	44 33	13 10	11 33	3 00	7 20	9 33	10 33
T_1V_3	61 10	47 83	14 13	12 40	3 17	6 17	7 00	8 00

contd

Treatment	Spike length (cm)	Rachis length (cm)	No of florets per sp ke	Size of florets (cm)	Girth of spike stalk (cm)	Days from spike emergence to opening	Blooming period (days)	Vase life (days)
T_2V_1	54 83	41 50	10 93	10 33	2 93	6 10	7 00	8 00
T_2V_2	60 57	45 43	11 67	12 00	2 90	7 63	8 00	9 33
T_2V_3	68 07	56 57	14 43	12 03	3 27	6 17	7 00	7 67
T_3V_1	48 87	35 60	11 60	10 17	2 80	6 17	6 00	7 67
T_3V_2	54 60	38 37	9 20	10 27	2 93	7 90	8 33	9 33
T_3V_3	63 47	49 83	14 43	12 23	3 17	6 43	6 67	8 00
T_4V_1	45 40	33 67	11 73	9 53	2 97	6 23	6 67	7 67
T_4V_2	53 10	38 30	9 15	11 00	3 27	7 97	7 00	8 33
T_4V_3	62 90	49 27	12 62	12 10	3 53	6 43	7 00	8 33
T_5V_1	42 20	31 47	9 40	9 00	2 87	6 00	6 33	7 33
T_5V_2	51 10	38 93	9 00	10 80	3 13	6 77	6 33	7 67
T_6V_3	56 93	43 47	9 67	11 70	3 37	6 27	6 00	6 67
T_6V_1	38 40	26 93	7 87	8 60	2 80	5 60	4 33	5 67
T_6V_2	47 77	33 60	8 33	10 47	3 07	6 43	6 00	6 67
T_6V_3	44 93	33 67	8 60	10 97	3 20	5 87	5 00	5 67
CD (0 05)	NS	4 941	1 662	NS	NS	NS	NS	NS

NS Not significant

Early plantings (viz August (T_1) September (T_2) October (T_3) and November (T_4) recorded larger sized florets of 11 57 cm 11 46 cm 10 89 m and 10 88 cm respectively and were on par The floret size of December (10 50 cm) and January (10 01 cm) plantings were significantly smaller

The floret size registered by the cultivars was maximum and significantly superior in Oscar (11 91 cm) and minimum in Her Majesty (9 77 cm) Vinks Glory produced a floret size of 10 98 cm which was significantly superior to Her Majesty

4 1 2 5 Girth of spike stalk

Significant differences could be noticed in the girth of spike stalks of different planting dates and cultivars The interaction effects were however not significant statistically (Table 2 and Appendix II)

November plantings (T_4) produced the maximum girth of spike stalks (3 26 cm) The girth of spike stalks recorded in all other planting dates ie December (3 12 cm)

September (3 03 cm) January (3 02 cm) August (3 00 cm) and October (2 97 cm) were found to be on par

The girth of spike stalks recorded by the three cultivars differed significantly from each other The maximum girth of 3 28 cm was recorded in Oscar and the minimum in Her Majesty (2 87 cm)

4 1 2 6 Days from spike emergence to opening of florets

The duration from spike emergence to opening of the florets was significantly influenced by different planting dates (Table 2 and Appendix II) The number of days taken by November (T_4) October (T_3) and September plantings (T_2) (6 88 6 83 and 6 63 respectively) were found to be on par The spikes of January planting (T_6) took the shortest time (5 97 days) and differed significantly from the other planting dates

The cultivars Oscar and Her Majesty took 6 22 and 6 02 days respectively from spike emergence to opening of florets and were on par Vinks Glory recorded a significantly longer duration of 7 32 days

The planting date x variety interaction effect however did not significantly influence the duration from spike emergence to floret opening

4 1 2 7 Blooming period

The number of days taken for blooming (opening of the first floret to the last floret) was significantly influenced by planting dates and varieties The interaction effect was not significant (Table 2 and Appendix II)

The blooming period showed a decreasing trend with delay in planting August planting took the maximum number of days (8 22) which was on par with September planting (7 33 days) The minimum date was taken by January planting (5 11 days) The blooming period of spikes of December planting (6 22) was on par with that of January plantings

The varieties Her Majesty and Oscar had shorter blooming periods of 6 44 and 6 45 days respectively and were on par Vinks Glory recorded significantly longer blooming period of 7 50 days

4 1 2 8 Vase life of cut spikes

The vase life of cut gladiolus inflorescence recorded in days was significantly influenced by both planting dates and cultivars The planting date x cultivar interaction had no significant effect interaction on vase life (Table 2 and Appendix II)

The vase life of cut spikes was significantly reduced by delay in planting The maximum vase life of spikes in distilled water was shown by August planting (9 34 days) September (T_2) and October (T_3) planting which recorded a vase life of 8 33 days were on par with August planting The shortest vase life of spikes was in January planting (6 00 days)

Among the three varieties Vinks Glory gave significantly higher vase life of 8 61 days Her Majesty and Oscar were on par and recorded vase life of 7 67 and 7 39 days respectively

4 1 2 9 Colour of florets

The colour of the florets of the three varieties under study recorded by visual observation were the following

Her Majesty - Medium violet coloured florets with white blotches inside the throat of the coralla

Vinks Glory - Medium yellow coloured florets with pink specks deep inside the throat of the corolla

Oscar Deep red coloured florets

Visual observation did not reveal any significant difference in the colour of the florets produced from the spikes collected from the six different planting dates

4 1 3 Effect of planting date and varieties on corm and cormel characters of gladiolus

The data on the effect of planting dates and cultivars on corm and cormel character of gladiolus are presented in Table 3 and results of analysis of variance in Appendix II

4 1 3 1 Weight of corms

The data revealed that the effect of planting dates on the weight of corms was not significant The interaction effect was also not significant However the varietal difference showed significant effect on the weight of corms (Table 3 and Appendix II)

Vinks Glory produced the heaviest corms weighing 84 73 g which was significantly higher compared to the other two varieties Oscar produced corms weighing 75 02 g which significantly differed from to the corm weight recorded in Her Majesty (50 24 g)

4 1 3 2 Volume of corms

No significant influence was exerted by planting date and interaction effects on the volume of corms produced (Table 3) and Appendix II) The cultivars however had significant influence on the volume of corms produced The

Table 3 Effect of planting dates and cultivars on corm and cormel characters of gladiolus

Treatments	Weight of corm (g)	Volume of corms (cc)	No of cormels per plant	Weight of cormels (g)
Planting dates				
T_1 Mid Aug	70 40	68 76	6 99	3 06
T_2 Mid Sept	70 72	68 70	7 35	2 96
T_3 Mid - Oct	73 68	69 50	10 65	5 15
T_4 Mid - Nov	76 29	74 60	3 46	2 79
T_5 Mid - Dec	68 68	68 05	2 89	2 23
T_6 Mid Jan	60 51	56 79	2 12	2 72
CD (0 05)	NS	NS	2 729	NS
Cultivars				
V_1 Her Majesty	50 24	48 91	7 67	3 16
V_2 Vinks Glory	84 73	83 37	2 81	2 43
V_3 Oscar	75 02	70 92	6 26	3 87
CD (0 05)	8 901	8 916	1 930	1 196
Interactions				
T_1V_1	54 30	52 37	10 53	3 32
T_1V_2	82 77	80 48	3 58	3 07
T_1V_3	74 13	73 43	6 88	2 78

Treatments	Weight of corms (g)	Volume of corms (cc)	No of cormels per plant	Weight of cormels (g)
T_2V_1	53 07	48 57	11 33	3 21
T_2V_2	85 38	88 87	3 63	2 77
T_2V_3	72 80	68 66	7 08	2 90
T_3V_1	59 56	57 68	17 76	7 36
T_3V_2	86 65	88 39	6 52	4 75
T_3V_3	74 83	62 41	7 68	3 34
T_4V_1	46 11	46 67	1 67	1 04
T_4V_2	102 24	97 80	1 56	2 18
T_4V_3	80 52	79 33	7 16	5 16
T_5V_1	44 39	45 50	2 03	1 62
T_5V_2	84 56	81 98	1 34	1 30
T_5V_3	77 08	76 67	5 31	3 77
T_6V_1	44 03	42 67	2 72	2 41
T_6V_2	66 75	62 70	0 20	0 48
T_6V_3	70 75	65 00	3 44	5 27
CD (0 05)	NS	NS	4 727	2 941

NS - Not significant

largest corms were produced by Vinks Glory (volume of 83 37 cc) Corms of Oscar recorded a volume of 70 92 cc which was significantly smaller in size than Vinks Glory Her Majesty produced the smallest sized corms (48 91 cc)

4 1 3 3 **Number of cormels per plant**

The data on the number of cormels produced per plant indicated significant difference as a result of the influence of different planting dates and cultivars and their combination effects (Table 3 and Appendix II)

October planting (T_3) recorded the highest number of cormels per plant (10 65) which significantly differed from other planting dates The next best planting dates were September (T_2) and August (T_1) which were on par (7 35 and 6 99 respectively) The last three planting dates recorded a further decline in the number of cormels per plant (3 46 in November 2 89 in December and 2 12 in January planting)

Her Majesty produced the maximum number of cormels per plant (7 67) and was on par with Oscar (6 26) The cultivar Vinks Glory recorded a significantly lesser number of cormels per plant (2 81)

The number of cormels per plant ranged from 0 20 in the variety Vinks Glory planted in January (t_6V_2) to 17 76 in Her Majesty planted in October (t_3V_1) The number of cormels produced by Her Majesty in November (1 67) December (2 03) and January (2 72) Vinks Glory in November (1 56) and December (1 34) and Oscar in January (3 44) were on par with the lowest number of cormels recorded

4 1 3 4 Weight of cormels

The weight of cormels produced was not significantly influenced by the different planting dates However the varietal and the planting date x cultivar interaction effects showed significant influence (Table 3 and Appendix II)

Oscar produced cormels of maximum weight (3 87 g) Her Majesty produced cormels weighing 3 16 g which was on par with Oscar The cultivar Vinks Glory showed the lowest weight of cormels (2 43 g)

The weight of cormels produced ranged from 0 48g in Vinks Glory planted in January (t_6V_2) to 7 36 g in Her Majesty planted in October (t_3V_1) The weight of cormels from Vinks Glory planted in October (4 75 g) and Oscar planted in November (5 16g) and January (5 27 g) were on par with the maximum cormel weight recorded

4 1 4 Correlation studies

The correlation coefficient of some important biometric character with weather parameters like maximum and minimum temperature relative humidity total rainfall number of rainy days and sunshine hours and their interrelationships are shown in Table 4

