EFFECT OF GROWTH REGULATORS AND NUTRIENTS ON SPIKE QUALITIES OF GLADIOLUS

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THESIS

Submitted in partial fulfilment of the
requirement for the degree of

Master of Science in Horticulture

Faculty of Agriculture
Kerala Agricultural University

Department of Horticulture
(Pomology, Floriculture and Landscaping)
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1991

DECLARATION

I hereby declare that this thesis entitled **"Effect of growth regulators and nutrients on spike qualities of gladiolus"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Vellanikkara,

16-11-1991.

LEENA RAVIDAS

CERTIFICATE

Certified that this thesis entitled "**Effect of growth regulators and nutrients on spike qualities of gladiolus**" is a record of research work done independently by **Smt.Leena Ravidas** 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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Chairman
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Vellanikkara
16-11-1991

Dedicated to my father

CERTIFICATE

We, the undersigned, Members of the Advisory Committee of Smt.Leena Ravidas, a candidate for the degree of Master of Science in Horticulture with major in Horticulture, agree that the thesis entitled "Effect of growth regulators and nutrients on spike qualities of gladiolus" may be submitted by Smt.Leena Ravidas in partial fulfilment of the requirement for the degree.

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LEENA RAVIDAS

LIST OF TABLES

LIST OF FIGURES

C O N T E N T S

Introduction

INTRODUCTION

A renowned cut flower of the age, gladiolus is magnificent with its great size, elegance and large number of individual blooms per stem. Florets of massive form, brilliant colours, attractive shapes, varying sizes and excellent keeping quality, make it ideal for both gardens and floral decorations. No wonder, in the international cut-flower trade it now occupies the fourth place.

The name gladiolus was originally coined by Pliny the Elder (A.D. 23-79) from the Latin word 'gladius', which means sword, referring to the shape of its foliage. As a genus it was christened by Tournefort and accepted in botanical literature by Linnaeus (Lewis et al., 1972). It belongs to the family Iridaceae. Gladiolus is a fairly large genus, comprising about 250 species distributed in Central Europe, Mediterranean region, Central America and South Africa.

Gladiolus was brought into cultivation from its native habitat in South Africa, perhaps during the ancient Greek period. The systematic improvement began only after the discovery of the Primulinus gladioli, growing wild near the Victoria falls in South Africa. The cultivated gladiolus is an assemblage of cultivars originating from the complex ancestry of natural and artificial hybridisation involving at least a dozen species. There are two most important types in gladioli, the large flowered varieties and the butterfly and miniature gladioli. Early, mid season and late flowering varieties are found under each. Inflorescences of gladioli may be large, medium or small in size, sometimes with ruffled petals, blotches or streaks.

In India, gladiolus is mainly grown in Srinagar, Nainital, Kalimpong and in the State of Assam. Other areas of importance are Bangalore, Pune, Delhi and Chandigarh. In Kerala it still is not under commercial cultivation.

In relation to the economic importance of gladiolus, very little work has so far been done on the effect of foliar application of growth regulators and nutrients on spike qualities. In the present study, growth regulators and nutrients were tried in order to improve the spike quality and vase life. Gladiolus being a relatively new crop to Kerala, a general assessment of the performance of different varieties under two seasons formed another aspect of the study. The specific objectives of the experiment are listed below:

i) To study the effect of growth regulators and nutrients on the qualities of spike, with special reference to vase life.

ii) To ascertain the effect of season of planting on the quality and yield of gladiolus.

iii) To evaluate the gladiolus varieties based on suitability for growing under Vellanikkara conditions.

Review of Literature

REVIEW OF LITERATURE

The improvement work in gladiolus is aimed at developing quality floral spikes with excellent keeping quality. Reports on the nutritional and hormonal response of gladiolus are meagre. Available literature related to the subject is reviewed.

2.1. Effect of nutrients

2.1.1. Growth parameters

Sand culture experiments were conducted by Woltz (1954) to investigate the nutritional requirements of gladiolus using commercial sized corms of Elizabeth the Queen and Picardy. It was concluded that the leaf production was most effected by N, K and P deficiencies. Guttay and Krone (1957) studied the effect of rates of different fertilizers on the qualities of gladiolus over two seasons. Three fertilizer grades, 4-16-4, 4-16-8 and 4-16-16 were applied to gladiolus at four rates, 100, 250, 500 and 1000 lb per acre, over two seasons in green house study. During both seasons, differences in fertilizer grade had little effect on plant growth.

The effect of nutritional treatments on flowering and blindness in gladiolus grown from cormels was studied by Kosugi and Kondo (1961). Treatments were applied to gladiolus plants grown from cormels in boxes of sand included 1N (50 ppm) 1P (25 ppm), 1K (40 ppm),

2N1P2K, 4N1P1K, 1N1P2K, 2N1P2K, 4N1P2K, 1N2P1K, 2N2P1K, 4N2P1K, 1N2P2K, 2N2P2K and 4N2P2K. Significant difference in the number of leaves was observed between the treated and untreated plots. 2N gave the tallest plants. Kosugi and Sano (1961) on the other hand, reported that with N application, the plant height was lower in the plants which did not receive N.

In another experiment, Lemeni and Lemeni (1965) observed that the highest level of mineral fertilization, namely, 600 kg super phosphate, 300 kg muriate of potash and 400 kg ammonium nitrate per hectare resulted in the greatest plant height. According to Deswal et al. (1983), plants receiving higher N rate (100 kg/ha) and spaced at 30 cm x 45 cm were the tallest. Shah et al. (1984) studied the effect of different levels of nitrogen and phosphorus on growth, flowering and corm yield of gladiolus cv. Vink's Glory. He concluded that increased N rates (24 g/60 x 60 cm^{-2} plot) augmented plant growth and number of leaves/plant.

The effect of Agromin (containing Zn, Mn, Cu, Mg, Fe, B and Mo + 2% N) on growth and flowering of gladiolus was studied by Chaturvedi et al. (1986). Single or double foliar sprays of Agromin at 0, 1000, 2000, 3000 and 4000 ppm were applied to the cv. Sylvia. It was observed that application at 3000 ppm improved plant height and increased the number of leaves. Potti and Arora (1986) studied the effect of N, P and K on growth, flowering, corm and cormel production of gladiolus cv. Sylvia. They obtained the best plant growth with the treatment combination 60 g N + 20 g P + 20 g K.

2.1.2. Spike characters

A disorder affecting gladiolus in Florida, characterised by soft spikes, weak, soft stems and flaccid leaves, was corrected by spraying with a fixed copper compound and scattering 45 lb copper sulphate per acre before planting again. The varieties Valeria and Snow Princess were affected more severely. Soft spikes, caused by insufficient potassium to balance the N supply, were prevented by spraying, as they developed, with 5 lb potassium sulphate or carbonate in 100 gal water (Magie, 1951).

Studies with topple of gladiolus (Fink, 1953) showed that the tendency of gladiolus flowers to break over at the top after having opened partially may be largely prevented by a 2% calcium nitrate spray applied two weeks before flower harvest. Soil treatment with various calcium material achieved little or no effect. In an experiment on foliar nutrition of gladiolus conducted by Sarova (1954) on cv. Picardy, it was observed that foliar application, especially when combined with soil application, extended the flowering period, produced large number of flowers per spike and increased the size of the lower flowers.

Woltz (1954) resorted to sand culture experiments to investigate the nutritional requirement of gladiolus, using commercial sized corms of Elizabeth the Queen and Picardy. Omission of nitrogen was a factor in causing blindness and also reduced the number of florets per spike. In the order of decreasing effect, magnesium, potassium, phosphorus and calcium deficiencies lowered the average floret count and potassium, magnesium, nitrogen and calcium deficiencies resulted in shorter spikes. Potassium and magnesium deficiencies appeared to delay flowering. The weight of spikes was reduced by omission of nitrogen, calcium, phosphorus and magnesium, in that order.

Sand culture experiments showed that flowering size gladiolus corms did not contain sufficient reserves of nitrogen or potassium to produce normal flowers. The reservé of calcium was also inadequate for normal production of flowers (Woltz, 1955). He also suggested that small corms required high levels of nitrogen for optimum production of flowers.

Guttay and Krone (1957), in their studies on the flowering of gladiolus, tried three fertilizer grades, 4-16-4, 4-16-8 and 4-16-16, at four rates,, 100, 250, 500 and 1000 lb per acre, over two seasons, in green house. They concluded that during both the seasons, differences on fertilizer grade had little effect on plant growth. However, during the second season, the 4-16-16 grade produced the highest per cent of plants to blossom as well as the slowest rate of opening of florets. All fertilizer treatments hastened plant maturity in the first season. During the second season, maturity was affected only by the higher rates of fertilization in respect to delaying time of bloom. During the second season all fertilizer treatments increased weight of flower spike and number of florets per spike.

Trials in North Carolina (Jenkins, 1961) showed increased height of spikes following side dressings of potassium sulphate, but no response to nitrogen, manganese or iron fertilizers was obtained. Side dressings of atleast 50 lb available potassium per acre are recommended when the plants first start to send up flower spikes.

Effect of nutritional treatments on flowering and blindness in gladiolus grown from cormels was studied by Kosugi and Kondo. (1961). Flowering was the earliest with the 1N (50 ppm) 2P (50 ppm) 2K (80 ppm) treatment and the latest with the 4N (200 ppm), 1P (25 ppm), 2K (80 ppm) treatment. As the nitrogen application increased, the date of flowering was delayed. The percentage of flowering was highest with 4N (200 ppm), 2P (50 ppm), 2K (80 ppm) and lowest with 4N (200 ppm), 1P (25 ppm), 1K (40 ppm). The percentage of blind stalks was 11.8 in the 4N (200 ppm), 2P (50 ppm), 1K (40 ppm) treatment. Based on another experiment Kosugi and Sano (1961) concluded that percentage of flowering was lower in the plants which did not receive nitrogen.

The number of inflorescences per corm was slightly increased by nitrogen, phosphorus, potassium and combinations of these elements, according to Garibaldi (1964). When potassium was applied alone, the height of the inflorescence was reduced, but nitrogen and phosphorus had the opposite effect. The number of flowers per spike was slightly increased by all treatments and the flowering period was prolonged by nitrogen. Lemeni and Lemeni (1965) found that the highest level of mineral fertilization, namely, 600 kg superphosphate, 300 kg muriate of potash and 400 kg ammonium nitrate per ha, resulted in increased flower number per plant and flower size.

Kantartzis (1966) observed no benefits to flowering by foliar application to gladiolus of a 0.40 per cent solution of XL60 (a 15-30-15 fertilizer with added manganese, copper, iron and boron) or of 0.15 per cent and 1.00 per cent solution of 7-0-29 Agricole (a 39.4-0-8.75 mixture at 80 kg per 0.1 ha.).

The effect of lime on gladiolus was studied by Fernandes and Lima (1974). The plants were treated with ordinary lime and dolomitic lime at 1.5, 3.0 and 4.5 t/ha. Dolomitic lime led to longer spikes than ordinary lime. There were no effect on earliness or number of flower buds per spike.

In an experiment on nitrogen fertilization, sodium nitrate (12 g/m of row) or sulphate of ammonia (10 g/m of row) was applied to gladioli cv. Friendship at different times (Puccinelli and Fernandes, 1974). The earliest flowers were obtained with sodium nitrate surface bands on both sides of the crop row. Motilal et al. (1979) observed a delay in spike emergence with NPK application. Number of buds per spike was not appreciably affected by NPK. Flower spikes were the tallest in plants receiving 25 g urea + 100 g P_2O_5 + 100 g K_2O per square metre.

According to Battacharjee (1981), increasing levels of N advanced the time of flowering and greatly increased spike length. The maximum number of florets per spike and the largest flowers were obtained with 20 g N/m^2. The application of phosphorus and potassium and rising levels of each element tended to improve the flower spike quality.

The effect of various iron containing fertilizers on growth and propagation of Gladiolus grandiflorus was evaluated by Chen et al. (1982). About 95 per cent of the Barjeva 55 (self produced iron enriched peat) treated plants flowered, compared with 79-89 per cent for other treatments and they started flowering a few days earlier. Plants receiving the higher nitrogen rate and spaced at 30 x 45 square inches were tallest and produced the greatest number of florets per spike and corms per plant (Deswal et al., 1983).

Jayaselan (1983) studied the effect of pre-sowing treatments of gladiolus corms on their sprouting, cormel development, growth and flowering. Cormels of cv. Bangalore local, soaked in 2.0 per cent KNO_3 solution for 2-4 hours, sprouted earlier but the treatment had no significant effect on the other indices. According to Borrelli (1984), increasing the nitrogen supply increased the number of flowering shoots. High rates of nitrogen were needed to counteract the decline in spike quality associated with close spacing. Effect of different levels of nitrogen and phosphorus on growth and flowering of gladiolus cv. Vink's Glory was studied by Shah et al. (1984). Increasing nitrogen rates delayed flowering but augmented spike length and the number of florets per spike.

In an outdoor trial with the cultivars Peter Pears, Stardust and Daydream, Plantosan 4D (20 N : 10 P : 15 K : 6 Mg + trace elements) at 0.2 kg/m^2 alone as basal dressing produced the largest number of florets/spike and the longest spikes (Afify, 1985). All treatments delayed flowering in all cultivars compared with the control. Mukhopadhyay (1985) suggested that nitrogen application at 50 g/m^2 significantly improved plant height in cv. Friendship. Days to flowering was delayed at 60 g/m^2 while length of spike improved. The higher doses of phosphorus applied (20 g/m^2) improved spike length.

The effect of Agromin (containing Zn, Mn, Cu, Mg, Fe, B and Mo + 2% N) on growth and flowering of gladiolus was studied by Chaturvedi et al. (1986). Single or double foliar sprays of Agromin at 0, 1000, 2000, 3000 and 4000 ppm were applied to the cv. Sylvia. It was observed that application at 3000 ppm increased the floret size but delayed spike formation. Double sprays at 4000 ppm were most effective for longest duration of flowering with the longest spikes but they delayed the first floret bud emergence and its opening.