4 1 4 1 Days to 100 per cent corm sprouting

The number of days taken for 100 per cent sprouting of corms had no significant correlation with maximum and minimum temperature relative humidity or sunshine hours However significant positive correlation of this character with total rainfall (0 8508) and number of rainy days (0 8949) was observed

Table 4 Correlation of weather data with biometric observations

Weather parameter	Days to 100% corm sprouting	Days to 100% corm spike emergence	No of florets per spike	Weight of corms	Number of cormels
Maximum Temperature	0 4807	-0 7535	0 6718	0 3536	0 3412
Minimum Temperature	0 5620	0 4452	-0 6069	-0 7568	-0 8506*
Relative humidity	0 4991	0 8207*	0 0947	0 9115*	-0 5491
Total rainfall	0 8508*	0 8926*	0 6322	0 5809	0 0199
No of rainy days	0 8949*	0 9781**	0 2892	0 9024*	-0 3372
Sunshine hours	0 4065	0 5588	-0 8718*	0 3261	0 6072

** Significant ($p < 0.01$)

* Significant ($p < 0.05$)

4 1 4 2 Days to 100 per cent spike emergence

The number of days taken for 100 per cent spike emergence showed highly significant positive correlation with number of rainy days (0 9781) significant positive correlation with total rainfall (0 8926) and relative humidity (0 8207) There was no significant correlation with maximum and minimum temperature and sunshine hours

4 1 4 3 Number of florets per spike

The number of florets produced per spike had significant negative correlation with sunshine hours (0 8718) The correlations with all other weather parameters were not significant

4 1 4 4 Weight of corms

The weight of corms produced showed significant negative correlations with relative humidity (0 9115) and number of rainy days (0 9024) There negative non significant correlations with minimum temperature rainfall and sunshine hours

4 1 4 5 Number of cormels produced

The number of cormels produced showed significant negative correlation (0 8506) with minimum temperature The correlations with maximum temperature relative humidity total rainfall number of rainy days and sunshine hours are negative though not significant

4 2 Post harvest studies on the effect of floral preservatives on spike qualities of gladiolus

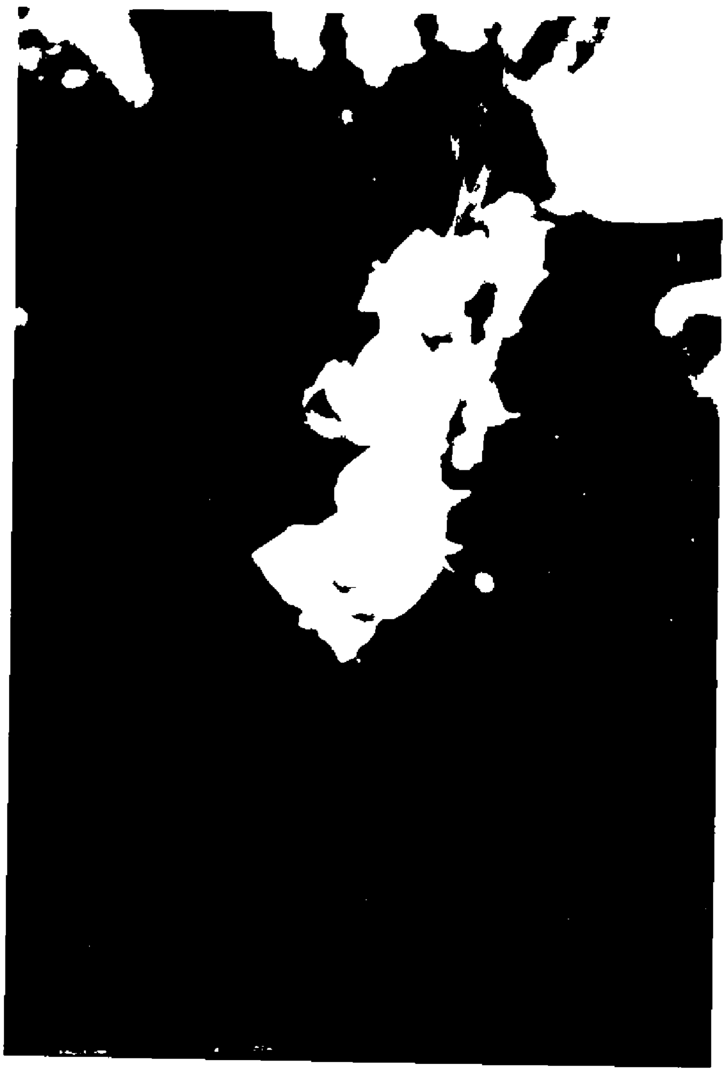
Analysis of variance was computed to study the effects of the seven vase solutions on improving the post harvest life of gladiolus cut flowers The six planting dates were taken as replications The results are presented in Table 5 to 8 and Appendix III

4 2 1 Days to full bloom

Number of days taken for full blooming was found to be significantly influenced by different vase solutions (Table 5 and Appendix III) for all the three cultivars

Plate 5
Gladiolus cv Her Majesty

Plate 6
Gladiolus cv Vinks Glory



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4 2 1 1 Her Majesty

The maximum number of days taken for full bloom (9 78 days) was recorded by spikes held in vase solution S_7 (Sucrose + $AgNO_3$ 200 ppm) The time taken by flowers placed in sucrose solutions containing 8-HQ 600 ppm (S_3) and $AgNO_3$ 100 ppm (S_6) were 9 67 and 9 50 days respectively and were on par with S_7 The number of days taken for full blooming was minimum (6 50 days) in spikes held in distilled water (S_1) which was the control treatment

4 2 1 2 Vinks Glory

Spikes held in solutions S_3 (sucrose + 8 HQ 600 ppm) and S_7 (sucrose + $AgNO_3$ 200 ppm) took the maximum date for full blooming (10 56 days and 9 89 days respectively) and were on par Vase solution S_1 (Control) recorded the minimum time (7 50 days)

4 2 1 3 Oscar

Vase solutions S_3 and S_2 containing sucrose + 8 HQ (600 or 300 ppm) did not show any significant difference and

Table 5 Effect of different vase solutions on days to full bloom and vase life of cut gladiolus spikes

Treatments	Days to full bloom			Vase life (days)		
	Her Majesty	Vinks Glory	Oscar	Her Majesty	Vinks Glory	Oscar
S_1 Control (distilled water)	6 50	7 50	6 50	7 67	8 61	7 39
S_2 Sucrose 5% + 300 ppm 8 HQ	9 00	8 78	9 94	10 89	11 06	12 22
S_3 Sucrose 5% + 600 ppm 8 HQ	9 67	10 56	10 50	12 39	13 33	13 44
S_4 Sucrose 5% + 100 ppm $Al_2(SO_4)_3$	7 83	7 95	8 72	9 11	9 56	9 72
S_5 Sucrose 5% + 300 ppm $Al_2(SO_4)_3$	8 50	8 44	8 67	10 11	10 50	10 67
S_6 Sucrose 5% + 100 ppm $AgNO_3$	9 50	9 11	8 17	11 61	10 67	10 33
S_7 Sucrose 5% + 200 ppm $AgNO_3$	9 78	9 89	8 95	11 72	11 89	11 28
CD (0 05)	0 748	0 757	0 943	0 866	0 676	0 921

took the maximum time to attain full blooming (10 50 and 9 94 days respectively) The least number of days for full blooming (6 50 days) was recorded in control (S_1) The other four vase solutions S_7 (Sucrose + $AgNO_3$ 200 ppm) S_4 (Sucrose + Al_2SO_4 100 ppm) S_5 (Sucrose + Al_2SO_4 300 ppm) and S_6 (Sucrose + $AgNO_3$ 100 ppm) were on par recording 8 95 8 72 8 67 and 8 17 days respectively

4 2 2 Vase life

The vase life of spikes of the three cultivars in the seven holding solutions are presented in Table 5 and Appendix III Significant effect was exerted by the different solutions on the vase life of all the three cultivars

4 2 2 1 Her Majesty

The maximum vase life was recorded in the holding solution of Sucrose + 8-HQ 600 ppm (12 39 days) and the minimum in distilled water (7 67 days) The vase life of spikes held in Sucrose + $AgNO_3$ 200 ppm (11 72 days) and Sucrose + $AgNO_3$ 100 ppm (11 61 days) were on par with the best treatment The vase life in S4 (Sucrose + $Al_2(SO_4)_3$ 100 ppm) was 9 11 days which was significantly superior only to control

4 2 2 2 Vinks Glory

Vase solution S_3 (sucrose + 8 HQ 600 ppm) recorded the maximum vase life of 13 33 days which was significantly superior to all the other treatments The vase life was the shortest (8 61 days) in S1 (control)

4 2 2 3 Oscar

In this variety too S_3 (sucrose + 8 HQ 600 ppm) recorded the maximum vase life (13 44 days) S_2 (sucrose + 8 HQ 200 ppm) recorded the next best vase life of 12 22 days which was significantly inferior to S_2 Vase life was the shortest (7 39 days) in S_1 (control)

4 2 3 Size of florets

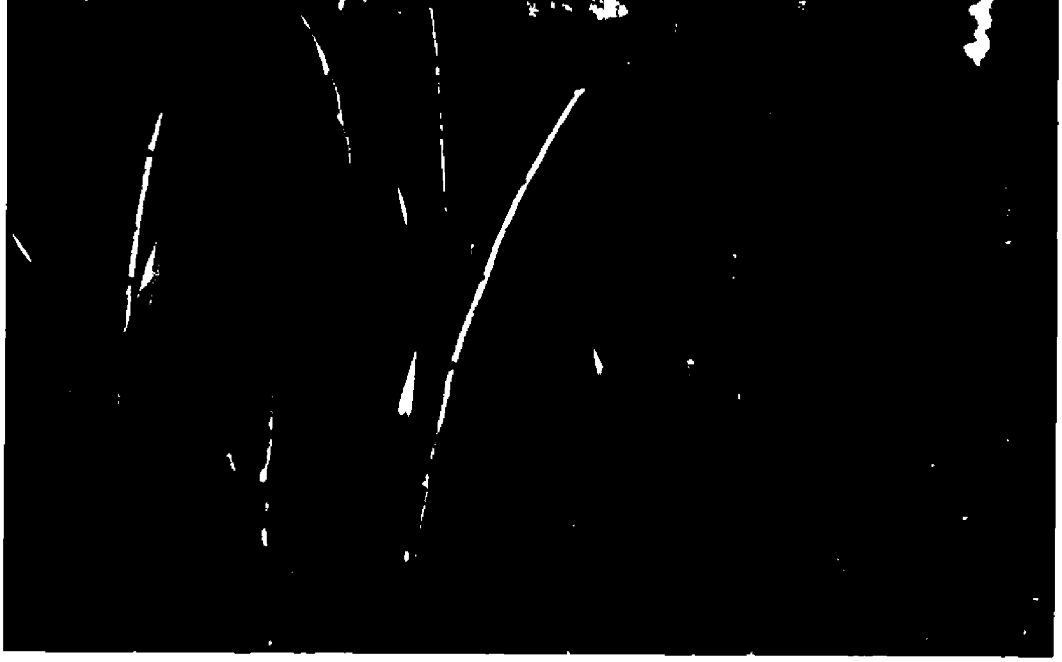
The data on floret size (diameter of the second floret) attained by the spikes of all the three cultivars

Plate 7

Gladiolus cv Oscar

Plate 8

Cut spikes of cv Her Majesty in different vase solutions (S_1 S_3 S_5 and S_7)



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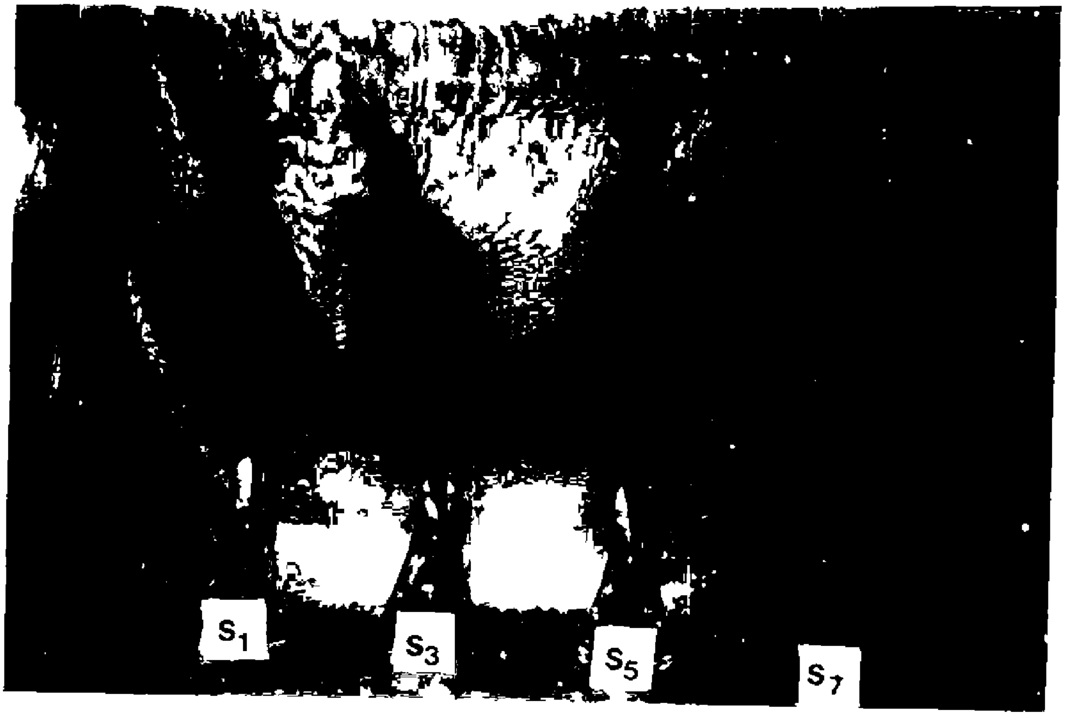

Her Majesty Vinks Glory and Oscar are presented in Table 6 and Appendix III All the three cultivars were significantly influenced by the seven vase solutions

4 2 3 1 Her Majesty

The maximum floret size (11 65 cm) in this variety was recorded in spikes held in vase solution S3 (Sucrose + 8-HQ 600 ppm) However the floret size attained by the spiles held in solutions S_7 (sucrose + $AgNO_3$ 200 ppm) and S_2 (Sucrose + 8 HQ 300 ppm) were on par with the floret size in S_3 (11 39 cm and 11 32 cm respectively) The minimum floret size (9 76 cm) was recorded by spikes held in control (S_1)

4 2 3 2 Vinks Glory

Spikes held in vase solution S_3 (sucrose + 8 HQ 600 ppm) recorded the maximum floret size (13 11 cm) and was significantly superior to all the other treatments Vase solution S_2 and S_7 (sucrose solutions containing 300 ppm 8 HQ and 200 ppm $AgNO_3$ respectively) gave the next best floret

Table 6 Effect of different vase solutions on floret size and number of open florets of cut gladiolus spikes

Treatments	Floret size (cm)			Number of open florets		
	Her Majesty	Vinks Glory	Oscar	Her Majesty	Vinks Glory	Oscar
S_1 - Control (distilled water)	9 76	10 96	11 90	3 22	3 95	3 22
S_2 - Sucrose 5% + 300 ppm 8 HQ	11 32	12 78	13 47	4 33	5 00	3 83
S_3 - Sucrose 5% + 600 ppm 8 HQ	11 65	13 11	14 26	5 17	5 45	4 83
S_4 Sucrose 5% + 100 ppm $(Al_2(SO_4)_3$	10 46	11 31	12 62	3 33	4 28	3 39
S_5 Sucrose 5% + 300 ppm $(Al_2(SO_4)_3$	10 50	11 53	12 70	3 61	4 39	3 78
S_6 - Sucrose 5% + 100 ppm $AgNO_3$	11 19	12 35	13 16	4 28	4 61	3 83
S_7 - Sucrose 5% + 200 ppm $AgNO_3$	11 39	12 60	13 47	4 45	5 06	4 11
CD (0 05)	0 328	0 257	0 330	0 352	0 260	0 338

sizes of 12 78 cm and 12 60 cm respectively and they were on par The floret size was the minimum (10 96 cm) in S_1 (control) and was significantly inferior when compared to all other treatments

4 2 3 3 Oscar

In the cultivar Oscar the vase solution S_3 (Sucrose + 8 HQ 600 ppm) registered the maximum floret size (14 26 cm) Spikes held in vase solution S_2 (Sucrose + 8 HQ 300 ppm) S_7 (Sucrose+ $AgNO_3$ 200 ppm) and S_6 (Sucrose + $AgNO_3$ 100 ppm) recorded floret sizes of 13 47 cm 13 47 cm and 13 16 cm respectively and were on par Spike held in distilled water (S_1) registered the minimum floret size of 11 90 cm

4 2 4 Number of florets open at a time

The different vase solutions exerted significant effect on the number of florets open at a time in the spikes of all the three cultivars Her Majesty Vinks Glory and Oscar (Table 6 and Appendix III)

Plate 9

Cut spikes of cv Vinks Glory in different vase solutions (S_1 S_3 and S_5)

Plate 10

Cut spikes of cv Oscar in different vase solutions (S_1 and S_3)

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4 2 4 1 Her Majesty

Spikes of variety Her Majesty held in the solution S_3 (Sucrose + 8 HQ 600 ppm) were found to be the superior combination recording the maximum number of open florets at a time (5 17) The treatments S_7 (Sucrose + $AgNO_3$ 200 ppm) S_2 (Sucrose + 8 HQ 300 ppm) and S_6 (Sucrose + $AgNO_3$ 100 ppm) registred 4 45 4 33 and 4 28 number of open florets respectively and were on par Spikes held in control (S_1) had the minimum number of open florets (3 22) and was significantly inferior to all other vase solutions

4 2 4 2 Vinks Glory

The maximum number of florets open at a time (5 45) was recorded in the spikes held in vase solution of sucrose + 8 HQ 600 ppm (S_3) which was significantly superior to all other treatments The vase solutions S_7 and S_2 recorded 5 06 and 5 00 number of open florets at a time and were on par The number of florets open at a time was the minimum (3 95) in the vase solution S_1 (Control)

4 2 4 2 Oscar

The spikes held in vase solution S_3 (Sucrose + 8-HQ 600 ppm) recorded the maximum number of florets open at a time (4 83) which was significantly superior to all other treatments The spikes in distilled water (S_1) had the minimum number of florets open at a time (3 22) The number of florets open at a time in the vase solution S_4 (Sucrose + $Al_2(SO_4)_3$ 100 ppm) was 3 39 and was on par with the number of open florets recorded in distilled water

4 2 5 Days to bending of spikes

The data on the number of days taken for spike bending in the three cultivars in the different vase solutions is presented in Table 7 and Appendix III The days taken for spike bending in all the three cultivars was found to be significantly influenced by the different vase solutions

4 2 5 1 Her Majesty

The maximum time lapse before spikes show bending (11 67 days) was recorded by the spikes held in the solution

S_3 (Sucrose + 8 HQ 600 ppm) The next longest time taken before spike bending were 10 45 10 28 and 9 78 days observed in the spikes held in solutions S_7 S_6 and S_2 respectively which were on par The number of days taken before spike bending was minimum (5 83) in spike held in control (S_1)

4 2 5 2 Vinks Glory

The number of days taken by the spikes to show bending was the maximum (10 28 days) in S_3 (Sucrose + 8 HQ 600 ppm) and minimum (4 39 days) in S_1 (control) Spikes held in S_2 S_7 and S_6 took 8 78 8 67 and 8 28 days respectively and were on par However they were significantly inferior to the best vase solution (S_3)

4 2 5 3 Oscar

The maximum time taken before spike bending in Oscar (11 94 days) was recorded in the vase solution S_3 (Sucrose + 8 HQ 600 ppm) Vase solution S_2 (Sucrose + 8-HQ 300 ppm) was the next best treatment (10 50 days) through it was significantly inferior compared to S_3 The number of

Table 7 Effect of different vase solutions on days to bending and location of bending of cut gladiolus spikes

Treatments	Days to bending			Location of bending		
	Her Majesty	Vinks Glory	Oscar	Her Majesty	Vinks Glory	Oscar
S_1 - Control (distilled water)	5 83	4 39	5 56	6 05	4 92	8 33
S_2 - Sucrose 5% + 300 ppm 8 HQ	9 78	8 78	10 50	9 22	7 83	10 95
S_3 - Sucrose 5% + 600 ppm 8 HQ	11 67	10 28	11 94	9 83	7 56	11 39
S_4 Sucrose 5% + 100 ppm $(Al_2(SO_4)_3$	7 28	6 33	7 22	7 34	6 39	9 11
S_5 Sucrose 5% + 300 ppm $(Al_2(SO_4)_3$	8 17	6 67	7 67	7 72	6 50	9 39
S_6 - Sucrose 5% + 100 ppm $AgNO_3$	10 28	8 28	8 17	8 72	7 06	10 22
S_7 - Sucrose 5% + 200 ppm $AgNO_3$	10 45	8 67	8 94	9 11	7 33	10 50
CD (0 05)	0 980	0 838	0 930	0 448	0 815	0 670

days taken for spike bending was the least (5 56 days) in the S_1 (control)