Potti and Arora (1986) conducted studies on the effect of N, P and K on growth and flowering of gladiolus cv. Sylvia. The best results were obtained with the treatment combination 60 g N + 20 g P + 20 g K per square metre. Mukhopadhyay and Bankar (1987) reported that addition of nitrogenous and phosphatic fertilizers at the rate of 10 g and 40 g/m^2 respectively were found to be optimum for growth and flowering of cv. Friendship. For Vink's Glory, 40 or 50 g N/m^2 was found good for floret size. Phosphorus application at the rate of 20 g/m^2 significantly improved spike length.

According to Seth and Lal (1987) use of excessive nitrogen results in delayed flowering. Gowda et al. (1988) studied the effect of N and P on flowering in gladiolus cv. Debonair. Plants were given N and P, each at 20, 30 or 40 g/m^2 and K at 20 g/m^2 as basal dressing. A large floret diameter (9.0 cm), the highest number of florets per plant (14.6) and the greatest spike length (89.7 cm) were obtained with the highest NP rates.

Aouichaoui and Tissaoui (1989) studied the effect of mineral nutrition on flowering of hybrid gladiolus cultivars grown under plastic green house. The corms were planted in early November and on third December and KNO_3 at 25 g/m^2 was applied at weekly intervals until 24 April. With the K treatment, 100 per cent flowering in all cultivars (Peter Pears, Hunting Song, Cordula, Flower Song, Trader Horn) and good stem lengths were obtained.

2.1.3. Vase life

Nitrogen fertilizers placed in the soil at a depth of 8-10 cm, together with phosphorus fertilizers placed at a depth of 25-30 cm, had most favourable effect on the quality and length of life of gladiolus flowers (Mantrova and Zdasjuk, 1958). NK, K and NPK aided sugar synthesis which was most intensive during flowering. Deswal and Patil (1983) worked the influence of soil fertility and induction media on vase life of spikelets of Gladiolus grandiflora. The cut spikes were placed for 10 days in water or in a preservative solution containing 6 per cent sucrose + 650 ppm aluminium sulphate + 50 ppm silver nitrate. Vase life was found to be the longest in spike from plots receiving nitrogen at 100 kg/ha but no P and K and held in the preservative solution. Based on another study Anserwadekar and Patil (1986), reported that nitrogen had a significant effect on vase life, with spikes from the lowest nitrogen treatment having the largest number of open florets per spike.

2.1.4. Corm and cormel yield

Woltz (1955), based on sand culture experiments, suggested that smaller corms required higher levels of nitrogen for optimum production of corms. But rotting caused by Fusarium was increased by high nitrogen ratios. Guttay and Krone (1957), based on their studies on the effect of rates of different fertilizers on the corm production of gladiolus over two seasons, concluded that higher fertilization rates (500 and 1000 lb per acre) produced significantly higher yields of corms in the first season. During the second season, there was little difference in the yield of corms.

Trials in North Carolina on a sandy loam soil showed increased corm yields following side dressings of potassium sulphate, but no response to nitrogen, manganese or iron fertilizers (Jenkins, 1961). Kosugi and Kondo (1961) studied the effect of nutritional treatments in gladiolus grown from cormels. Root weight and number of cormels formed decreased with increasing nitrogen. 2N (100 ppm) gave the heaviest cormels. Fernandes and Lima (1974) studied the effect of lime on gladiolus. They used ordinary lime and dolomitic lime at 1.5, 3.0 or 4.5 t/ha. At the highest rate, both kinds of lime increased the number of corms and cormels, without affecting their average weight. In an experiment on nitrogen fertilization, sodium nitrate (12 g/m of row) or sulphate of ammonia (10 g/m of row) was applied to gladioli cv. Friendship at different times (Puccinelli and Fernandes, 1974). It was found that delaying nitrogen application increased the weight of corms and cormels.

A trial was conducted on fertilizing to increase the size of gladiolus corms, by Cirrito (1976). He reported that the ideal N, P_2O_5 and K_2O formulation for corm enlargement dependend on the cultivar. While the ideal level for Eurovision was 50 : 328 : 58 kg/1000 m^2, for Tequendama it was 60 : 240 : 42 kg/1000 m^2. Somewhat different fertilizer treatments were optimal for cormel production. For the cv. Spic and Span the optimum formulation was 60 : 50 : 60 kg/1000 m^2. Shoushan et al. (1980) studied the effect of planting date and chemical fertilization on corm development in gladiolus. Corms were planted monthly from April to November, some plots being fertilized with NPK, NP, NK or N (providing 25 per cent N, 5 per cent P_2O_5 and 5 per cent K_2O, applied monthly, at 12.5 g/m^2. The later the planting date, the longer the growing period, but at each date N or NPK fertilizer treatment shortened the growing period. All fertilizer treatments increased corm size, fresh and dry weights, NK being the best for all the three parameters. Planting date had little effect on corm size.

According to Battacharjee (1981), increasing levels of N greatly increased corm weight and size and number of cormels per plant. The application of phosphorus and potassium and rising levels of each element tended to improve corm growth and cormel production. Chen et al. (1982) studied the effect of various iron containing fertilizers on growth and propagation of Gladiolus grandiflorum and concluded that about 95 per cent of the Bar-Teva 55 (self produced iron enriched peat) treated plants produced more number of cormels per corm.

High rates of N were needed to counteract the decline in corms and cormel sizes associated with close spacing (Borrelli, 1984). Shah et al. (1984) studied the effect of different levels of nitrogen and phosphorus on corm yield of gladiolus cv. Vink's Glory. Corm weight and number per plot were highest with N : P_2O_5 at 18 : 12 g per plot (60 x 60 cm^2) and the number of cormels and cormel weight per plot were highest with N : P_2O_5 at 12 : 12 g per plot. Afify (1985) reported that Plantosan 4 D (20 N : 10 P : 15 K : 6 Mg + trace elements) at 0.2 kg/m^2 alone as basal dressing produced the greatest fresh and dry corm weights.

The effect of N, P and K on corm and cormel production in gladiolus cv. Sylvia was studied by Potti and Arora (1986). The best results were obtained with the treatment combination 60 g N + 20 g P + 20 g K/m^2. Mukhopadhyay and Bankar (1987) reported that heavier corms were obtained with the application of 30 g P_2O_5/m^2.

2.2. Effect of growth regulators

2.2.1. Growth parameters

Tonecki (1979) studied the effect of growth and shoot apex differentiation in Gladiolus hortorum cv. Acca Laurantia. Gladiolus corms were soaked for 24 hours in IAA, IBA, NAA, GA_3 or Kinetin each at 100, 500, 1000 and 2000 ppm, prior to planting. All treatments inhibited early growth except GA_3, which stimulated corm sprouting. The final effect of GA_3, however was to decrease leaf length. Kinetin, IBA and 100 ppm NAA increased leaf length, compared to the controls.

Soaking of corms in Colchicine at 200 ppm for 6 hours increased plant height and number of leaves (El. Meligy, 1981). According to Battacharjee (1984) GA_3 at 10 and 100 ppm increased vegetative growth. Spraying 3 times with GA_3 100 ppm increased plant height and the number of leaves (Dua et al., 1984). RoyChoudhuri et al. (1985) reported that Kinetin at 25 ppm gave the greatest increase in plant height and number of leaves.

Hwang et al. (1986) studied the influence of Paclobutrazol on growth and flowering of pot grown gladiolus (Gladiolus gandavensis). Paclobutrazol was applied at the 2 leaf or at the 4 leaf stage, either as a soil drench at the rate of 0-10 mg/15 cm diameter plot or as a foliar spray at 0-100 ppm. They observed that plant height for Hunting Song was reduced more by treatments at the 2-leaf than at the 4-leaf stage, whereas Spic and Span showed no difference in response. Soil application at the highest concentration produced the shortest plants, especially with treatment at the 2-leaf stage.

Suh and Kwack (1986) observed that NAA 20 ppm and ethychlozate 100 ppm induced sprouting of corms and increased the rate of stem growth. Mukhopadhyay and Bankar (1987), based on pot culture experiment with GA_3 on Friendship, reported that GA_3 at all concentrations (10, 50, 100, 250 and 500 ppm) improved plant height. There was hardly any effect of ethrel on vegetative growth. Soaking corms in Ethrel (100 or 200 ppm) for 6 hours was reported (Roy Choudhury, 1989) to inhibit plant growth.

Based on a study on the effect of Benzyl Amino Purine (BAP) and Triadimefom (TAF), Murali (1988) reported that plants from BAP (30, 60 and 90 ppm) or TAF (100, 1000 and 10,000 ppm) dipped corms were dwarfer. An increase in concentration further reduced the plant height. Number of leaves and leaf area per plant were reduced with higher concentrations of TAF. Increase in BAP concentration on the other hand, increased the leaf area.

2.2.2. Spike characters

Responses of auxins on flower production in gladiolus was studied by Sharga (1979). He reported that IAA and IBA concentrations of more than 50 ppm had a negative effect. The best results with regard to time taken to flower (92.85 days), duration of flowering (16.21 days), spike length (59.95 cm) and number of flowers/spike (14.6) were obtained with NAA at 50 ppm.

According to El-Meligy (1981), soaking the corms with colchicine solution at 200 ppm for six hours was reported to increase plant height and number of leaves. El-Meligy (1982b) further studied the effect of soaking of gladiolus cormels in GA_3 at 500 ppm + irradiation at 1000 rad. He reported that flower colour was deeper in the treated plants due to a higher anthocyanin content. In another experiment, El-Meligy (1982a) studied the effect of cold storage for 50-150 days, followed by soaking in IBA at 0-1000 ppm for 24 hours. It was observed that there was no significant effect on flower quality.

Auge (1982) reported that GA treated corms flowered 10 days earlier than the untreated corms. The post emergence sprays with GA advanced flowering in about half the treated plants. In another trial, the effect of soil drench application of CCC (chloremquat) and B-Nine (daminozide), each at 1000, 2500 and 5000 ppm, Ethrel (ethephon) at 500, 1000 and 2000 ppm and IAA, GA_3 and NAA, each at 10, 100 and 1000 ppm was studied on growth, and flowering of cv. Friendship (Battacharjee, 1984). GA_3 at 10 and 100 ppm stimulated flower stalk and rachis length, accelerated floret size and number per spike and lengthened the life of the spike. Marked improvements in flowering was obtained with 100 ppm IAA. Application of CCC, B-Nine and ethrel generally increased flower size and IAA, GA_3 and NAA at 10 and 100 ppm increased the number of flowers per spike.

Dua et al. (1984) reported that spraying with GA_3 at 50, 100 or 200 ppm improved spike quality in terms of number and size of flowers. In most cases a concentration of 100 ppm, applied three times, was the most effective spray treatment. In a report of IIHR (1984), it is stated that GA_3 spray at 10 or 50 ppm concentration helped in accelerating flowering in gladiolus.

Corms treated with ethylene, camporan (ethephon) or heat, shortened dormancy and advanced flowering of the cv. Newmoon forced in artificial light. Ethephon, applied at 0.05 per cent for 30 minutes, was the most effective treatment (Mukhamed, 1985). Roy Choudhuri et al. (1985) reported that, ethephon at 100 ppm increased flower size and length of flower stalk. In pot culture experiments with GA_3 on cv. Friendship, GA_3 soaking at lower concentrations (10 or 50 ppm) accelerated the flowering date (Mukhopadhay and Banker, 1987). There was hardly any effect of ethrel (0, 50, 100, 250, 500 and 1000 ppm) on flowering.

Roy Choudhary (1989) studied the effect of plant spacing and growth regulators on growth and flower yield of gladiolus grown under polythene tunnel. Corms were soaked for 6 hours in GA_3 (50 or 100 ppm), ethrel (100 or 200 ppm) or kinetin (25 or 50 ppm), before planting. Treatment with kinetin increased the number of florets per spike and flower size, especially at the lower planting density.

2.2.3. Corm and cormel yield

The effect of auxins on cormel production in gladiolus was studied by Sharga (1979). He reported that the number of cormels per plant was greatest in plants treated with NAA at all the levels (50, 100, 200 and 500 ppm). Based on a study on the effect of colchicine on the corm production of gladiolus, El-Meligy (1981) reported that soaking the corms in colchicine solution at 200 ppm for six hours increased corm and cormel weight. The effect of cold storage periods and growth regulators on the production of gladiolus corms and cormels was studied by El-Meligy (1982a). Cormels of cv. Eurovision stored at 5 to 7°C for 50 days followed by soaking in IBA at 500 ppm for 24 h had a beneficial effect on corm production. El-Meligy (1982b) further studied the effect of Gibberellin and radiation on corm production in cv. Eurovision. He reported that soaking in GA_3 at 500 ppm + irradiation at 1000 rad gave a cormel yield 1.5 times greater than in the control.

The effect of soil drench application CCC and B9, each at 1000, 2500 and 5000 ppm, ethrel at 500, 1000 and 2000 ppm and IAA, GA_3 and NAA, each at 10, 100 and 1000 ppm on corm and cormel formation of cv. Friendship was studied by Bhattacharjee (1984). GA_3 at 10 and 100 ppm improved corm size and weight and induced more cormel production. Marked improvement on flowering was obtained with 100 ppm IAA.

The number and quality of corms and cormels produced were enhanced by spraying with GA_3 at 50, 100 or 200 ppm (Dua et al., 1984). The maximum number of corms and cormels resulted from either in three fold GA_3 spray or a pre-planting dip at 100 ppm + spraying at 100 ppm at 30 days interval. Based on another study, Roy Chaudhuri et al. (1985) reported that kinetin at 25 ppm gave the greatest increase in corm weight.

Hwang et al. (1986) studied the influence of paclobutrazol on corm and cormel production in gladiolus. Paclobutrazol was applied at the two leaf or at the four leaf stage, either as a soil drench at 0-10 mg/pot or as a foliar spray at 0-100 ppm. The fresh weight of the new corms produced was increased by foliar application, but the various treatments had no effect on the number of cormels produced. In another study, pre-planting soaking of corm in gibberellic acid was found to reduce the number of cormels/plant but to increase cormel weight per plant, irrespective of the concentrations (0, 10, 50, 100, 250 and 500 ppm) used (Mukhopadhyay and Bankar, 1987).