4 2 6 Location of bending

The location at which bending occurs in the spikes of the cultivars Her Majesty Vinks Glory and Oscar were significantly influenced by the vase solution (Table 7 and Appendix III)

4 2 6 1 Her Majesty

The position of florets from the base at which bending occurred (9 83rd floret) was significantly higher in the spikes held in S_3 (Sucrose + 8 HQ 600 ppm) The lowest location at which bending occurred (at 6 05 floret from the base) was recorded in S_1 (control) and was significantly inferior to all other treatments

4 2 6 2 Vinks Glory

In this cultivar the location at which bending occurred was the highest (at the 7 38th floret from the base) in S_2 (Sucrose + 8 HQ 300 ppm) However the position of the floret at which bending occurred in S_3 (Sucrose + 8-HQ 600 ppm) S_7 (Sucrose + $AgNO_3$ 200 ppm) and S_6 (Sucrose + $AgNO_3$ 100 ppm) were on par with S_2 (7 56th 7 33rd and 7 06th florets respectively) The location of bending was the lowest (at the 4 92nd floret) in spikes held in S_1 (control)

4 2 6 3 Oscar

The position of the florets at which bending occurred was the highest (11 39) in spikes held in S_3 (Sucrose + 8 HQ 600 ppm) and was on par with the location of bending (at the 10 95th floret) in spikes held in S_2 (Sucrose + 8 HQ 300 ppm) The lowest location at which bending occurred (at the 8 33rd floret) was recorded in spikes held in S_1 (control) which was significantly lower to all other treatments

4 2 7 Anthocyanin content

The anthocyanin content of flower petals of the three varieties was analysed on the second and tenth day after harvest The data presented in Table 8 and Appendix III revealed that anthocyanin content of the flower petals was significantly influenced by the different vase solutions in all the cases

4 2 7 1 Her Majesty

4 2 7 1 1 Two days after harvest

The data revealed that vase solution S_3 (Sucrose + 8 HQ 600 ppm) recorded the maximum anthocyanin content of petals (211 50 mg per 100g) two days after harvest spikes held in S_2 (Sucrose + 8-HQ 300 ppm) and S_5 (Sucrose + $Al_2(SO_4)_3$ 300 ppm) recorded pigment content of 168 16 and 141 40 mg per 100 g sample respectively and were on par The minimum anthocyanin content (73 26 mg per 100g) was registered in spikes held in S_1 (control) However vase solutions S_6 and S_7 (sucrose solutions with 100 and $AgNO_3$ 200 ppm) recorded anthocyanin content of 98 32 and 83 19 mg per 100g respectively and were on par with anthocyanin content of spikes held in control

4 2 7 1 2 Ten days after harvest

The maximum anthocyanin content was registered in spiles held in S_3 and S_2 (sucrose solutions containing 600 and 300 ppm 8 HQ respectively) solutions which were on par (620 78 and 590 61 mg per 100 g respectively) The minimum content (330 51 mg per 100g) was recorded in spikes held in control (S_1) which was on par with the anthocyanin content (369 92 mg 100g) of vase solution S_4 (Sucrose + $Al_2(SO_4)_3$ 100 ppm)

4 2 7 2 Vinks Glory

4 2 7 2 1 Two days after harvest

Anthocyanin content was maximum (3 03 mg per 100g) in the spikes held in S_3 (Sucrose + 8 HQ 600 ppm) Spikes placed in solution S_2 (Sucrose + 8 HQ 300 ppm) registered an anthocyanin content of 2 78 mg per 100g which was on par with S_3 The minimum anthocyanin content (1 13 mg per 100g) was recorded by spikes held in S_1 (control)

4 2 7 2 2 **Ten days after harvest**

Anthocyanin content estimated 10 days after harvest was the highest in spikes held in S_3 and S_2 (Sucrose solutions containing 8 HQ 600 and 300 ppm) which were on par (28 81 and 26 62 mg per 100g respectively) The solution S_1 (control) recorded the minimum anthocyanin content of 8 02 mg per 100 g

4 2 7 3 **Oscar**

4 2 7 3 1 **Two days after harvest**

Vase solutions of sucrose + 8-HQ 600 ppm (S_3) recorded the maximum anthocyanin content (459 46 mg per 100 g) However the spikes on vase solutions S_5 (Sucrose + $Al_2(SO_4)_3$ 300 ppm S_4 (Sucrose + $Al_2(SO_4)_3$ 100 ppm) and S_2 (Sucrose + 8 HQ 300 ppm) had anthocyanin contents which were on par (448 07 435 43 and 433 80 mg per 100g respectively) with S_3 The solution S_1 (control) held spikes showing the minimum anthocyanin content in petals (321 74 mg per 100 g)

Table 8 Effect of different vase solutions on anthocyanin content of cut gladiolus spikes

Anthocyanin (mg per 100 g sample)

Treatments	Two days after harvest			Ten days after harvest		
	Her Majesty	Vinks Glory	Oscar	Her Majesty	Vinks Glory	Oscar
S_1 - Control (distilled water)	73 26	1 13	321 74	330 51	8 02	833 83
S_2 - Sucrose 5% + 300 ppm 8 HQ	168 16	2 78	433 80	590 61	26 62	1490 03
S_3 - Sucrose 5% + 600 ppm 8 HQ	211 50	3 03	459 46	620 78	28 81	1604 81
S_4 - Sucrose 5% + 100 ppm $(Al_2(SO_4)_3$	130 75	1 89	435 43	369 92	17 17	1021 17
S_5 - Sucrose 5% + 300 ppm $(Al_2(SO_4)_3$	141 40	2 03	448 07	491 04	18 51	1047 35
S_6 - Sucrose 5% + 100 ppm $AgNO_3$	98 32	1 52	405 33	431 75	18 14	1114 04
S_7 - Sucrose 5% + 300 ppm $AgNO_3$	83 19	1 51	412 36	447 72	17 19	1047 49
CD (0 05)	33 320	0 268	34 414	69 562	5 671	241 059

4 2 7 3 2 Ten days after harvest

Vase solutions S_3 and S_2 containing sucrose + 8 HQ (600 and 300 ppm respectively) were on par in registering the maximum anthocyanin content in the petals (1604 81 and 1490 03 mg per 100g respectively) The vase solution S_1 (control) had spike with minimum petal anthocyanin content (833 83 mg per 100 g) which was significantly inferior to all other treatments The other four vase solutions (S_6 S_7 S_5 and S_4) were found to be on par (1114 04 1047 49 1047 35 and 1021 17 mg per 100 g respectively)

4 2 8 Colour and colour fading

The florets withered and darkened as senescence proceeded No marked differences between spikes kept in different holding solutions could be detected by visual observation

DISCUSSION

DISCUSSION

Gladiolus is one of the most ideal and coveted cut flowers and is now rankel fourth in the international cut flower trade But it is practically a new crop in kerala and little information is available on crop production of gladiolus and its management under Kerala conditions The standardisation of optimum planting time is of paramount importance for successful crop production as far as the cultivation of a new crop is concerned Since the spikes are most valued as cut flowers methods of improving it post-harvest life and quality also needs immediate attention

An experiment was conducted in the Department of Horticulture College of Agriculture Vellayani with a view to determine the effects of different planting dates on growth spike characteristics corm and cormel production of three cultivars of gladiolus and to study the effects of three floral preservative chemicals at two concentrations each on the post harvest life and quality of cut spikes

The results generated from the experiments conducted are briefly discussed here under

5 1 Effects of planting dates and cultivars on the performance of gladiolus crop

Genetic constitution of the plant growing environment nutrition soil moisture etc are the important factors affecting the growth and flowering in gladiolus The range of genet c variation in gladiolus is very large and cultivars with different growth habits producing various types of flowers of different shapes sizes and colour are available The environmental factors such as light temperature and available water exert significant influence on crop growth and spike development in gladiolus

The current experimental findings indicated that the time taken for 50 and 100 per cent corm sprouting followed more or less a similar trend (Table 1) October plantings showed the earliest corm sprouting (32 67 days) closely followed by November and December planting (Fig 1) August and September planting took abnormally longer time to complete sprouting which might be due to the non readiness of the freshly supplied corms to sprout A similar finding was reported by Arora and Sandhu (1987) wherein they observed that the significantly lesser time taken for sprouting by late plantings might be due to the influence of storing corms for extra time periods compared to early plantings Another reason might be the heavy rains which occurred during that period The present study has revealed significant positive correlation between number of days taken for corm sprouting and total rainfall and number of rainy days received during that period (Table 4) Among the three cultivars Oscar was the first to complete sprouting (42 56 days) and Vinks Glory the last (49 67 days) Significant differences exhibited by different varieties studied with regard to time taken for corm sprouting was reported by Arora and Sandhu (1987)

In the case of gladiolus plant height in combination with leaf characteristics constitute the main vegetative parameters that influence the spike characteristics The present study revealed significant influence of planting times on these growth parameters (Table 1) October and November plantings produced the tallest plants with more number of leaves and maximum leaf area

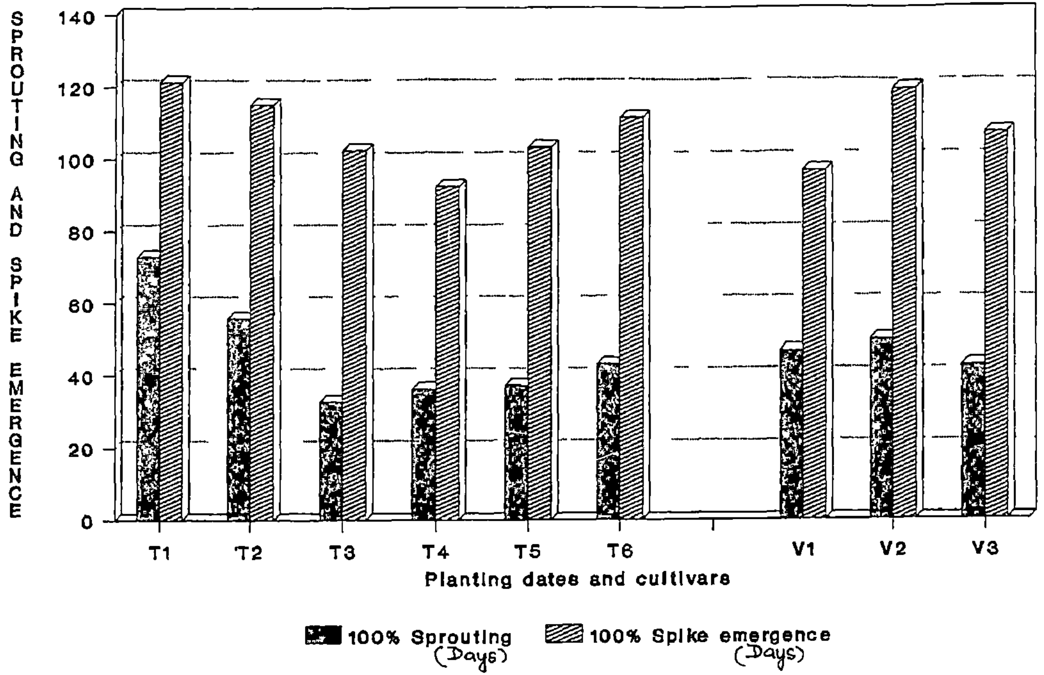

Fig 1 Effect of planting dates and cultivars on days to 100 per cent sprouting and spike emergence