Ancymidol (10 ppm) was reported to increase corm weight but had no effect on the number of cormels, whereas paclobutrazol (upto 100 ppm) increased corm weight and decreased the number of cormels (Suh and Kwack, 1986). In a 5-year trial on cut flower production with hybrid cultivar Psittacinus, the corms were soaked for 6 hours in GA_3 (50 or 100 ppm), ethrel (100 or 200 ppm) or kinetin (25 or 50 ppm), before planting (Roy Choudhury, 1989). The higher planting density increased the yield of corms per unit area. Ethrel markedly increased corm yield.

Materials and Methods

MATERIALS AND METHODS

The experiment was conducted at the College of Horticulture, Vellanikkara, during 1989-90. The investigations were carried out with a view to study the effect of certain growth regulators and nutrients on the qualities of spike of gladiolus, with special reference to vase life. The other objectives were to study the effect of season of planting on the quality and yield of gladiolus and to evaluate the varieties suitable for growing under Vellanikkara conditions.

3.1. Season

The studies were conducted during the periods, November 1989 to April 1990 and April 1990 to September 1990. First crop was planted on November 15th, 1989. Harvesting of flowers was started by February and continued upto March end (70 to 125 days after planting, depending on duration). Corms and cormels were lifted from the field in April, 1990. Second crop was planted on 6th April, 1990. Harvesting of flowers was started by June and continued upto August. Corms and cormels were collected from the field in the month of September, 1990.

3.2. Varieties

Five varieties of gladiolus procured from Bangalore were used for the experiment which are listed below:

V_1 Agnirekha

V_2 American Beauty

V_3 Friendship

V_4 Mansoer Red

V_5 True Yellow

3.3. Treatments

3.3.1. Growth regulators

Two growth promoters and two growth inhibitors were tried.

3.3.1.1. Growth promoters

i) Naphthalein acetic acid (NAA)

Levels: 100 ppm, 200 ppm

ii) Gibberellic acid (GA)

Levels: 50 ppm, 100 ppm

3.3.1.2. Growth inhibitors

i) 2,3,5 - tri iodo benzoic acid (TIBA)

Levels: 150 ppm, 300 ppm

ii) 2 - chloro ethyl trimethyl ammonium chloride (CCC)

Levels: 250 ppm, 500 ppm

3.3.2. Nutrients

Nitrate and sulphate of two nutrient elements, calcium and potassium, were tried.

3.3.2.1. Calcium

i) Calcium nitrate

Levels: 0.5%, 1.0%

ii) Calcium sulphate

Levels: 0.5%, 1.0%

3.3.2.2. Potassium

i) Potassium nitrate

Levels: 0.5%, 1.0%

ii) Potassium sulphate

Levels: 0.5%, 1.0%

Thus there were 17 treatments in total, which are listed below:

T_1	Control
T_2	TIBA 150 ppm
T_3	TIBA 300 ppm
T_4	NAA 100 ppm
T_5	NAA 200 ppm
T_6	CCC 250 ppm
T_7	CCC 500 ppm

T_8 GA 50 ppm

T_9 GA 100 ppm

T_{10} $Ca(NO_3)_2$ 0.5%

T_{11} $Ca(NO_3)_2$ 1.0%

T_{12} $CaSO_4$ 0.5%

T_{13} $CaSO_4$ 1.0%

T_{14} KNO_3 0.5%

T_{15} KNO_3 1.0%

T_{16} K_2SO_4 0.5%

T_{17} K_2SO_4 1.0%

The treatments were imposed as foliar spray. Distilled water was sprayed for control plants.

Time of application of treatments

i) Four weeks after planting

ii) Six weeks after planting

iii) Eight weeks after planting

3.4. Experimental design

The experiment was laid out in a completely randomised design with five varieties and 17 treatments. Each treatment had 10 plants from which three plants were randomly selected for recording field observations. For conducting vase studies (post harvest observations) three randomly selected spikes from each treatment were cut.

3.5. Preparation of land

A piece of land left fallowed for many years was used for raising the crop. The area was cleared, levelled and ploughed to a fine tilth. Fine beds of width 1.5 m and length 8.5 m were prepared.

3.6. Preparation of planting material

Uniform sized corms were taken as the planting material. These corms were soaked in 0.2 per cent Bavistin for half an hour before planting.

3.7. Planting

Corms were planted at a spacing of 20 cm between rows and 30 cm between plants in a row. Mulching was provided soon after planting.

3.8. Cultural management

3.8.1. Fertilizers

At the time of land preparation, dried cowdung was applied at the rate of 25 tonnes/ha. The fertilizer dose followed was 100: 60:60 kg NPK/ha (NESA, 1970). Of the above dose, 50 kg N, 60 kg P_2O_5 and 60 kg K_2O/ha were applied as basal dose.

Top dressing with 25 kg N/ha was given twice, 45 days after planting and when harvesting of flower spikes was completed.

3.8.2. Plant protection measures

Soil drenching with Bavistin (0.2%) was done three times as follows:

Two weeks after planting

Eight weeks after planting

After the harvest of spikes

3.8.3. Other operations

The beds were given soaking irrigation every morning. Plants were staked at the time of spike emergence and earthed up. Weeding was also done occassionally.

3.9. Harvesting

3.9.1. Spikes

At flowering three spikes from each treatment were taken when the first floret showed colour, for conducting vase studies. The spikes kept on the plant for taking other floral observations were harvested after the blooming period.

3.9.2. Corms

After the harvest of flowers, plants were left undisturbed until the leaves dried. Corms were then lifted and the cormels also were collected. After taking observations, they were treated with Bavistin (0.2%) for half an hour, dried under shade and stored.

3.10. Observations

Three plants were selected at random from each treatment for recording biometric observations. The observations recorded were the following:

3.10.1. Growth parameters

Growth parameters were recorded at six weeks and eight weeks after planting, just before the application of chemicals.

3.10.1.1. Plant height

The height of the plants was measured from the collar region to the tip of the topmost leaf and expressed in cm.

3.10.1.2. Number of leaves

The total number of leaves borne on the plant was counted and recorded.

3.10.1.3. Total leaf area

The length and width of each leaf was measured. Area of each leaf was computed using the following formula suggested by Rajeevan et al. (unpublished).

$$\text{Leaf area} = l \times b \times 0.635 + 12.9$$

where l = length and b = breadth

The sum of leaf area of individual leaves gave the total leaf area of the plant which was recorded as square cm.

3.10.1.4. Duration from planting to spike emergence

Number of days taken from the planting of corms to the appearance of spike was recorded.

3.10.1.5. Duration from spike emergence to opening

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

3.10.1.6. Blooming period

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

3.10.1.7. Total duration

Number of days taken from planting to the opening of the last floret was recorded which was computed by adding the duration from planting to spike emergence, from spike emergence to opening and the blooming period.

3.10.2. Spike characters

3.10.2.1. Length of the spike

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

3.10.2.2. Diameter of the spike

Diameter of the spike just below the basal floret was measured and expressed in cm.

3.10.2.3. Length of the rachis

Length of the rachis was measured from the first basal floret to the last floret in a spike and expressed in cm.

3.10.2.4. Number of florets per spike

Total number of florets per spike was counted and recorded.

3.10.2.5. Length of the floret

Length of the floret was measured from the base to the tip of the second floret and expressed in cm (ICAR, 1988-89).

3.10.2.6. Size of the floret

Diameter of the second floret was measured and expressed in cm (ICAR, 1988-89).

3.10.3. Vase characters

At flowering three spikes from each treatment were taken for recording the vase characters.

3.10.3.1. Fresh weight of the spike

Weight of the spike was taken soon after harvesting and expressed in g.

3.10.3.2. Vase life

The point of termination of vase life varies from the first sign of wilting or fading to the death of all flowers with all the intermediate values between these points (Helevy and Mayak, 1979). In the study, number of days from the opening of the first floret to the drying of the last fully opened floret was recorded.

3.10.3.3. Percentage of fully opened florets

Number of fully opened florets was counted and expressed as the percentage of the total florets.

3.10.3.4. Percentage of partially opened florets

Number of partially opened florets was counted and expressed as the percentage of the total florets.

3.10.3.5. Percentage of unopened floret

Number of unopened florets was counted and expressed as the percentage of the total florets.

3.10.3.6. Longevity of individual floret

Duration from opening to drying of each floret was recorded, and expressed in days.

3.10.3.7. Number of florets opened at a time

Number of florets opened at the time when the first floret started wilting was counted and recorded.

3.10.3.8. Nature of bending

Days taken in the vase for bending/breaking the floral stem was recorded. Position of breakage was also recorded and expressed as the number of florets below the point of break.

3.10.3.9. Water uptake

The spike was placed in a conical flask containing measured quantity of water. The quantity of water left in the flask after the removal of spike on the last day in vase was also measured. The difference gave the water uptake, which was expressed in ml.

3.10.4. Corm and cormel yield

The corms and cormels were collected separately from each plant and the following observations were recorded.

3.10.4.1. Weight of the corms

Harvested corms were cleaned weighed and expressed, in g.

3.10.4.2. Size of the corms

Volume of the corms was recorded by immersing them in a measuring cylinder containing water and expressed in cc.

3.10.4.3. Number of cormels per plant

Cormels collected from each plant were counted and recorded.

3.10.4.4. Weight of cormels

Cormels from each observation plant were collected, weighed and recorded in g.

3.11. Interpretation of data

The data generated from the study were subjected to analysis of variance using the methods suggested by Panse and Sukhatme (1985). In order to compare the effect of seasons and varieties, graphical representations of the selected characters (Leaf area, Duration from planting to spike emergence, Blooming period, Total duration, Length of the spike, Number of florets per spike, Fresh weight of the spike, Vase life, Number of florets opened at a time, Weight of corms and Weight of cormels) were made, irrespective of the treatments employed.

Results

RESULTS

Studies were conducted at the College of Horticulture, Vellanikkara during 1989-90 to examine the effect of different nutrients and growth regulators on spike qualities of gladiolus in two seasons. Five varieties, viz., Agnirekha, American Beauty, Friendship, Mansoer Red and True Yellow were used for conducting the trial. The results of the experiment are presented in this chapter.

4.1. Growth parameters

4.1.1. Plant height

4.1.1.1. Agnirekha

During the first season the influence of growth regulators and nutrients was significant at eight weeks after planting (Table 1). T_{16} (K_2SO_4 0.5%) was found to be the best treatment (50.30 cm) which was on par with T_{17} (K_2SO_4 1.0%) and T_6 (CCC 250 ppm). T_1 (control) recorded the least height (35.00 cm).

The treatment could exert significant influence in this variety both at six weeks and at eight weeks after planting during the second season (Table 2). T_{17} (K_2SO_4 1.0%) was found to be the best treatment (26.13 cm) at six weeks after planting, which was on par with T_{15} (KNO_3 1.0%), T_{12} ($CaSO_4$ 0.5%), T_2 (TIBA 150 ppm), T_4 (NAA 100 ppm)

Table 1

Effect of treatments on the growth parameters of gladiolus cv. Agnirekha during first season

Treatment		Plant height (cm)		Number of leaves		Leaf area (cm^2)	
		6th week after planting	8th week after planting	6th week after planting	8th week after planting	6th week after planting	8th week after planting
T_1	Control	31.87	35.00	4.67	7.00	254.63	386.83
T_2	TIBA 150 ppm	38.40	41.90	4.67	6.67	237.23	422.43
T_3	TIBA 300 ppm	39.00	42.00	4.67	7.67	228.10	512.10
T_4	NAA 100 ppm	37.73	41.57	5.33	7.33	299.30	553.20
T_5	NAA 200 ppm	33.57	37.73	5.00	7.00	229.93	431.53
T_6	CCC 250 ppm	41.67	46.60	5.00	8.00	275.40	496.67
T_7	CCC 500 ppm	36.90	43.83	4.67	6.33	234.70	450.97
T_8	GA 50 ppm	35.17	42.67	4.33	6.67	234.37	429.50
T_9	GA 100 ppm	39.33	45.07	4.33	6.67	236.07	492.83
T_{10}	$Ca(NO_3)_2$ 0.5%	38.90	42.30	4.67	7.00	237.30	509.50
T_{11}	$Ca(NO_3)_2$ 1.0%	41.80	44.50	5.00	7.00	268.47	491.23
T_{12}	$CaSO_4$ 0.5%	39.57	40.67	4.00	6.67	197.73	398.93
T_{13}	$CaSO_4$ 1.0%	38.57	43.93	4.67	7.00	240.60	466.47
T_{14}	KNO_3 0.5%	33.17	44.00	4.00	6.33	206.43	430.57
T_{15}	KNO_3 1.0%	40.37	43.80	4.67	7.67	250.17	509.23
T_{16}	K_2SO_4 0.5%	44.93	50.30	5.33	7.67	330.13	602.47
T_{17}	K_2SO_4 1.0%	38.57	48.30	4.00	6.00	288.57	586.40
	CD (0.05)	NS	4.24	NS	NS	NS	86.35
	SEm±	2.51	1.47	0.43	0.53	32.80	30.05

Table 2

Effect of treatments on growth parameters of gladiolus cv. Agnirekha during second season

Treatment		Plant height (cm)		Number of leaves		Leaf area (cm^2)	
		6th week after planting	8th week after planting	6th week after planting	8th week after planting	6th week after planting	8th week after planting
T_1	Control	12.17	23.43	2.33	2.67	67.10	79.67
T_2	TIBA 150 ppm	22.80	37.17	1.67	3.33	52.60	127.53
T_3	TIBA 300 ppm	4.83	16.20	2.33	2.00	48.27	59.80
T_4	NAA 100 ppm	18.63	29.33	1.67	3.00	43.47	106.07
T_5	NAA 200 ppm	9.47	17.00	1.33	2.00	34.13	44.90
T_6	CCC 250 ppm	4.87	21.00	2.33	2.67	45.67	82.33
T_7	CCC 500 ppm	16.90	29.83	2.00	3.67	57.00	115.87
T_8	GA 50 ppm	15.00	22.67	1.00	2.33	21.50	76.23
T_9	GA 100 ppm	15.47	27.83	1.67	2.33	31.10	72.83
T_{10}	$Ca(NO_3)_2$ 0.5%	9.83	27.83	1.67	1.67	38.33	58.37
T_{11}	$Ca(NO_3)_2$ 1.0%	8.87	30.80	2.33	2.67	72.67	103.17
T_{12}	$CaSO_4$ 0.5%	22.97	34.00	1.67	3.33	67.97	116.73
T_{13}	$CaSO_4$ 1.0%	12.23	20.97	2.00	3.00	48.80	102.53
T_{14}	KNO_3 0.5%	7.70	22.17	2.00	1.33	76.97	36.77
T_{15}	KNO_3 1.0%	24.27	32.50	2.00	3.33	62.97	110.70
T_{16}	K_2SO_4 0.5%	13.37	29.20	1.33	3.00	39.93	115.37
T_{17}	K_2SO_4 1.0%	26.13	41.38	1.67	3.33	84.50	152.80
	CD (0.05)	10.00	13.80	NS	NS	NS	NS
	SEm±	3.48	4.80	0.45	0.54	21.72	27.09

and T_7 (CCC 500 ppm). T_3 (TIBA 300 ppm) recorded the least height (4.83 cm). At eight weeks after planting also, T_{17} (K_2SO_4 1.0%) recorded maximum height (41.38 cm) which was on par with T_2 (TIBA 150 ppm), T_{12} ($CaSO_4$ 0.5%), T_{15} (KNO_3 1.0%), T_{11} ($Ca(NO_3)_2$ 1.0%), T_7 (CCC 500 ppm), T_4 (NAA 100 ppm), T_{16} (K_2SO_4 0.5%), T_9 (GA 100 ppm) and T_{10} ($Ca(NO_3)_2$ 0.5%). Here also T_3 (TIBA 300 ppm) recorded the least height (16.20 cm).