However the last two planting dates (December and January) produced shorter plants with less number of leaves and leaf area which could be attributed to the hot dry climate that prevailed during the later growth period

Vinks Glory was the tallest (78 15 cm) of the three cultivars tested having the maximum number of leaves (9 76) and leaf area (674 39 cm^2) Her Majesty indicated the shortest plant height number of leaves and leaf area Lal et al (1985) observed a wide range of variability existing among different cultivars of gladiolus for some characteristics particularly plant height The number of shoots produced per plant was influenced by varietal differences only and not by planting dates Vinks Glory recorded the maximum tillering capacity and Her Majesty the minimum

The days taken for 50 and 100 per cent spike emergence reflected the earliness and exhibited significant variation due to planting dates and cultivars (Table 1) The results obtained from experiments conducted by Khanna and Gill (1983) and Arora and Sandhu (1987) confirmed these results November plantings (92 44 days) followed by October and December plantings took lesser time to complete spike emergence compared to other planting dates (Fig 1) Delay in spike emergence in August and September plantings could be attributed to the delay that was observed in corm sprouting The last plantings undertaken during January also exhibited delayed flowering Saini et al (1988) attributed early spike emergence under late sown conditions to higher temperatures and longer day lengths Correlation studies conducted now also revealed significant positive correlation between days taken for spike emergence and weather parameters like relative humidity total rainfall and number of rainy days The studies further indicated that the heavy rainfall occurring in Kerala during June to August might act as a major limiting factor adversely affecting the crop growth and performance

Her Majesty was the first to attain complete flowering (96 67 days) followed by Oscar (107 06 days) and subsequently by Vinks Glory Arora and Khanna (1985) found that the time taken for spike emergence and for the basal floret to show colour varied significantly owing to cultivars They attributed the differential behaviour of some cultivars to the individual response of the cultivars to temperature conditions that prevailed during colour break

Corm rot (Fusarium wilt) caused by Fusarium oxysporum fsp gladioli is the most destructive diseases of glodioli The present study did not reveal significant influence of planting times on the degree of disease incidence However it can be observed that the attack was more severe under wet and humid rainy seasons than during drier periods The cultivars exhibited significant differences in the degree of susceptibility to corm rot Vinks Glory was the most tolerant among the three cultivars (a mean of 1 11 infected plants per plot) and Her Majesty showed the maximum susceptibility (6 50 plants per plot) Experiments on evaluation of gladiolus cultivars and hybrids for resistance to Fusarium by Chandra et al (1985) revealed that cultivars differed with regard to the degree of incidence Kaur et al (1989) after testing 50 cultivars of gladiolus could not find a cultivars totally resistant to the diseases So Fusarium wilt forms the major limiting factor in commercial cultivation of gladiolus

The beauty of the spikes and their acceptability as cut flower is mainly determined by the inflorescence (spike) characteristics like spike length number of florets per spike and size of the florets The spike and rachis length

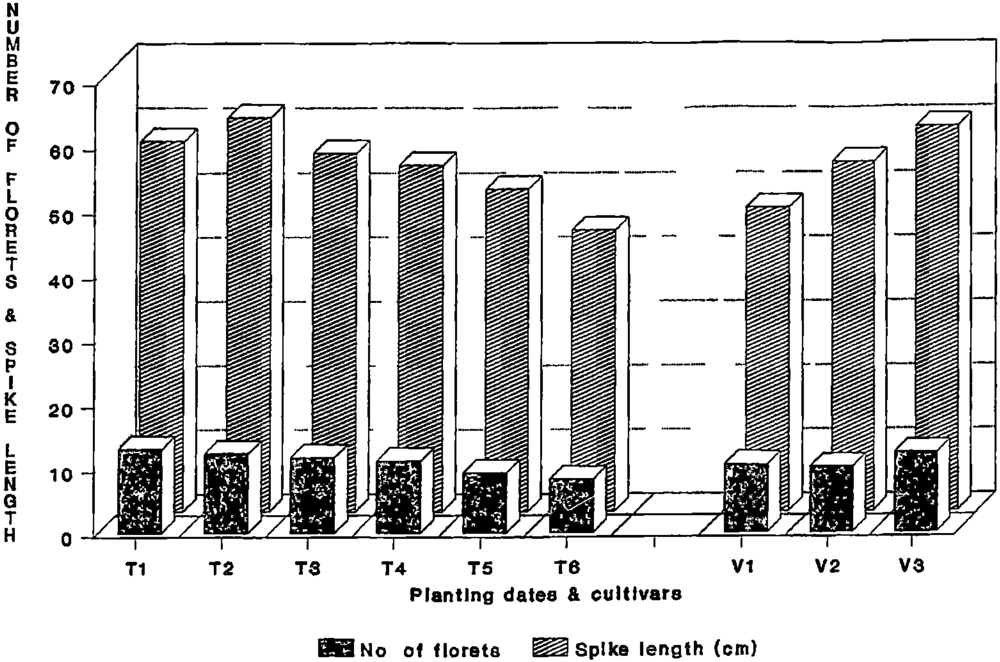

Fig 2 Effect of planting dates and cultivars on spike length and number of florets per spike

influence the quality of the spike by determining the number florets present per spike and also through its influence on post harvest preservation

Among the six planting dates September followed by August and October plantings produced the langest spikes with the maximum rachis length The later plantings done in December and January produced significantly shorter spikes (Fig 2) Khanna and Gill (1983) also found that the longest spikes were produced by September plantings under Punjab conditions In the present study it was observed that Oscar produced spikes of maximum spike (59 57 cm) and rachis (46 77 cm) lengths Her Majesty had the shortest spikes and rachis length among the three varieties Significant varietal effect on the spike length and number of florets produced has been reported by Khanna and Gill (1983) and Arora and Khanna (1985)

The number of florets produced per spike and floret size also influenced the spike quality by improving the appearance and beauty of the spikes From this experiment it was found that delayed planting after November significantly reduced the number of florets per spike and floret size (fig 2) This reduction in the spike length number and size of florets may be due to the decrease in plant height and size of December and January plantings Correlation and path coefficient studies done by Mishra and Saini (1990) demonstrated a significant positive correlation between plant height and number of florets per spike However correlation studies from the present investigation revealed significant negative correlation of number of florets per spile with sunshine hours only

The maximum number of florets (12 31) and floret size (11 91 cm) were recorded in Oscar The minimum floret size was recorded in Her Majesty (9 77 cm) Vinks Glory had the least number of florets per spike (10 08) though the spikes were taller compared to these of Her Majesty This indicated a loose arrangement of florets on the rachis in Vinks Glory leaving gaps in between them which slightly affected the beauty and quality of the spikes

The girth of the spike stalk determines the stiffness and strength of the spike and influences spike bending which is an undesirable trait Though the sturdiest stalks were produced by November plantings (3 26 cm) all the other plantings dates did not differ much from each other with respect to girth of spike stalks Oscar recorded the maximum spike girth while Her Majesty the minimum among the three cultivars

The duration from spike emergence to opening of the first floret was longer in earlier plantings The shorter duration taken by later plantings could be attributed to the faster growth attained under the hot climate that prevailed during that period Vinks Glory took significantly longer time (7 32 days) compared to Oscar and Her Majesty

Long blooming periods and keeping quality of cut spikes make gladiolus one of the superb among cut flowers for interior decoration Spikes from later plantings had shorter blooming periods and vase life in distilled water Spikes from the first three planting dates (August September and October) had significantly longer blooming periods and vase life (Fig 3) This could be due to the longer spikes and more number of florets present in these spikes from early plantings Mukhopadhyay and Bankar (1987) postulated that spikes from April plantings had shorter vase life than October or November plantings because of the hot weather that

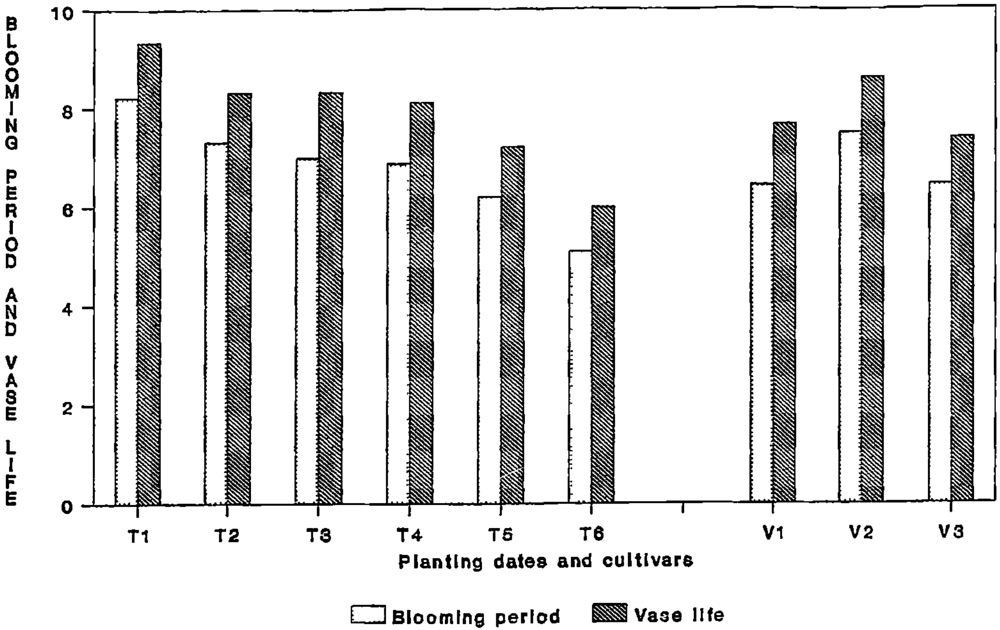

Fig 3 Effect of planting dates and cultivars on blooming period and vase life of spikes

prevailed during that period Ravidas (1990) recently reported that under Kerala conditions planting in November than in April resulted in better crop performance and longer blooming periods in gladiolus Among the cultivars Vinks Glory had the maximum blooming period and vase life followed by Oscar and Her Majesty