4.1.1.2. American Beauty

The treatments showed significant influence in this variety at eight weeks after planting during the first season (Table 3). T_{17} (K_2SO_4 at 1.0%) produced maximum height (60.43 cm) and T_7 (CCC 500 ppm) the minimum (43.53 cm). T_{17} was found to be on par with T_{16} (K_2SO_4 0.5%), T_8 (GA 50 ppm), T_{13} ($CaSO_4$ 1.0%), T_{12} ($CaSO_4$ 0.5%), T_{15} (KNO_3 1.0%) and T_2 (TIBA 150 ppm) and significantly superior to all other treatments. During the second season, the influence of the treatments was insignificant (Table 4).

4.1.1.3. Friendship

During the first season, the treatments had significant influence on the height of the plants in this variety at eight weeks after planting (Table 5). T_9 (GA 100 ppm) gave maximum height to the plants (53.87 cm) and T_{14} (KNO_3 0.5%) the minimum (39.07 cm). T_9 (GA 100 ppm) was found to be on par with T_{16} (K_2SO_4 0.5%), T_8 (GA 50 ppm), T_{13} ($CaSO_4$ 1.0%) and T_{17} (K_2SO_4 1.0%).

Table 3

Effect of treatments on the growth parameters of gladiolus cv. American Beauty during first season

Treatment		Plant height (cm)		Number of leaves		Leaf area (cm^2)	
		6th week after planting	8th week after planting	6th week after planting	8th week after planting	6th week after planting	8th week after planting
T_1	Control	41.10	51.97	4.33	7.00	248.50	559.60
T_2	TIBA 150 ppm	41.27	53.23	3.67	6.67	272.43	681.37
T_3	TIBA 300 ppm	34.03	52.13	5.33	7.33	326.70	662.76
T_4	NAA 100 ppm	43.33	48.27	4.33	6.00	266.77	517.13
T_5	NAA 200 ppm	47.00	52.93	5.33	8.00	402.07	744.60
T_6	CCC 250 ppm	36.00	44.90	5.00	8.00	360.73	767.13
T_7	CCC 500 ppm	33.20	43.53	3.67	6.33	185.87	479.67
T_8	GA 50 ppm	42.07	56.20	5.33	8.00	401.27	804.93
T_9	GA 100 ppm	42.80	52.97	4.00	6.67	261.40	634.33
T_{10}	$Ca(NO_3)_2$ 0.5%	41.20	51.53	4.67	7.67	380.20	782.63
T_{11}	$Ca(NO_3)_2$ 1.0%	37.37	44.20	4.00	6.00	223.17	503.73
T_{12}	$CaSO_4$ 0.5%	45.20	54.37	5.33	7.67	322.40	672.60
T_{13}	$CaSO_4$ 1.0%	36.93	55.77	4.67	6.67	269.07	659.93
T_{14}	KNO_3 0.5%	44.17	50.60	5.00	7.33	336.13	726.30
T_{15}	KNO_3 0.1%	46.50	54.07	4.67	7.33	343.13	730.27
T_{16}	K_2SO_4 0.5%	44.53	56.80	4.67	7.33	373.93	782.50
T_{17}	K_2SO_4 1.0%	46.67	60.43	5.00	8.00	416.60	880.23
	CD (0.05)	NS	7.30	NS	NS	NS	163.69
	SEm±	3.74	2.55	0.48	0.58	52.56	56.96

Table 4

Effect of treatments on growth parameters of gladiolus cv. American Beauty during second season

Treatment		Plant height (cm)		Number of leaves		Leaf area (cm^2)	
		6th week after planting	8th week after planting	6th week after planting	8th week after planting	6th week after planting	8th week after planting
T_1	Control	41.40	57.23	3.33	6.00	138.63	378.07
T_2	TIBA 150 ppm	39.30	62.83	4.00	6.33	193.67	417.43
T_3	TIBA 300 ppm	42.73	63.17	4.33	6.00	199.67	392.83
T_4	NAA 100 ppm	37.03	57.17	4.00	6.00	186.23	336.80
T_5	NAA 200 ppm	39.33	59.17	4.33	7.00	226.63	451.03
T_6	CCC 250 ppm	50.67	72.00	4.67	7.33	241.60	537.97
T_7	CCC 500 ppm	37.33	56.40	4.00	6.33	175.97	352.27
T_8	GA 50 ppm	42.97	59.17	4.67	6.67	193.63	410.20
T_9	GA 100 ppm	49.83	70.17	4.67	7.67	245.17	577.90
T_{10}	$Ca(NO_3)_2$ 0.5%	38.67	46.17	3.67	5.00	173.80	272.27
T_{11}	$Ca(NO_3)_2$ 1.0%	39.00	60.00	4.00	6.33	194.03	396.40
T_{12}	$CaSO_4$ 0.5%	41.77	62.33	4.00	6.33	204.37	444.83
T_{13}	$CaSO_4$ 1.0%	42.93	56.00	4.00	6.33	184.33	357.13
T_{14}	KNO_3 0.5%	45.83	62.50	4.33	6.33	222.27	441.53
T_{15}	KNO_3 1.0%	40.77	63.67	4.33	7.00	213.90	439.63
T_{16}	K_2SO_4 0.5%	42.07	64.00	4.67	6.33	189.23	392.83
T_{17}	K_2SO_4 1.0%	42.80	62.33	4.33	6.67	189.53	401.07
	CD (0.05)	NS	NS	NS	NS	NS	NS
	SEm±	3.39	5.43	0.39	0.55	31.44	60.94

Table 5

Effect of treatments on growth parameters of gladiolus cv. Friendship during first season

Treatments		Plant height (cm)		Number of leaves		Leaf area (cm^2)	
		6th week after planting	8th week after planting	6th week after planting	8th week after planting	6th week after planting	8th week after planting
T_1	Control	31.67	44.90	2.67	5.67	163.30	467.23
T_2	TIBA 150 ppm	24.77	40.83	2.33	4.67	95.80	374.93
T_3	TIBA 300 ppm	38.60	41.53	3.67	6.67	263.00	636.47
T_4	NAA 100 ppm	22.07	39.20	2.00	4.33	67.80	285.67
T_5	NAA 200 ppm	25.00	42.40	2.00	4.00	73.93	318.20
T_6	CCC 250 ppm	18.77	40.83	2.00	4.00	102.50	337.83
T_7	CCC 500 ppm	32.10	46.70	2.67	5.00	146.50	436.23
T_8	GA 50 ppm	30.77	49.43	3.00	4.67	182.93	434.57
T_9	GA 100 ppm	42.53	53.87	3.67	6.33	291.60	596.33
T_{10}	$Ca(NO_3)_2$ 0.5%	34.73	42.47	3.00	6.33	194.50	595.83
T_{11}	$Ca(NO_3)_2$ 1.0%	33.37	46.93	2.00	4.67	119.27	444.70
T_{12}	$CaSO_4$ 0.5%	30.13	46.30	2.33	5.00	135.10	446.47
T_{13}	$CaSO_4$ 1.0%	37.47	48.47	3.00	5.67	206.13	507.60
T_{14}	KNO_3 0.5%	22.73	39.07	2.00	4.00	166.10	493.07
T_{15}	KNO_3 1.0%	26.73	44.83	1.67	4.33	83.93	414.17
T_{16}	K_2SO_4 0.5%	40.67	53.23	3.67	6.33	245.87	576.73
T_{17}	K_2SO_4 1.0%	39.73	48.23	3.33	5.67	238.23	502.10
	CD (0.05)	NS	6.93	NS	1.82	NS	198.67
	SEm±	5.21	2.41	0.57	0.61	56.38	69.14

During the second season the treatments exerted significant influence in this variety, only at six weeks after planting (Table 6). At this stage, T_{12} ($CaSO_4$ 0.5%) was found to be the best (39.77 cm) and T_9 (GA 100 ppm) the least effective (8.67 cm). T_{12} was on par with T_{10} ($Ca(NO_3)_2$ 0.5%), T_{17} (K_2SO_4 1.0%), T_{13} ($CaSO_4$ 1.0%), T_3 (TIBA 300 ppm), T_2 (TIBA 150 ppm), T_{16} (K_2SO_4 0.5%), T_7 (CCC 500 ppm), T_4 NAA 100 ppm), T_6 (CCC 250 ppm), T_8 (GA 50 ppm), T_{14} (KNO_3 0.5%), T_1 (control) and T_5 (NAA 200 ppm).

4.1.1.4. Mansoer Red

The influence of the treatments on the height of the plants was insignificant in this variety during the first season (Table 7).

During the second season the treatments exerted significant influence in this variety, at eight weeks after planting (Table 8). At this stage, T_{17} (K_2SO_4 1.0%) produced the tallest plants (56.80 cm) and T_{13} ($CaSO_4$ 1.0%), the shortest (29.37 cm). T_{17} (K_2SO_4 1.0%) was found to be on par with T_{16} (K_2SO_4 0.5%), T_6 (CCC 250 ppm), T_5 (NAA 200 ppm), T_{15} (KNO_3 1.0%), T_9 (GA 100 ppm), T_{11} ($Ca(NO_3)_2$ 1.0%), T_7 (CCC 500 ppm), T_2 (TIBA 150 ppm), T_8 (GA 50 ppm) and T_3 (TIBA 300 ppm).

4.1.1.5. True Yellow

The influence of the treatments on the height of plant in this variety was insignificant during the first season as is evident from

Table 6
Effect of treatments on growth parameters of gladiolus cv. Friendship during second season

Treatment		Plant height (cm)		Number of leaves		Leaf area (cm^2)	
		6th week after planting	8th week after planting	6th week after planting	8th week after planting	6th week after planting	8th week after planting
T_1	Control	28.73	44.33	2.67	5.38	75.70	249.53
T_2	TIBA 150 ppm	36.20	42.33	3.67	5.00	145.13	231.77
T_3	TIBA 300 ppm	37.37	52.67	4.00	6.67	167.60	378.73
T_4	NAA 100 ppm	33.10	49.67	5.00	7.33	280.07	359.00
T_5	NAA 200 ppm	28.50	42.33	3.33	5.33	108.13	230.80
T_6	CCC 250 ppm	30.73	47.33	3.33	5.33	113.47	265.00
T_7	CCC 500 ppm	33.90	48.33	3.33	5.00	127.90	286.50
T_8	GA 50 ppm	29.80	48.50	3.00	5.00	102.43	274.43
T_9	GA 100 ppm	8.67	30.17	3.00	3.67	51.60	194.97
T_{10}	$Ca(NO_3)_2$ 0.5%	39.43	40.33	3.67	5.00	156.80	257.40
T_{11}	$Ca(NO_3)_2$ 1.0%	23.97	46.33	2.67	4.67	70.57	219.90
T_{12}	$CaSO_4$ 0.5%	39.77	54.17	4.67	6.33	212.37	346.00
T_{13}	$CaSO_4$ 1.0%	37.70	45.67	3.33	5.67	146.60	314.47
T_{14}	KNO_3 0.5%	28.77	47.17	3.00	5.33	123.57	252.27
T_{15}	KNO_3 1.0%	26.23	36.00	3.67	5.67	124.07	272.30
T_{16}	K_2SO_4 0.5%	34.60	43.73	3.33	5.00	125.40	345.03
T_{17}	K_2SO_4 1.0%	39.30	49.33	4.67	6.33	200.77	360.90
	CD (0.05)	13.10	NS	NS	NS	112.05	NS
	SEm±	4.56	5.47	0.57	0.68	38.99	65.81

Table 7

Effect of treatments on the growth parameters of gladiolus cv. Mansoer Red during first season

Treatment		Plant height (cm)		Number of leaves		Leaf area (cm^2)	
		6th week after planting	8th week after planting	6th week after planting	8th week after planting	6th week after planting	8th week after planting
T_1	Control	31.23	38.73	3.00	4.67	157.90	313.23
T_2	TIBA 150 ppm	28.67	40.03	3.00	4.33	138.93	325.87
T_3	TIBA 300 ppm	36.13	40.67	2.67	4.00	135.77	263.17
T_4	NAA 100 ppm	31.60	34.53	3.33	4.00	160.93	259.70
T_5	NAA 200 ppm	30.77	40.80	3.67	5.00	218.57	417.10
T_6	CCC 250 ppm	36.83	42.90	3.00	5.00	227.50	317.13
T_7	CCC 500 ppm	30.57	41.13	2.67	4.67	138.83	310.90
T_8	GA 50 ppm	33.03	42.90	3.00	4.33	189.50	405.47
T_9	GA 100 ppm	36.77	45.03	3.33	4.33	241.03	405.27
T_{10}	$Ca(NO_3)_2$ 0.5%	32.83	44.43	3.33	5.00	177.97	533.10
T_{11}	$Ca(NO_3)_2$ 1.0%	32.83	39.13	3.33	4.67	181.73	343.57
T_{12}	$CaSO_4$ 0.5%	35.10	43.10	3.33	5.00	223.73	493.87
T_{13}	$CaSO_4$ 1.0%	35.27	41.50	3.33	4.67	210.47	390.57
T_{14}	KNO_3 0.5%	32.60	43.50	3.33	5.00	208.70	461.00
T_{15}	KNO_3 1.0%	31.50	43.37	3.67	5.00	204.17	455.90
T_{16}	K_2SO_4 0.5%	32.50	39.90	3.67	4.33	198.10	424.17
T_{17}	K_2SO_4 1.0%	36.87	39.13	3.67	4.33	289.73	472.80
	CD (0.05)	NS	NS	NS	NS	NS	109.52
	SEm±	2.26	2.38	0.32	0.45	35.14	38.11