Studies on the effect of planting time and cultivars on weight and volume of corms produced indicated no significant influence of different planting times However varietal differences on corm size was significant The heaviest and largest corms were produced by Vinks Glory and the smallest ones by Her Majesty (Fig 4) Arora and Sandhu (1987) and Saini et al (1988) observed significant influence of both varieties and planting dates on the size of corms produced Correlation studies done during the course of the present experiment revealed significant negative influence of relative humidity and number of rainy days on the weight of corms produced indicating that corms produced under wet and humid weather conditions were inferior in size and weight

High cormel production in a cultivar is a desirable quality which helps in enhanced production of propagating

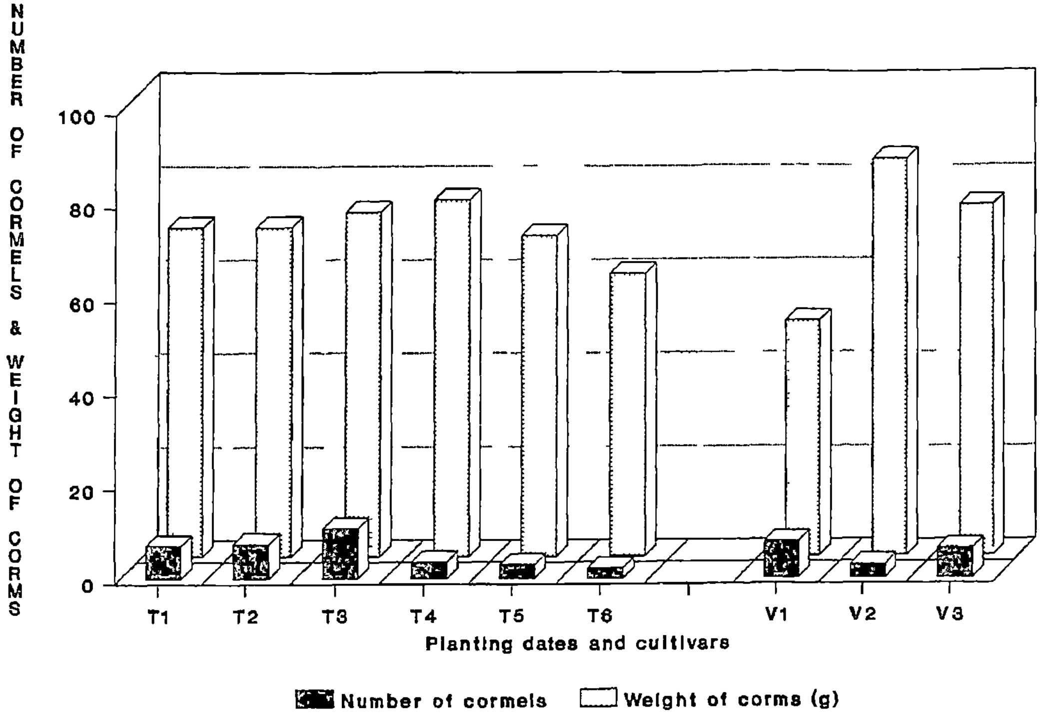

Fig 4 Effect of planting dates and cultivars on weight of corms and number of cormels produced

materials The results from this experiment proved that the number of cormels produced per plant though not their weight was significantly influenced by planting dates This may be due to the fact that increase in the number of cormels automatically reduced the individual cormel weight The number of cormels produced was greater in early planting dates (August September and October) which tended to decline with further delay in planting (Fig 4) Reports by Khanna and Gill (1983) also confirmed the significant influence of different planting dates on cormel production in gladiolus

The cultivars varied significantly from each other in this respect Though Her Majesty produced the maximum number of cormels per plant (7 67) the maximum weight of cormels per plant (3 87 g) was recorded in Oscar Vinks Glory registered the lowest number and weight of cormels per plant Many earlier workers have proved that the number of cormels produced per plant varied significantly among cultivars (Khanna and Gill 1983 Arora and Khanna 1985 Arora and Sandhu 1987)

5 2 Post harvest study on the effect of floral preservatives on spike qualities of gladiolus

The use of floral preservatives to promote the quality and to prolong the life of cut flowers has been known since many years Four main uses of water and chemical solutions in extension of vase life are conditioning pulsing bud opening and holding Though several attempts have been made to study the effect of different chemicals germicides sugars and hormones on the longevity of cut flowers having economic value relatively little work has been done to prolong the vase life of gladiolus a commercially important cut flower Murali (1988) attempted to study the effect of sucrose and metal salts like silver thiosulphate nickel aluminium calcium and cobalt on the post harvest physiology of cut gladiolus flowers

Since the vase life of gladiolus is a major problem in the tropics the present study envisaged the use of floral preservatives containing sucrose and 8 hydroxyquinoline aluminium sulphate or silver nitrate for standardising the optimum combination that can be used as an ideal holding

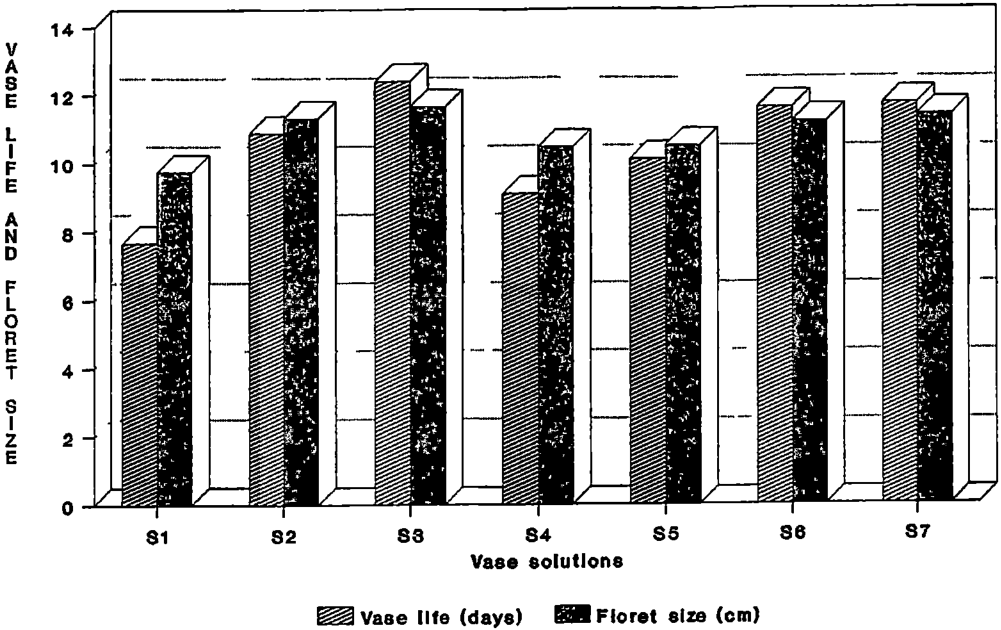

Fig 5 Effect of different vase solutions on vase life and floret size of spikes of cv Her Majesty

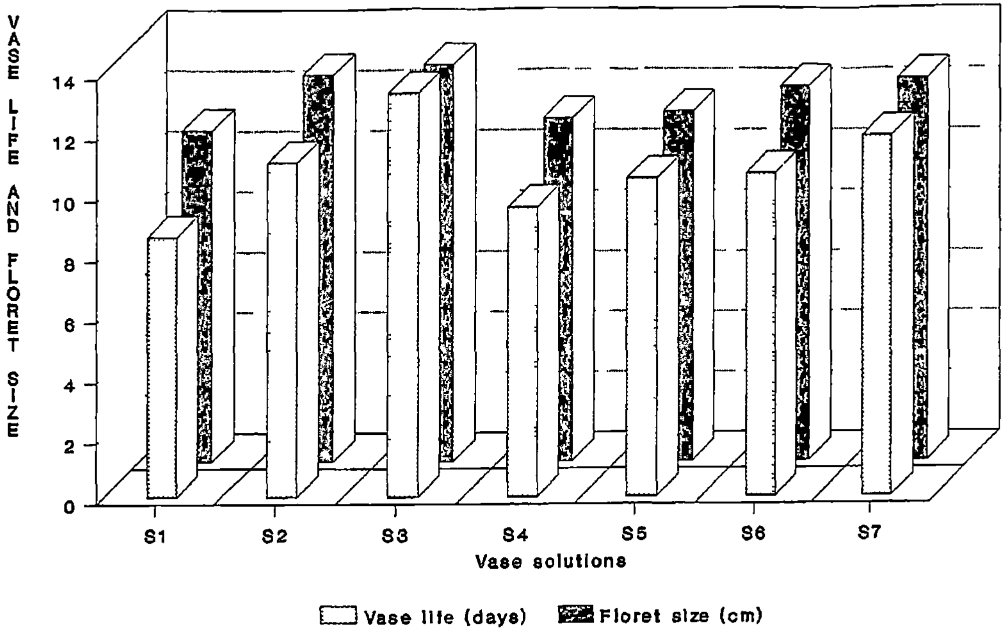

Fig 6 Effect of different vase solutions on vase life and floret size of spikes of cv Vinks Glory