Table 8

Effect of treatments on growth parameters of gladiolus cv. Mansoer Red during second season

Treatment		Plant height (cm)		Number of leaves		Leaf area (cm^2)	
		6th week after planting	8th week after planting	6th week after planting	8th week after planting	6th week after planting	8th week after planting
T_1	Control	33.87	37.83	2.67	4.00	118.60	239.00
T_2	TIBA 150 ppm	32.40	41.50	2.67	4.00	113.83	229.70
T_3	TIBA 300 ppm	32.73	40.67	2.33	3.67	148.77	196.80
T_4	NAA 100 ppm	28.37	32.17	3.00	3.33	91.83	126.43
T_5	NAA 200 ppm	38.83	52.67	3.00	4.67	159.23	325.40
T_6	CCC 250 ppm	34.70	54.03	2.33	5.00	135.43	314.83
T_7	CCC 500 ppm	34.40	44.47	2.00	4.00	107.17	272.87
T_8	GA 50 ppm	28.40	41.00	3.67	6.00	117.93	198.10
T_9	GA 100 ppm	38.10	46.37	4.00	4.33	100.43	253.90
T_{10}	$Ca(NO_3)_2$ 0.5%	33.63	37.83	3.00	4.33	139.13	269.70
T_{11}	$Ca(NO_3)_2$ 1.0%	32.30	46.33	2.33	4.67	108.83	256.33
T_{12}	$CsSO_4$ 0.5%	28.57	33.33	2.00	3.33	117.57	145.47
T_{13}	$CaSO_4$ 1.0%	25.90	29.37	3.67	3.67	164.83	152.50
T_{14}	KNO_3 0.5%	22.80	34.23	2.33	4.33	69.43	141.10
T_{15}	KNO_3 1.0%	41.10	52.40	3.67	5.33	141.47	312.80
T_{16}	K_2SO_4 0.5%	37.13	55.47	3.67	4.67	156.43	297.17
T_{17}	K_2SO_4 1.0%	35.47	56.80	3.00	6.00	182.73	318.73
	CD (0.05)	NS	16.37	NS	NS	NS	NS
	SEm±	5.05	5.69	0.51	0.77	33.37	55.49

the data presented in Table 9. During the second season, the treatments influenced the height of plants at six weeks after planting (Table 10). At this stage, T_9 (GA 100 ppm) was found to be the best treatment (47.90 cm) which was on par with T_{11} ($Ca(NO_3)_2$ 1.0%), T_3 (TIBA 300 ppm), T_8 (GA 50 ppm), T_{16} (K_2SO_4 0.5%), T_{13} ($CaSO_4$ 1.0%), T_7 (CCC 500 ppm), T_4 (NAA 100 ppm), T_{15}(KNO_3 1.0%), T_{12} ($CaSO_4$ 0.5%), T_{14} (KNO_3 0.5 %) and T_2 (TIBA 150 ppm). T_{10} ($Ca(NO_3)_2$ 0.5%) recorded the least height (36.50 cm).

4.1.2. Number of leaves

4.1.2.1. Agnirekha

The influence of the treatments on the number of leaves produced was insignificant at both the stages of growth during both the seasons (Table 1 and Table 2).

4.1.2.2. American Beauty

In this variety, the treatments could not significantly influence the number of leaves at any of the stages of growth during both the seasons (Table 3 and 4).

4.1.2.3. Friendship

The treatments could significantly influence the number of leaves at eight weeks after planting during the first season (Table 5). At this stage, T_3 (TIBA 300 ppm) was found to be the best treatment

Table 9

Effect of treatments on growth parameters of gladiolus cv. True Yellow during first season

Treatment		Plant height (cm)		Number of leaves		Leaf area (cm^2)	
		6th week after planting	8th week after planting	6th week after planting	8th week after planting	6th week after planting	8th week after planting
T_1	Control	45.37	50.30	2.67	3.67	207.97	440.57
T_2	TIBA 150 ppm	45.37	48.40	2.67	4.33	208.27	410.17
T_3	TIBA 300 ppm	31.67	45.73	2.33	4.00	148.17	359.53
T_4	NAA 100 ppm	43.07	46.13	3.00	4.67	192.87	419.53
T_5	NAA 200 ppm	38.57	47.47	3.67	5.00	226.77	384.60
T_6	CCC 250 ppm	42.27	47.33	3.67	6.00	254.20	401.00
T_7	CCC 500 ppm	40.00	48.10	2.33	4.67	172.63	433.93
T_8	GA 50 ppm	37.80	46.20	2.67	4.00	137.53	498.43
T_9	GA 100 ppm	44.30	52.00	3.33	4.67	224.30	458.53
T_{10}	$Ca(NO_3)_2$ 0.5%	45.40	51.33	2.67	5.33	150.30	516.73
T_{11}	$Ca(NO_3)_2$ 1.0%	41.47	54.97	3.67	5.67	250.20	496.67
T_{12}	$CsSO_4$ 0.5%	45.50	53.80	3.00	5.33	266.73	550.13
T_{13}	$CaSO_4$ 1.0%	40.87	50.03	2.67	5.00	180.33	446.03
T_{14}	KNO_3 0.5%	40.53	56.07	2.33	4.33	167.07	377.13
T_{15}	KNO_3 1.0%	46.47	55.23	3.00	4.67	231.97	451.47
T_{16}	K_2SO_4 0.5%	39.97	45.33	3.67	5.33	250.93	447.67
T_{17}	K_2SO_4 1.0%	44.73	58.43	3.67	5.33	265.47	500.23
	CD (0.05)	NS	NS	NS	1.26	NS	74.93
	SEm±	3.01	3.52	0.62	0.44	54.64	26.00

Table 10

Effect of treatments on growth parameters of gladiolus cv. True Yellow during second season

Treatment		Plant height (cm)		Number of leaves		Leaf area (cm^2)	
		6th week after planting	8th week after planting	6th week after planting	8th week after planting	6th week after planting	8th week after planting
T_1	Control	40.23	52.00	3.67	5.33	273.53	409.83
T_2	TIBA 150 ppm	41.00	51.50	3.33	5.00	177.77	327.80
T_3	TIBA 300 ppm	46.67	72.83	4.00	6.00	221.20	453.33
T_4	NAA 100 ppm	45.40	56.17	3.67	5.00	218.53	377.90
T_5	NAA 200 ppm	37.33	44.67	3.67	5.67	207.47	315.67
T_6	CCC 250 ppm	37.20	55.17	3.33	5.67	176.70	330.93
T_7	CCC 500 ppm	46.20	55.67	3.67	5.33	262.50	467.07
T_8	GA 50 ppm	46.67	49.77	3.33	5.67	269.23	397.50
T_9	GA 100 ppm	47.90	49.83	4.00	5.67	312.47	429.43
T_{10}	$Ca(NO_3)_2$ 0.5%	36.50	56.77	3.00	5.33	139.07	356.20
T_{11}	$Ca(NO_3)_2$ 1.0%	46.87	54.33	4.00	5.67	279.67	428.70
T_{12}	$CaSO_4$ 0.5%	42.50	53.33	3.67	6.33	201.77	362.20
T_{13}	$CaSO_4$ 1.0%	46.33	53.63	3.67	5.67	248.83	374.40
T_{14}	KNO_3 0.5%	41.70	52.33	3.33	5.33	201.33	346.97
T_{15}	KNO_3 1.0%	42.70	56.17	3.33	6.00	215.97	439.07
T_{16}	K_2SO_4 0.5%	46.57	57.43	4.00	5.33	309.10	438.07
T_{17}	K_2SO_4 1.0%	39.47	52.50	3.33	5.67	219.60	417.40
	CD (0.05)	7.59	NS	NS	NS	84.35	NS
	SEm±	2.64	4.76	0.34	0.50	29.35	50.59

(6.67 leaves) which was on par with T_9 (GA 100 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%), T_{16} (K_2SO_4 0.5%), T_{13} ($CaSO_4$ 1.0%), T_{17} (K_2SO_4 1.0%), T_1 (control), T_7 (CCC 500 ppm) and T_{12} ($CaSO_4$ 0.5%). T_5 (NAA 200 ppm) and T_6 (CCC 250 ppm) produced the minimum number of leaves (4.00).

During the second season, the treatments could not significantly influence the number of leaves at any stage of growth (Table 6).

4.1.2.4. Mansoer Red

The influence of the treatments on the number of leaves produced was insignificant at all the stages of growth in both the seasons (Table 7 and 8).

4.1.2.5. True Yellow

In this variety, during the first season, the treatments influenced the number of leaves significantly at eight weeks after planting (Table 9). At this stage, T_6 (CCC 250 ppm) was found to be the best treatment (6.00 leaves) which was on par with T_{11} ($Ca(NO_3)_2$ 1.0%), T_{10} ($Ca(NO_3)_2$ 0.5%), T_{12} ($CaSO_4$ 0.5%), T_{16} (K_2SO_4 0.5%), T_{17} (K_2SO_4 1.0%), T_5 (NAA 200 ppm) and T_{13} ($CaSO_4$ 1.0%). T_1 (control) produced the minimum number of leaves (3.67).

The treatments could not significantly influence the number of leaves during the second season (Table 10).

4.1.3. Leaf area

4.1.3.1. Agnirekha

During the first season, the treatments produced significant influence on the leaf area in this variety at eight weeks after planting (Table 1). Leaf area was found to be the maximum (602.47 cm^2) in T_{16} (K_2SO_4 0.5%) which was on par with T_{17} (K_2SO_4 1.0%) and T_4 (NAA 100 ppm). Minimum leaf area (386.83 cm^2) was recorded in T_1 (control). The treatments could not exert any significant influence on the leaf area of the plants during the second season (Table 2).

4.1.3.2. American Beauty

The influence of the treatments on the leaf area was significant in this variety during the first season, at eight week after planting (Table 3). Treatment T_{17} (K_2SO_4 1.0%) recorded the maximum leaf area (880.23 cm^2) and T_{11} ($Ca(NO_3)_2$ 1.0%), the minimum (503.73 cm^2). T_{17} (K_2SO_4 1.0%) was found to be on par with T_8 (GA 50 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%), T_{16} (K_2SO_4 0.5%), T_6 (CCC 250 ppm), T_5 (NAA 200 ppm), T_{15} (KNO_3 1.0%) and T_{14} (KNO_3 0.5%).

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

4.1.3.3. Friendship

The treatments revealed significant influence in this variety at eight weeks after planting during the first season (Table 5). T_3 (TIBA 300 ppm) was found to be the best treatment (636.47 cm^2) which was on par with T_9 (GA 100 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%), T_{16} (K_2SO_4 0.5%), T_{13} ($CaSO_4$ 1.0%), T_{17} (K_2SO_4 1.0%), T_{14} (KNO_3 0.5%), T_1 (control) and T_{12} ($CaSO_4$ 0.5%). T_4 (NAA 100 ppm) recorded the least leaf area of (285.67 cm^2).

During the second season, the growth regulators and nutrients significantly influenced the leaf area at six weeks after planting (Table 6). At this stage, T_4 (NAA 100 ppm) was found to be the best treatment (280.07 cm^2) which was on par with T_{12} ($CaSO_4$ 0.5%) and T_{17} (K_2SO_4 1.0%). T_9 (GA 100 ppm) recorded the minimum leaf area (51.60 cm^2).

4.1.3.4. Mansoer Red

Effect of treatments on the leaf area in this variety was significant in the first season at eight weeks after planting (Table 7). The maximum leaf area (533.10 cm^2) was exhibited by T_{10} ($Ca(NO_3)_2$ 0.5%) which was on par with T_{12} ($CaSO_4$ 0.5%), T_{17} (K_2SO_4 1.0%), T_{14} (KNO_3 0.5%), T_{15} (KNO_3 1.0%) and T_{16} (K_2SO_4 0.5%). Minimum leaf area (259.70 cm^2) was recorded in T_4 (NAA 100 ppm).

The growth regulators and nutrients failed to influence the leaf area of plants during the second season (Table 8).