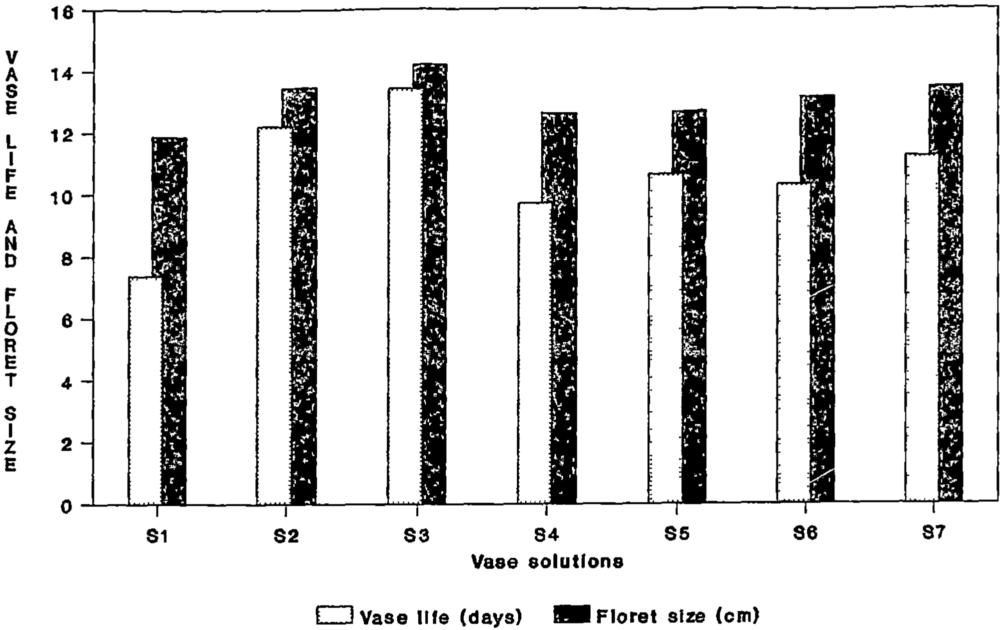

Fig 7 Effect of different vase solutions on vase life and floret size of spikes of cv Oscar

solution for cut gladiolus spikes The results of the experiments revealed that the different vase solutions exerted significant influence on different post harvest vase characteristics that were under study

From the experiment it was found that the number of days taken for full blooming in the spiles of Her Majesty and Vinks Glory was the maximum in holding solutions of 5 per cent sucrose and either 8 HQ (300 or 600 ppm) or $AgNO_3$ (100 or 200 pm) For spikes of Oscar the optimum holding solutions for maximising blooming period were those containing sucrose and 8-HQ (300 or 600 ppm) The higher concentrations were more effective than lower concentrations in both 8-HQ and $AgNO_3$

The maximum vase life of cut spikes in all the three cultivars was also recorded in spikes held in sucrose 5 per cent plus 8 HQ 600 ppm (12 39 days in Her Majesty 13 33 days in Vinks Glory and 13 44 days in Oscar) However for Her Majesty the vase solution of $AgNO_3$ (100 and 200 ppm) with sucrose were equally effective as 600 ppm 8 HQ in extending vase life (Fig 5) $Al_2(SO_4)_3$ was less effective compared to the other two chemicals Spikes held in distilled water which was used as control recorded the lowest blooming period and vase life in all the three cultivars

The manifold role of sucrose in combination with chemical preservatives on improving the vase life of out gladiolus flowers has been elucidated by many workers (Marousky 1970 Mayak et al 1973 Bravdo et al 1974 Choi and Roh 1980 Rao and Ram 1981 Wang and Gu 1985 and Garibaldi and Deambrogio 1989) 8 hydroxyquinoline has for long been considered as the most effective preservative that can be used in combination with sucrose for increasing the post harvest quality of cut spikes (Marousky 1973 Marovsky and Woltz 1975 Wang and Gu 1985 Khondarkar and Mazumdar 1985 and Gao and Wu 1990) The use of silver nitrate with sucrose in holding solutions to reduce vascular plugging - thereby increasing the vase like was reported by Choi and Roh (1980) and Deswal and Patil (1982)

The maximum floret size and the maximum number of open florets in all the three cultivars were also recorded in spikes held in 5 per cent sucrose plus 8 HQ 600 ppm In Her Majesty the vase solutions containing sucrose plus 8 HQ 300 ppm or $AgNO_3$ 200 ppm were equally effective in producing maximum floret size (Fig 5) In all the cases the minimum floret size and number of open florets were observed in spikes held in distilled water Aluminium sulphate (100 and 200 ppm) in the vase solution produced significantly superior results only when compared with spikes held in distilled water

Rameshwar (1976) reported that aluminium sulphate 0 1% was a cheap and adequate substitute for 8-HQ salts in prolonging the vase life of cut gladiolus spikes Murali (1988) also proved that aluminium in the vase solution helped in increasing the number of fully open flower floret size and vase life in gladiolus 8-HQ and $AgNO_3$ in combination with sucrose were also observed to be effective in increasing the number of open florets and floret size (Wang and Gu 1985)

The tendency of bending or breaking of spikes after some days in vase has been reported in gladiolus This may be due to the weakness of the floral stem or due to the weight of the apex of floral axis Bending or breaking can occur after varying time spans and at different positions on the stem

Plate 11

Spike bending in cv Vinks Glory

The maximum time span before bending was recorded in spikes held in sucrose plus 8-HQ solution (600 and 300 ppm) Spikes held in sucrose plus $AgNO_3$ solutions also stood erect for longer periods before bending compared to other treatments The first ones to record bending were those placed in distilled water Marousky and Woltz (1975) had postulated that 8-HQ in vase solution caused more solution uptake than did water alone and thus kept the stem tissues more turgid Anatomical studies by Stenitz (1982) revealed strong post harvest cell wall thickening and lignification of phloem cells in sucrose treated cut flower stems which might help in preventing bending

The position at which bending occurred was the lowest in the spikes held in distilled water Bending occurred at the top only in spikes held in 8-HQ solutions $AgNO_3$ and $Al_2(SO_4)_3$ were also effective in controlling spike bending when compared to control

The pigment anthocyanin along with anthoxanthins form the major pigments contributing to the diverse colour range observed in the different cultivars of gladiolus Analysis of anthocyanin content in flower petals after two days and ten days in vase revealed that spikes held in 8 HQ plus sucrose retained the maximum colour pigments Spikes held in control had the minimum anthocyanin content in petals in all the cases studied The presence of sucrose in vase solutions of cut flowers tended to increase the anthocyanin content of petals (Choi and Sang 1989)

SUMMARY

SUMMARY

A study was conducted at the Department of Horticulture College of Agriculture Vellayani to find out the effect of different planting dates and floral preservatives on spike qualities of gladiolus Six planting dates at monthly intervals (from mid-August 1992 to mid-January 1993) were tried for three cultivars (Her Majesty Vinks Glory and Oscar)of gladiolus in a Factorial Randomised Block design with three replications The floral preservative study comprised of testing the effect of seven holding or vase solutions on the post harvest vase life of cut spikes of the three cultivars The six planting dates were taken as replications The results of the study are summarised below

The different planting dates and cultivars significantly influenced the time taken for 50 and 100 per cent corm sprouting October planting (T_3) took the shortest time to complete sprouting (32 67 days) There was significant positive correlation with total rainfall and the number of rainy days occurring during the period of sprouting Among the three cultivars tested Oscar was the

earliest to attain 100 per cent sprouting (42 56 days) There was also significant interaction between planting dates and cultivars on this character

The influence of planting dates and cultivars on vegetative characters like plant height number of leaves produced per plant and leaf area was also significant The tallest plants with maximum number of leaves and leaf area were recorded in October (T_3) and November (T_4) plantings The maximum plant height leaf number and leaf area among the three cultivars was found in Vinks Glory (V_2) These parameters were also significantly influenced by the interaction effect between planting dates and cultivars

The number of shoots produced per plant was under the significant influence of difference in cultivars only The cultivar Vinks Glory recorded the maximum of 1 18 shoots per plant Planting dates and interaction effects did not exert significant influence on the number of shoots per plant

The time taken to complete spike emergence was under the significant influence of both planting dates and cultivars Plants from November planting (T_4) were the earliest to complete 100 per cent spike emergence (92 44 days) Duration taken for complete spike emergence also exhibited significant positive correlation with total rainfall number of rainy days and relative humidity Among the cultivars Her Majesty was the earliest to complete flowering (96 67 days) and Vinks Glory was the latest (119 22 days) The influence of the interaction effect on this character was not significant

The degree of incidence of Fusarium wilt was significantly influenced by the cultivars The number of diseased plants per plot was maximum (6 50) in Her Majesty and the minimum (1 11) in Vinks Glory Planting dates did not significantly influence the incidence of Fusarium wilt though there was significant interaction effect

Planting dates and cultivars and their interaction also exerted significant influence on the spike and rachis lengths September planting (T_2) produced plants with the maximum spike (61 16 cm) and rachis lengths (47 83 cm) December and January plantings recorded inferior spike and rachis lengths The cultivar Oscar (V_3) produced the longest

Size of florets and number of florets produced per plant were under the significant influence of difference in planting dates and cultivars Maximum floret size and number of florets were observed in spikes from early planting dates of August September October and November Further delay in planting significantly reduced the number of florets and floret size Maximum number of florets and floret size among the three cultivars was recorded in Oscar (V_3)

The girth of spike stalk was maximum (3 26 cm) in plants from November plantings (T_4) However there was no significant differences among other planting dates Oscar (V_3) produced spikes with the thickest stalks (3 28 cm) when compared to the other two cultivars

The duration from spike emergence to opening of the first floret was longer in early plantings and reduced in the last two plantings dates (T_5 and T_6) Vinks Glory (V_2) took the longest time (7 32 days) to opening of the first floret and Her Majesty (V_1) the shortest (6 02 days)

Blooming period and vase life of spikes were significantly influenced by planting dates and cultivars Spikes from the early planting dates of August September and October had the maximum blooming period and vase life The last two planting dates (December and January) were significantly inferior in this respect Spikes of Vinks Glory had the maximum blooming period (7 50 days) and vase life (8 61 days) while Oscar (V_3) and Her Majesty (V_1) were on par

The weight and volume of corms produced were not significantly influenced by the planting dates or the interaction effects However there was significant negative correlation effect with relative humidity and number of rainy days occurring the growth period The cultivars significantly influenced this parameter Vinks Glory being the cultivar producing the largest corms and Her Majesty the smallest

The number of cormels produced per plant but not their weight was under the significant influence of difference in planting dates Early plantings of August September and October recorded more number of cormels per plant when compared to delayed plantings The different cultivars also exerted significant influence on this character Maximum number of cormels per plant (7 67) was recorded in Her Majesty while the maximum weight of cormels per plant (3 87 g) was registered in Oscar

The different vase solutions exerted significant influence on all the post harvest spike characteristics that were under study

The optimum holding solution for maximising the number of days taken full bloom were those that containing 5 per cent sources and either 8-HQ (300 or 600 ppm) or $AgNO_3$ (100 or 200 ppm) The higher concentrations were more effective than the lower concentrations in both cases

The maximum vase life of spikes in all the three cultivars was recorded in a holding solution of 5 per cent sucrose plus 600 ppm 8 HQ In the case of Her Majesty sucrose plus $AgNO_3$ (100 or 200 ppm) solutions were also equally effective The shortest blooming period and vase life in all the three cultivars were registered in spikes held in distilled water which was used as control