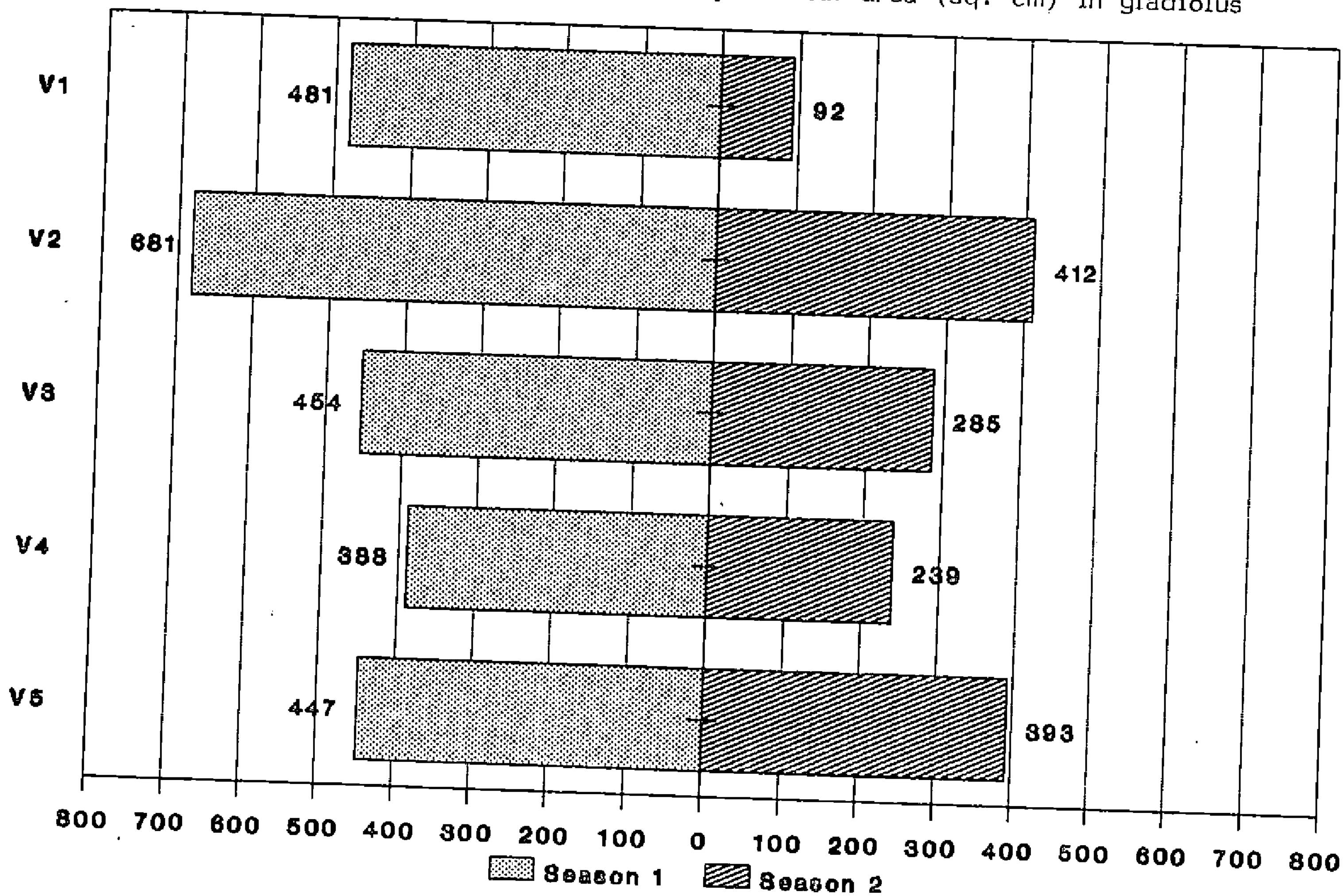
4.1.3.5. True Yellow

The influence of the treatments on the leaf area was significant at eight weeks after planting, during the first season (Table 9). Leaf area was found to be the maximum (550.13 cm^2) in T_{12} ($CaSO_4$ 0.5%), which was on par with T_{10} ($Ca(NO_3)_2$ 0.5%), T_{17} (K_2SO_4) 1.0%), T_8 (GA 50 ppm) and T_{11} ($Ca(NO_3)_2$ 1.0%). Minimum leaf area (359.53 cm^2) was recorded in T_3 (TIBA 300 ppm).

The growth regulators and nutrients showed significant influence on the leaf area of plants at six weeks after planting during the seond season (Table 10). At this stage, plants receiving T_9 (GA 100 ppm) had maximum leaf area (312.47 cm^2) and T_{10} ($Ca(NO_3)_2$ 0.5%), the minimum (139.07 cm^2). T_9 was found to be on par with T_{16} (K_2SO_4 0.5%), T_{11} ($Ca(NO_3)_2$ 1.0%), T_1 (control), T_8 (GA 50 ppm), T_7 (CCC 500 ppm) and T_{13} ($CaSO_4$ 1.0%).

The effect of seasons and varieties on leaf area, considered irrespective of the treatments, revealed that the performance of gladiolus was better during the first season in all the varieties (Fig.1). V_2 (American Beauty) had the maximum leaf area (681 cm^2 and 412 cm^2, respectively) during the first and second seasons. V_4 (Mansoer Red)

Fig.1. Effect of season and variety on leaf area (sq. cm) in gladiolus



recorded the minimum leaf area (388 cm^2) during the first season and V_1 (Agnirekha) during the second season (92 cm^2).

4.1.4. Duration from planting to spike emergence

4.1.4.1. Agnirekha

The treatments exerted significant influence on the duration from planting to spike emergence in this variety during both the seasons. T_1 (control) recorded the shortest duration (72.33 days) during the first season (Table 11). The duration was found to be the maximum (84 days) in T_{17} (K_2SO_4 1.0%).

During the second season (Table 12) duration was the shortest (94.00 days) in T_{17} (K_2SO_4 1.0%). The longest duration (121.33 days) was exhibited by T_8 (GA 50 ppm).

4.1.4.2. American Beauty

Effect of treatments on the duration from planting to spike emergence was significant during both the seasons in this variety. During the first season (Table 13) duration was the shortest (66.00 days) in T_{14} (KNO_3 0.5%). The longest duration (80.67 days) was exhibited by T_4 (NAA 100 ppm).

During the second season (Table 14) the minimum duration (80.67 days) was exhibited by T_{17} (K_2SO_4 1.0%). Maximum duration (94.33 days) was recorded in T_8 (GA 50 ppm).

Table 11
Effect of treatments on the duration of spike in gladiolus cv. Agnirekha during first season

Treatment		Planting to emergence (days)	Emergence to opening (days)	Blooming period (days)	Total (days)
T_1	Control	72.33	7.00	9.67	89.00
T_2	TIBA 150 ppm	83.33	6.33	12.33	102.00
T_3	TIBA 300 ppm	77.67	7.33	12.00	97.00
T_4	NAA 100 ppm	77.00	5.33	12.00	94.33
T_5	NAA 200 ppm	78.00	7.67	10.67	96.33
T_6	CCC 250 ppm	74.33	7.33	6.67	88.33
T_7	CCC 500 ppm	80.33	6.33	11.00	97.67
T_8	GA 50 ppm	76.67	6.33	12.67	95.67
T_9	GA 100 ppm	80.00	6.67	14.33	101.00
T_{10}	$Ca(NO_3)_2$ 0.5%	73.00	6.00	11.33	90.67
T_{11}	$Ca(NO_3)_2$ 1.0%	72.67	8.00	11.00	91.67
T_{12}	$CaSO_4$ 0.5%	81.33	7.00	14.00	102.33
T_{13}	$CaSO_4$ 1.0%	73.33	6.67	10.00	90.00
T_{14}	KNO_3 0.5%	80.33	5.33	12.00	97.67
T_{15}	KNO_3 1.0%	75.00	7.00	12.67	94.67
T_{16}	K_2SO_4 0.5%	74.00	5.00	13.67	92.67
T_{17}	K_2SO_4 1.0%	84.00	6.00	12.67	102.67
	CD (0.05)	6.61	NS	1.94	7.24
	SEm±	2.30	0.63	0.70	2.53

Table 12
Effect of treatments on the duration of spike in gladiolus cv. Agnirekha during second season

Treatment		Planting to emergence (days)	Emergence to opening (days)	Blooming period (days)	Total (days)
T_1	Control	106.33	6.00	8.00	120.33
T_2	TIBA 150 ppm	110.67	6.00	9.00	125.67
T_3	TIBA 300 ppm	109.33	8.67	7.33	125.33
T_4	NAA 100 ppm	113.67	7.00	8.33	129.00
T_5	NAA 200 ppm	113.33	6.00	8.67	128.00
T_6	CCC 250 ppm	104.67	6.33	8.33	119.33
T_7	CCC 500 ppm	102.67	7.67	10.67	121.00
T_8	GA 50 ppm	121.33	6.33	6.67	134.00
T_9	GA 100 ppm	113.33	6.33	10.00	129.67
T_{10}	$Ca(NO_3)_2$ 0.5%	117.67	4.67	7.00	129.33
T_{11}	$Ca(NO_3)_2$ 1.0%	115.67	5.00	9.33	130.00
T_{12}	$CaSO_4$ 0.5%	114.00	5.00	9.33	128.33
T_{13}	$CaSO_4$ 1.0%	116.00	7.33	8.67	132.00
T_{14}	KNO_3 0.5%	118.00	4.67	10.67	133.33
T_{15}	KNO_3 1.0%	103.00	7.00	10.00	120.33
T_{16}	K_2SO_4 0.5%	116.33	6.00	11.33	133.67
T_{17}	K_2SO_4 1.0%	94.00	4.67	10.00	108.67
	CD (0.05)	6.56	0.90	0.96	6.92
	SEm±	2.29	0.31	0.33	2.40

Table 13
Effect of treatments on the duration of spike in gladiolus cv. American Beauty during first season

Treatment		Planting to emergence (days)	Emergence to opening (days)	Blooming period (days)	Total (days)
T_1	Control	79.33	7.00	14.33	100.67
T_2	TIBA 150 ppm	76.67	7.67	15.67	100.00
T_3	TIBA 300 ppm	73.00	6.33	14.00	93.33
T_4	NAA 100 ppm	80.67	7.67	12.00	100.33
T_5	NAA 200 ppm	70.67	7.33	17.67	95.67
T_6	CCC 250 ppm	72.33	7.67	14.67	94.67
T_7	CCC 500 ppm	78.00	7.00	14.33	99.33
T_8	GA 50 ppm	68.67	6.33	14.67	89.67
T_9	GA 100 ppm	76.33	6.33	17.67	100.33
T_{10}	$Ca(NO_3)_2$ 0.5%	71.00	7.67	17.33	96.00
T_{11}	$Ca(NO_3)_2$ 1.0%	79.00	6.67	14.67	100.33
T_{12}	$CaSO_4$ 0.5%	73.33	7.33	12.33	93.00
T_{13}	$CaSO_4$ 1.0%	74.00	7.33	14.33	95.33
T_{14}	KNO_3 0.5%	66.00	7.00	15.00	88.00
T_{15}	KNO_3 1.0%	72.33	7.67	13.33	93.33
T_{16}	K_2SO_4 0.5%	72.67	6.00	12.00	90.67
T_{17}	K_2SO_4 1.0%	71.33	6.67	16.33	94.33
	CD (0.05)	7.32	NS	2.63	NS
	SEm±	2.55	0.65	0.91	3.08

Table 14
Effect of treatments on the duration of spike in gladiolus cv. American Beauty during second season

Treatment		Planting to emergence (days)	Emergence to opening (days)	Blooming period (days)	Total (days)
T_1	Control	87.33	8.67	8.33	104.33
T_2	TIBA 150 ppm	87.33	8.00	8.00	103.33
T_3	TIBA 300 ppm	90.00	8.00	8.00	106.00
T_4	NAA 100 ppm	87.00	8.53	6.67	102.00
T_5	NAA 200 ppm	83.33	7.33	9.33	100.00
T_6	CCC 250 ppm	82.33	8.67	8.00	99.00
T_7	CCC 500 ppm	84.00	8.67	6.67	99.33
T_8	GA 50 ppm	94.33	8.67	7.67	110.67
T_9	GA 100 ppm	82.33	8.00	10.00	100.33
T_{10}	$Ca(NO_3)_2$ 0.5%	84.67	8.00	8.00	100.67
T_{11}	$Ca(NO_3)_2$ 1.0%	93.33	6.67	12.33	112.33
T_{12}	$CaSO_4$ 0.5%	88.00	8.00	7.33	103.33
T_{13}	$CaSO_4$ 1.0%	87.00	8.67	5.67	101.33
T_{14}	KNO_3 0.5%	90.00	7.00	9.00	106.00
T_{15}	KNO_3 1.0%	88.67	6.33	7.33	102.33
T_{16}	K_2SO_4 0.5%	82.00	7.67	8.33	98.00
T_{17}	K_2SO_4 1.0%	80.67	8.33	8.67	97.67
	CD (0.05)	7.47	1.19	2.12	7.66
	SEm±	2.59	0.41	0.73	2.67

4.1.4.3. Friendship

In this variety, there was significant influence of the treatments on the duration from planting to spike emergence during both the seasons.

During the first season (Table 15) earliest flowering (66.67 days) was recorded in T_9 (GA 100 ppm). Maximum duration (80.33 days) was recorded in T_6 (CCC 250 ppm).

The duration was found to be the shortest (69.33 days) in T_{17} (K_2SO_4 1.0%) during the second season (Table 16). Maximum duration (84.33 days) was recorded in T_{12} ($CaSO_4$ 0.5%).

4.1.4.4. Mansoer Red

The treatments influenced the duration from planting to spike emergence during both seasons.

During the first season (Table 17), shortest duration (85.00 days) was exhibited by T_{12} ($CaSO_4$ 0.5%). Maximum duration (105.33 days) was recorded in T_4 (NAA 100 ppm).

Minimum duration (80.00 days) was exhibited by T_{17} (K_2SO_4 1.0%) and the maximum duration (121.33 days) was recorded in T_4 (NAA 100 ppm) during the second season (Table 18).

Table 15
Effect of treatments on the duration of spike in gladiolus cv. Friendship during first season

Treatment		Planting to emergence (days)	Emergence to opening (days)	Blooming period (days)	Total (days)
T_1	Control	71.67	7.67	10.33	89.67
T_2	TIBA 150 ppm	79.00	7.67	10.00	96.67
T_3	TIBA 300 ppm	67.33	7.00	11.00	85.33
T_4	NAA 100 ppm	79.67	6.00	11.00	96.67
T_5	NAA 200 ppm	79.33	7.33	11.33	98.00
T_6	CCC 250 ppm	80.33	7.33	10.33	98.00
T_7	CCC 500 ppm	73.33	7.67	9.67	90.67
T_8	GA 50 ppm	69.00	7.00	10.33	86.33
T_9	GA 100 ppm	66.67	6.00	10.33	83.00
T_{10}	$Ca(NO_3)_2$ 0.5%	75.33	7.33	11.00	93.67
T_{11}	$Ca(NO_3)_2$ 1.0%	74.33	7.00	9.67	91.00
T_{12}	$CaSO_4$ 0.5%	73.33	7.33	11.33	91.33
T_{13}	$CaSO_4$ 1.0%	68.67	6.33	12.33	87.33
T_{14}	KNO_3 0.5%	77.33	7.67	10.00	95.00
T_{15}	KNO_3 1.0%	77.00	7.67	11.00	95.67
T_{16}	K_2SO_4 0.5%	75.67	8.00	10.67	94.33
T_{17}	K_2SO_4 1.0%	69.33	7.00	10.67	87.00
	CD (0.05)	5.84	NS	NS	5.96
	SEm±	2.03	0.45	1.26	2.07

Table 16
Effect of treatments in the duration of spike in gladiolus cv. Friendship during second season

Treatment		Planting to emergence (days)	Emergence to opening (days)	Blooming period (days)	Total (days)
T_1	Control	69.67	7.00	9.00	85.67
T_2	TIBA 150 ppm	74.33	6.67	9.00	90.00
T_3	TIBA 300 ppm	72.67	5.33	8.00	86.00
T_4	NAA 100 ppm	71.00	6.67	5.67	83.33
T_5	NAA 200 ppm	80.67	7.67	6.67	95.00
T_6	CCC 250 ppm	75.33	6.33	10.33	92.00
T_7	CCC 500 ppm	74.67	7.00	9.00	90.67
T_8	GA 50 ppm	73.33	5.67	12.00	91.00
T_9	GA 100 ppm	73.33	6.67	10.33	90.33
T_{10}	$Ca(NO_3)_2$ 0.5%	82.67	4.67	7.67	95.00
T_{11}	$Ca(NO_3)_2$ 1.0%	80.33	7.33	8.33	96.00
T_{12}	$CaSO_4$ 0.5%	84.33	5.00	6.33	95.67
T_{13}	$CaSO_4$ 1.0%	76.00	7.00	7.67	90.67
T_{14}	KNO_3 0.5%	76.67	7.67	8.00	92.33
T_{15}	KNO_3 1.0%	76.67	7.33	8.00	92.00
T_{16}	K_2SO_4 0.5%	83.33	7.67	7.67	98.67
T_{17}	K_2SO_4 1.0%	69.33	8.00	9.67	87.00
	CD (0.05)	9.21	2.01	1.41	NS
	SEm±	3.20	0.70	0.50	3.31

Table 17
Effect of treatments on the duration of spike in gladiolus cv. Mansoer Red during first season

Treatment		Planting to emergence (days)	Emergence to opening (days)	Blooming period (days)	Total (days)
T_1	Control	103.00	7.00	10.33	120.33
T_2	TIBA 150 ppm	92.00	7.00	10.00	109.00
T_3	TIBA 300 ppm	91.00	7.33	11.00	109.33
T_4	NAA 100 ppm	105.33	9.33	8.33	123.00
T_5	NAA 200 ppm	90.67	8.00	13.00	111.67
T_6	CCC 250 ppm	89.33	7.00	8.33	104.67
T_7	CCC 500 ppm	90.00	7.67	10.33	108.00
T_8	GA 50 ppm	88.33	6.33	12.67	107.33
T_9	GA 100 ppm	88.00	7.00	12.00	107.00
T_{10}	$Ca(NO_3)_2$ 0.5%	94.00	5.67	13.67	113.33
T_{11}	$Ca(NO_3)_2$ 1.0%	97.00	7.00	11.67	115.67
T_{12}	$CaSO_4$ 0.5%	85.00	7.33	11.33	103.67
T_{13}	$CaSO_4$ 1.0%	92.00	7.33	11.00	110.33
T_{14}	KNO_3 0.5%	91.67	8.33	11.00	111.00
T_{15}	KNO_3 1.0%	97.33	9.33	9.33	116.00
T_{16}	K_2SO_4 0.5%	88.33	5.67	12.00	106.00
T_{17}	K_2SO_4 1.0%	86.67	6.67	11.67	105.00
	CD (0.05)	11.55	1.78	2.16	10.41
	SEm±	4.01	0.63	0.75	3.61

Table 18
Effect of treatments on the duration of spike in gladiolus cv. Mansoer Red during second season

Treatment		Planting to emergence (days)	Emergence to opening (days)	Blooming period (days)	Total (days)
T_1	Control	103.33	7.67	6.67	117.67
T_2	TIBA 150 ppm	109.67	6.67	8.00	124.33
T_3	TIBA 300 ppm	96.00	4.00	6.00	106.00
T_4	NAA 100 ppm	121.33	5.00	6.00	132.33
T_5	NAA 200 ppm	91.67	5.00	5.67	102.33
T_6	CCC 250 ppm	82.00	5.00	7.00	95.00
T_7	CCC 500 ppm	106.00	7.33	6.33	119.67
T_8	GA 50 ppm	101.00	8.00	6.33	115.33
T_9	GA 100 ppm	111.00	6.00	7.00	124.00
T_{10}	$Ca(NO_3)_2$ 0.5%	102.00	6.33	5.00	113.33
T_{11}	$Ca(NO_3)_3$ 1.0%	90.67	6.67	6.00	103.33
T_{12}	$CaSO_4$ 0.5%	118.67	6.00	6.00	130.67
T_{13}	$CaSO_4$ 1.0%	101.33	4.67	6.33	112.33
T_{14}	KNO_3 0.5%	103.33	6.00	7.00	116.33
T_{15}	KNO_3 1.0%	92.33	5.67	6.00	104.00
T_{16}	K_2SO_4 0.5%	118.33	6.00	6.33	130.67
T_{17}	K_2SO_4 1.0%	80.00	6.00	5.67	91.67
	CD (0.05)	13.17	1.58	NS	13.84
	SEm±	4.58	0.54	0.57	4.81

4.1.4.5. True Yellow

In this variety also, the treatments exerted significant influence on the duration from planting to spike emergence in both the seasons.

During the first season (Table 19), the duration was found to be the shortest in T_{16} (K_2SO_4 0.5%) which was significantly superior to all other treatments. Maximum duration (88.33 days) was recorded in T_9 (GA 100 ppm).

The shortest duration (74.67 days) was exhibited by T_9 (GA 100 ppm) during the second season (Table 20). This was significantly superior to only T_7 (CCC 500 ppm) which recorded the longest duration (104.00 days).

First season was found to be superior in earliness to flowering (Fig. 2) when considered irrespective of the treatments. In all the varieties the duration from planting to spike emergence was more during the second season, but much difference was not obtained in the varieties, Friendship and True Yellow. V_2 (American Beauty) and V_3 (Friendship) were found to be early flowering (74 days, each) during the first season whereas V_3 (Friendship) was early flowering (76 days) during the second season. Maximum delay in flowering was

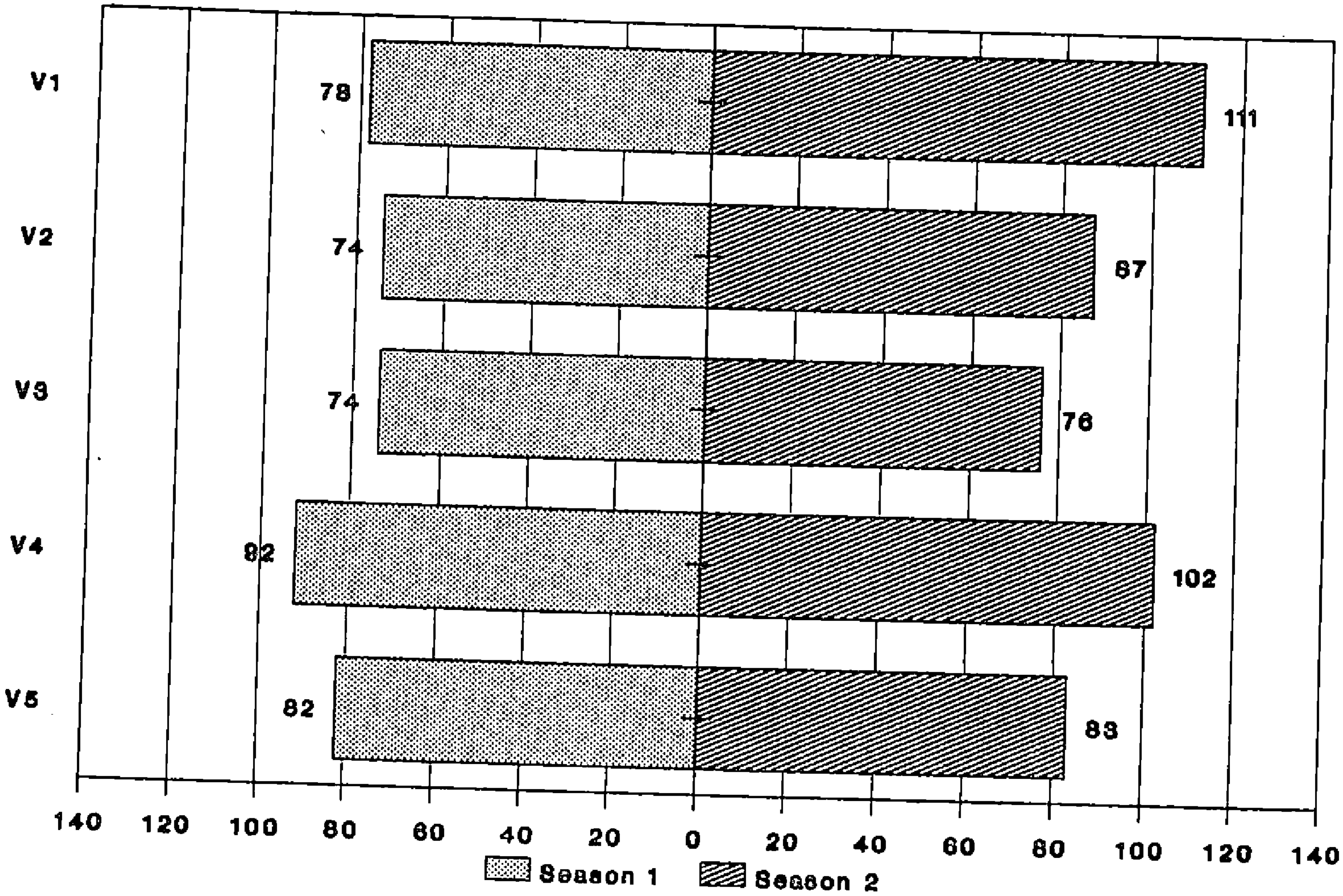
Table 19
Effect of treatments on the duration of spike in gladiolus cv. True Yellow during first season

Treatment		Planting to emergence (days)	Emergence to opening (days)	Blooming period (days)	Total (days)
T_1	Control	84.00	4.33	7.33	95.67
T_2	TIBA 150 ppm	82.33	5.00	9.00	96.33
T_3	TIBA 300 ppm	82.67	5.00	8.00	95.67
T_4	NAA 100 ppm	83.00	4.67	8.67	96.33
T_5	NAA 200 ppm	81.00	5.67	8.67	95.33
T_6	CCC 250 ppm	87.67	4.00	9.00	100.67
T_7	CCC 500 ppm	81.67	5.67	10.67	98.00
T_8	GA 50 ppm	86.00	4.33	9.00	99.33
T_9	GA 100 ppm	88.38	9.00	11.67	109.00
T_{10}	$Ca(NO_3)_2$ 0.5%	83.67	4.67	9.00	97.33
T_{11}	$Ca(NO_3)_2$ 1.0%	86.00	3.67	9.00	98.67
T_{12}	$CaSO_4$ 0.5%	83.33	4.00	7.00	94.33
T_{13}	$CaSO_4$ 1.0%	81.00	5.33	7.67	93.33
T_{14}	KNO_3 0.5%	81.00	5.00	7.67	93.67
T_{15}	KNO_3 1.0%	83.67	6.00	8.67	98.33
T_{16}	K_2SO_4 0.5%	58.67	4.67	10.00	73.33
T_{17}	K_2SO_4 1.0%	83.00	4.00	9.33	96.33
	CD (0.05)	9.07	2.34	1.60	8.72
	SEm±	3.15	0.82	0.56	3.04

Table 20
Effect of treatments on the duration of spike in gladiolus cv. True Yellow during second season

Treatment		Planting to emergence (days)	Emergence to opening (days)	Blooming period (days)	Total (days)
T_1	Control	79.00	8.33	5.00	92.33
T_2	TIBA 150 ppm	84.67	8.67	5.67	99.01
T_3	TIBA 300 ppm	78.33	9.00	7.33	94.66
T_4	NAA 100 ppm	82.67	7.67	6.00	96.34
T_5	NAA 200 ppm	79.67	9.00	7.00	95.67
T_6	CCC 250 ppm	79.67	8.33	8.00	96.00
T_7	CCC 500 ppm	104.00	8.33	6.00	118.33
T_8	GA 50 ppm	80.67	8.00	7.00	95.67
T_9	GA 100 ppm	74.67	9.33	6.33	90.33
T_{10}	$Ca(NO_3)_2$ 0.5%	82.33	6.33	7.33	95.99
T_{11}	$Ca(NO_3)_2$ 1.0%	79.00	8.00	7.00	94.00
T_{12}	$CaSO_4$ 0.5%	86.33	9.00	7.00	102.33
T_{13}	$CaSO_4$ 1.0%	81.00	8.00	6.33	95.33
T_{14}	KNO_3 0.5%	80.33	7.00	6.33	93.66
T_{15}	KNO_3 1.0%	79.33	8.00	8.33	95.66
T_{16}	K_2SO_4 0.5%	90.00	7.67	4.00	101.67
T_{17}	K_2SO_4 1.0%	78.67	9.33	7.67	95.67
	CD (0.05)	6.75	NS	1.12	14.84
	SEm±	2.36	0.65	0.74	5.16

Fig. 2. Effect of season and variety on the duration from planting to spike emergence (days) in gladiolus



recorded in V_4 (Mansoer Red) during the first season (92 days) and in V_1 (Agnirekha) during the second season (111 days).

4.1.5. Duration from spike emergence to opening

4.1.5.1. Agnirekha

The treatments did not differ significantly with respect to the duration from spike emergence to opening during the first season (Table 11).

During the second season (Table 12) T_{10} ($Ca(NO_3)_2$ 0.5%), T_{14} (KNO_3 0.5%) and T_{17} (K_2SO_4 1.0%) recorded the shortest duration (4.67 days, each). The duration was found to be the maximum (8.67 days) in T_3 (TIBA 300 ppm).