Holding the spikes in vase solutions of 5 per cent sucrose plus 600 ppm 8-HQ (S_3) also resulted in maximum floret size and number of open florets when compared to the other vase solutions Sucrose solutions containing 300 ppm 8-HQ and 200 ppm $AgNO_3$ also significantly improved floret size in cultivar Her Majesty Holding solutions containing Al_2SO_4 was superior only when compared to control

The number of days taken for spike bending was maximum in holding solutions of sucrose plus 8 HQ (600 or 300 ppm) and minimum in control (S_1) Bending occurred only at the top portion of spikes when held in sucrose plus 8-HQ solutions whereas it was at lowest portions in spike held in control solution

The estimation of anthocyanin pigments in flower petals two and ten days after harvest revealed that the colour pigments were maximum on the spikes held on sucrose plus 8 HQ solutions (S2 and S3) and minimum in control (S1)

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APPENDICES

Appendix I

Meteorological data of College of Agriculture Vellayani for the period August 1992 to May 1993

Month		Temperature (°C)		Relative humidity (%)	Total rainfall (mm)	No of rainy days	Sunshine hours
		Min	Max				
Aug	1992	27 32	23 38	83 90	149 80	11	6 05
Sept	1992	30 78	24 85	74 43	56 40	12	6 00
Oct	1992	30 56	24 52	76 74	415 00	13	5 14
Nov	1992	28 70	23 03	75 03	286 50	10	4 63
Dec	1992	32 91	21 48	68 00	15 10	2	6 55
Jan	1993	31 68	20 59	61 23	0 00	0	8 00
Feb	1993	31 43	21 30	62 85	2 80	1	8 39
Mar	1993	32 65	23 20	64 19	36 30	2	8 65
Apr	1993	31 67	25 59	78 60	39 60	7	8 34
May	1993	31 34	25 03	83 50	221 60	10	6 96

Append x II

Analys s of var ance tables

Effect of plant ng dates and cult vars on growth parameters of glad olus

Source of var abil ty	df	Days to 50% corm sporut ng	Days to 100% corm sporut ng	Plant he ght (cm)	No of shoots per plant	No of leaves per plant	Leaf area (cm^2)	Days to 50% spike emergence	Days to 100% sp ke emergence	Fusar um incidence
		Mean sum of squares and the r sign f cance								
Repl cat on	2	10 241	78 296	5 332	0 013	0 943	342 000	218 354	57 184	0 146
T me of plant ng (T)	5	1462 996**	2133 852**	105 672**	0 014^{ns}	2 586**	40398 840*	1292 064**	961 885*	0 504^{ns}
Cult var (V)	2	74 574**	229 407**	609 776**	0 158**	25 467**	389038 000**	984 521**	2294 128**	7 782
Interact on (TxV)	10	57 374**	46 985*	31 871*	0 018^{ns}	1 994**	8574 178^{ns}	41 385^{ns}	21 263^{ns}	0 360*
Error	34	7 849	18 257	13 153	0 010	0 355	8934 883	40 7644	43 872	0 167
Total	53	157 079	233 495	47 632	0 018	1 844	25854 380	201 243	211 629	0 522

** S 0 0

IIb Effect of plant ng dates and cultivars on spike character stics of gladiolus

Source of variability	df	Mean sum of squares and their significance							
		Spike length (cm)	Rachis length (cm)	No of florets per spike	Size of florets (cm)	Girth of spike stalk (cm)	Days from spike emergence to opening	Blooming period (days)	Vase life (days)
Replication	2	10 863	1 530	1 124	0 109	0 051	0 009	0 018	0 571
Time of planting (T)	5	336 454**	282 930**	29 975**	3 064**	0 101*	1 044**	9 961**	11 836**
Cultivar (V)	2	693 321**	638 141**	24 964**	20 707**	0 785*	8 790**	6 689**	7 367**
Interaction (TxV)	10	22 174^{ns}	21 079*	4 063**	0 636^{ns}	0 016^{ns}	0 208^{ns}	1 019^{ns}	0 778^{ns}
Error	3	10 860	8 225	0 931	0 512	0 029	0 109	1 340	1 446
Total	53	69 465	60 083	5 176	1 523	0 063	0 540	2 244	2 491

** Significant ($p < 0\ 01$) * Significant ($p < 0\ 05$) ns Not signif cant

IIc Effect of planting dates and cultivars on corm and cormel characters

Source of variability	df	Mean sum of squares and their significance			
		Weight of corm (g)	Volume of corms (cc)	No of cormels per plant	Weight of cormels (g)
Replication	2	94 689	278 527	6 182	2 160
Time of planting (T)	5	261 504^{ns}	309 811^{ns}	98 183**	9 372**
Cultivar (V)	2	5690 772**	5481 305**	112 822**	9 375*
Interaction (TxV)	10	138 549^{ns}	165 680^{ns}	27 125**	7 974*
Error	34	160 158	160 697	7 528	2 914
Total	53	374 874	380 928	23 700	4 694

** Significant ($p < 0$ 01)

* Significant ($p < 0$ 05)

ns Not significant

Appendix III

Analysis of variance table

Effect of floral preservatives on post - harvest life of cut gladiolus spikes

Source of variability	df	Mean sum of squares and their significance					
		Days to full bloom			Vase life (days)		
		Her Majesty	Vinks Glory	Oscar	Her Majesty	Vinks Glory	Oscar
Replication	5	17 178	18 353	8 757	19 414	20 024	8 954
Vase solution	6	8 465**	6 859**	9 930**	16 499**	14 121**	22 220**
Error	30	0 403	0 413	0 640	0 540	0 328	0 610
Total	41	3 628	3 544	2 989	5 177	4 749	4 790

** Significant ($p < 0.01$)

Appendix III (Contd)

Source of variability	df	Mean sum of squares and their significance					
		Floret size (cm)			No of open florets		
		Her Majesty	Vinks Glory	Oscar	Her Majesty	Vinks Glory	Oscar
Replication	5	5 698	2 6223	2 748	0 042	1 877	0 425
Vase solution	6	2 710**	4 059**	3 381**	2 923**	1 621**	1 647**
Error	30	0 078	0 048	0 678	0 089	0 049	0 082
Total	41	1 148	0 949	0 887	0 498	0 502	0 353

** Significant ($p < 0.01$)

Appendix III (Contd)

Source of variability	df	Mean sum of squares and their significance					
		Days to bending			Location of bending		
		Her Majesty	Vinks Glory	Oscar	Her Majesty	Vinks Glory	Oscar
Replication	5	20 986	8 9173	6 697	11 011	10 779	31 767
Vase solution	6	25 103**	22 941**	27 129**	10 344*	5 777**	7 059**
Error	30	0 691	0 506	0 622	0 145	0 478	0 323
Total	41	6 739	4 815	5 242	2 962	2 510	5 143

** Significant (p < 0 01)

* Significant (p < 0 05)

Appendix III (Contd)

Source of variability	df	Anthocyanin content of petals two days after harvest: Her Majesty	Vinks Glory	Oscar	Anthocyanin content of petals ten days after harvest: Her Majesty	Vinks Glory	Oscar
		Mean sum of squares and their significance					
Replication	1	28 150	0 0001	110 143	2120 500	8 057	263 429
Vase solution	6	4880 346**	0 973**	4207 167**	23050 130**	94 095**	217810 000**
Error	6	185 465	0 012	197 851	808 375	5 372	7654 762
Total	13	2340 232	0 455	2041 558	11174 730	46 527	104080 900

** Significant ($p < 0\ 01$)

LIST OF ABBREVIATIONS

%	Per cent
ppm	Parts per million
g/l	Gram per litre
mM	Milli molar
pH	Potential hydrogen
8 HQ	8 hydroxyquioline
8 HQS	8-hydroxyquinoline sulphate
8 HQC	8 hydroxyquinoline citrate
STS	Silver thiosulphate

EFFECTS OF PLANTING DATES AND FLORAL PRESERVATIVES ON SPIKE QUALITIES OF GLADIOLUS (*Gladiolus grandiflorus*)

By

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ABSTRACT OF A THESIS
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ABSTRACT

Investigations were carried out at the Department of Horticulture College of Agriculture Vellayani during 1992 93 to gather information on the effect of six planting dates at monthly intervals from mid August to mid January on the general performance of three gladiolus cultivars A post harvest study was also conducted to find out the effect of seven holding solutions on the post harvest spike characteristics

Studies revealed that corms planted during October were the earliest to complete sprouting October plantings also produced the tallest plants with maximum leaf number and leaf area Delayed plantings took more time to attain 100 per cent sprouting and the plants were shorter with less number of leaves and leaf area The earliest plants to complete spike emergence were the ones planted during November

Among the three cultivars tested Oscar was the earliest to sprout and Vinks Glory the latest Maximum plant height leaf number and leaf area were recorded in the cultivar Vinks Glory Vinks Glory also produced the maximum

number of tillers per plant Her Majesty was the earliest of the three cultivars to complete flowering while Vinks Glory took the longest time Maximum susceptibility to Fusarium wilt was exhibited by the cultivar Her Majesty whereas Vinks Glory was the least susceptible

Observations on the effect of planting dates on spike characteristics indicated that September plantings registered the maximum spike and rachis lengths In general delayed planting resulted in reduced spile and rachis length floret size and number of florets per spike Early plantings done in August September and October also produced the maximum number of florets per spike and floret size

The longest spikes with the maximum rachis length number of florets and floret size were observed in Oscar The spikes of Oscar also recorded the maximum girth of spike stalk

Early plantings done in August September and October increased the time taken from spike emergence to opening of first floret blooming period and vase life of spikes Delayed planting produced spikes which were inferior in this respect Vinks Glory was the cultivar with spikes of maximum blooming period and vase life

Weight of corms produced was highest in the cultivar Vinks Glory and lowest in Her Majesty Her Majesty registered the maximum number of cormels per plant while Oscar produced the maximum cormel weight per plant Delayed plantings resulted in a reduction of number of cormels per plant

Vase life studies conducted on the spikes of all the three cultivars revealed that the spikes held in preservative solutions produced better results when compared to those held in distilled water The optimum holding solution for maximising the number of days to full bloom and vase life of spikes was a 5 per cent sucrose solution containing 8 hydroxyquinoline (300 or 600 ppm) Holding solutions containing 5 per cent sucrose and silver nitrate (100 or 200 ppm) gave the next best results

Floret size and number of open florets was maximum in spikes held in 5 per cent sucrose + 8-hydroxyquinoline 600 ppm This holding solution also significantly delayed the bending of spikes in vase Sucrose solutions containing aluminium sulphate produced superior results only when compared to control

Estimation of anthocyanin colour pigments in flower petals 2 and 10 days after harvest also revealed better retention of colour pigments in spikes held in sucrose plus 8 hydroxyquinoline solutions when compared to the other solutions