4.1.5.2. American Beauty

Effect of treatments on the duration from spike emergence to opening was found to be insignificant during the first season (Table 13).

During the second season (Table 14) the shortest duration (6.33 days) was recorded by T_{15} (KNO_3 1.0%) and the maximum duration (8.67 days, each) by T_1 (control); T_6 (CCC 250 ppm), T_7 (CCC 500 ppm), T_8 (GA 50 ppm) and T_{13} ($CaSO_4$ 1.0%).

4.1.5.3. Friendship

The treatments could not exert any significant influence in this variety during the first season (Table 15).

During the second season the treatments influenced the duration from spike emergence to opening significantly (Table 16). The duration was the shortest (4.67 days) in T_{10} ($Ca(NO_3)_2$ 0.5%) and was the maximum (8.00 days) in T_{17} (K_2SO_4 1.0%).

4.1.5.4. Mansoer Red

The treatments significantly influenced the duration from spike emergence to opening during both the seasons. T_{10} ($Ca(NO_3)_2$ 0.5%) and T_{16} (K_2SO_4 0.5%) recorded shortest duration (5.67 days, each) during the first season (Table 17). The duration was the maximum (9.33 days, each) in T_4 (NAA 100 ppm) and T_{15} (KNO_3 1.0%).

During the second season (Table 18), the duration was found to be the shortest (4.00 days) in T_3 (TIBA 300 ppm). The maximum duration (8.00 days) was recorded in T_8 (GA 50 ppm).

4.1.5.5. True Yellow

Effect of treatments on the duration from spike emergence to opening was found to be significant in this variety during the first season (Table 19). The minimum duration (4.00 days, each) was shown by T_6 (CCC 250 ppm), T_{12} ($CaSO_4$ 0.5%) and T_{17} (K_2SO_4 1.0%). The longest duration (9.00 days) was exhibited by T_9 (GA 100 ppm) which was significantly different from all other treatments.

The treatments could not influence the duration during the second season (Table 20).

4.1.6. Blooming period

4.1.6.1. Agnirekha

The treatments significantly influenced the blooming period in the variety during both the seasons.

During the first season (Table 11) the blooming period was the maximum (14.33 days) in T_9 (GA 100 ppm) which was on par with T_{12} ($CaSO_4$ 0.5%), T_{16} (K_2SO_4 0.5%), T_{15} (KNO_3 1.0%), T_8 (GA 50 ppm), T_{17} (K_2SO_4 1.0%), T_2 (TIBA 150 ppm), T_3 (TIBA 300 ppm), T_4 (NAA 100 ppm) and T_{14} (KNO_3 0.5%). Blooming period was the shortest (6.67 days) in T_6 (CCC 250 ppm).

During the second season (Table 12) the blooming period was the maximum (11.33 days) in T_{16} (K_2SO_4 0.5%) which was on par with T_7 (CCC 500 ppm) and T_{14} (KNO_3 0.5%). It was the shortest (6.67 days) in T_8 (GA 50 ppm).

4.1.6.2. American Beauty

Influence of the treatments on the blooming period was significant in this variety during both the seasons.

T_5 (NAA 200 ppm) and T_9 (GA 100 ppm) recorded the maximum blooming period (17.67 days, each) during the first season (Table 13) which was on par with T_{10} ($Ca(NO_3)_2$ 0.5%), T_{17} (K_2SO_4 1.0%) and T_2 (TIBA 150 ppm). Blooming period was found to be minimum (12.00 days, each) in T_4 (NAA 100 ppm) and T_{16} (K_2SO_4 0.5%).

During the second season (Table 14) the maximum period (12.33 days) was recorded in T_{11} ($Ca(NO_3)_2$ 1.0%), which was significantly superior to all other treatments. The minimum period (5.67 days) was exhibited by T_{13} ($CaSO_4$ 1.0%).

4.1.6.3. Friendship

The treatments did not significantly influence the blooming period during the first season (Table 15).

During the second season (Table 16) the longest blooming period (12.00 days) was recorded in T_8 (GA 50 ppm) which was significantly superior to all other treatments. The shortest blooming period (5.67 days) was recorded in T_4 (NAA 100 ppm).

4.1.6.4. Mansoer Red

In this variety, the treatments influenced the blooming period significantly during the first season (Table 17). It was found to be the maximum (13.67 days) in T_{10} ($Ca(NO_3)_2$ 0.5%) which was on par with T_5 (NAA 200 ppm), T_8 (GA 50 ppm), T_9 (GA 100 ppm), T_{16} (K_2SO_4 0.5%), T_{11} ($Ca(NO_3)_2$) 1.0%) and T_{17} (K_2SO_4 1.0%). Blooming period was the shortest (8.33 days, each) in T_4 (NAA 100 ppm) and T_6 (CCC 250 ppm).

During the second season the treatments failed in producing significant influence on the blooming period (Table 18).

4.1.6.5. True Yellow

The influence of treatments on the blooming period was significant during both the seasons.

The maximum blooming period (11.67 days) was recorded by T_9 (GA 100 ppm) during the first season (Table 19) which was on par with T_7 (CCC 500 ppm). Blooming period was the minimum (7.00 days) in T_{12} ($CaSO_4$ 0.5%).

During the second season (Table 20) the blooming period was found to be the maximum (8.33 days) in T_{15} (KNO_3 1.0%), which was on par with T_6 (CCC 250 ppm), T_{17} (K_2SO_4 1.0%), T_3 (TIBA 300 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%), T_5 (NAA 200 ppm), T_8 (GA

50 ppm), T_{11} ($Ca(NO_3)_2$ 1.0%), T_{12} ($CaSO_4$ 0.5%), T_9 (GA 100 ppm) and T_{13} ($CaSO_4$ 1.0%). T_{16} (K_2SO_4 0.5%) recorded the shortest blooming period (4.00 days).

When the effect of seasons on blooming period was considered irrespective of treatments, maximum blooming period was longer in season 1 in all the varieties (Fig. 3). Among the varieties, V_2 (American Beauty) had the longest blooming period (14.7 days), during the first season, whereas V_1 (Agnirekha) was superior (9.0 days) during the second season. Blooming period was found to be the minimum (8.8 days) in V_5 (True Yellow) during the first season and in V_4 (Mansoer Red) during the second season (6.3 days).

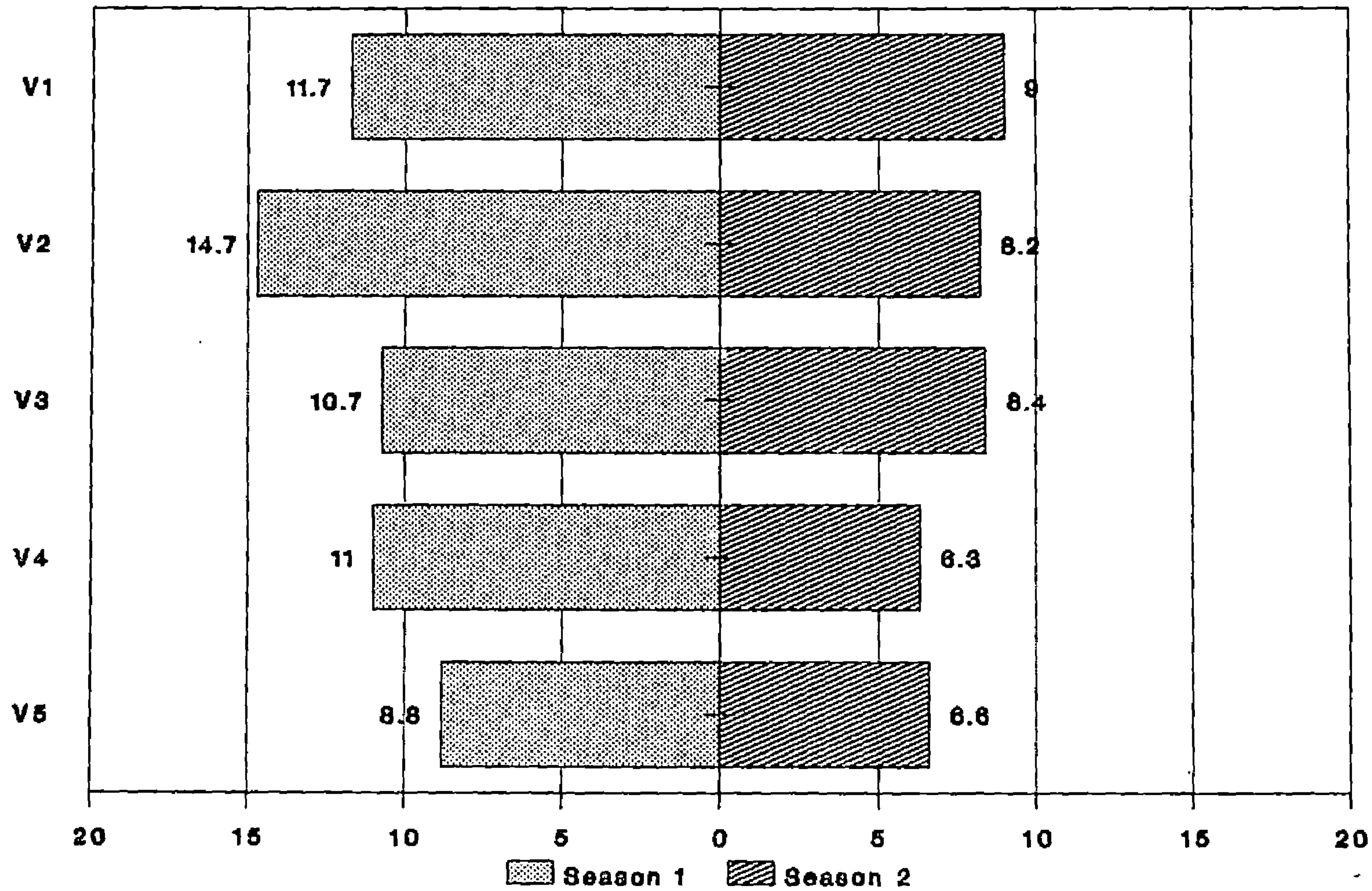
4.1.7. Total duration

4.1.7.1. Agnirekha

The treatments influenced the total duration of plants significantly in this variety during both the seasons.

T_6 (CCC 250 ppm) recorded the minimum duration (88.33 days) during the first season (Table 11). The longest (102.67 days) duration was recorded in T_{17} (K_2SO_4 1.0%). This was on par with T_{12} ($CaSO_4$ 0.5%), T_2 (TIBA 150 ppm), T_9 (GA 100 ppm), T_7 (CCC 500 ppm), T_{14} (KNO_3 0.5%), T_3 (TIBA 300 ppm), T_5 (NAA 200 ppm) and T_8 (GA 50 ppm).

Fig. 3. Effect of season and variety on the blooming period (days) in gladiolus



The duration was found to be the maximum (134.00 days) in T_8 (GA 50 ppm) during the second season (Table 12). T_{17} (K_2SO_4 1.0%) recorded the minimum duration (108.67 days). T_8 (GA 50 ppm) was on par with T_{16} (K_2SO_4 0.5%), T_{14} (KNO_3 0.5%), T_{13} ($CaSO_4$ 1.0%), T_{11} ($Ca(NO_3)_2$ 1.0%), T_9 (GA 100 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%), T_4 (NAA 100 ppm), T_{12} ($CaSO_4$ 0.5%) and T_5 (NAA 200 ppm).

4.1.7.2. American Beauty

The treatments did not influence the total duration of plants significantly during the first season (Table 13).

Total duration was found to be the maximum (112.33 days) in T_{11} ($Ca(NO_3)_2$ 1.0%), during the second season (Table 14) whereas T_{17} (K_2SO_4 1.0%) recorded the minimum duration (97.67 days).

4.1.7.3. Friendship

The effect of treatments on the total duration of the plants in this variety was significant during the first season (Table 15). It was found to be the minimum (83.00 days) in T_9 (GA 100 ppm) and the maximum (98.00 days, each) in T_5 (NAA 200 ppm) and T_6 (CCC 250 ppm).

The influence of the treatments on the total duration of plants in this variety was insignificant during the second season (Table 16).

4.1.7.4. Mansoer Red

Significant difference could be observed on the total duration of plants during both the seasons.

During the first season (Table 17) the minimum duration (103.67 days) was recorded by T_{12} ($CaSO_4$ 0.5%). The longest duration (120.33 days) was exhibited by T_1 (control).

T_{17} (K_2SO_4 1.0%) exhibited the minimum total duration (91.67 days) during the second season (Table 18). The longest duration (132.33 days) was exhibited by T_4 (NAA 100 ppm).

4.1.7.5. True Yellow

The treatments significantly influenced the total duration in this variety during both the seasons.

The shortest duration (73.33 days) was recorded in T_{16} (K_2SO_4 0.5%) during the first season (Table 19). The duration was found to be the maximum (109.00 days) in T_9 (GA 100 ppm).

During the second season (Table 20), the shortest duration (90.33 days) was recorded in T_9 (GA 100 ppm). The longest duration (118.33 days) was exhibited by T_7 (CCC 500 ppm) which was significantly different from all other treatments.

When considered irrespective of the treatments, the total duration was minimum in V_3 (Friendship) during both the seasons (92 and 91 days, respectively). Total duration was found to be more during the second season (Fig. 4). In V_3 (Friendship) and V_5 (True Yellow) there was not much difference. Maximum duration was shown by V_4 (Mansoer Red) during the first season (111 days) and V_1 (Agnirekha) during the second season (126 days).

4.2. Spike characters

4.2.1. Length of the spike

4.2.1.1. Agnirekha

The treatments produced significant influence on the spike length of this variety during both the seasons. During the first season (Table 21) T_{16} (K_2SO_4 0.5%) produced the longest spike (65.7 cm) which was on par with T_{10} ($Ca(NO_3)_2$ 0.5%), T_{13} ($CaSO_4$ 1.0%), T_6 (CCC 250 ppm), T_5 (NAA 200 ppm) and T_{17} (K_2SO_4 1.0%). Shortest spike (43.3 cm) was recorded in T_1 (control).

Fig. 4. Effect of season and variety on the total duration (days) in gladiolus

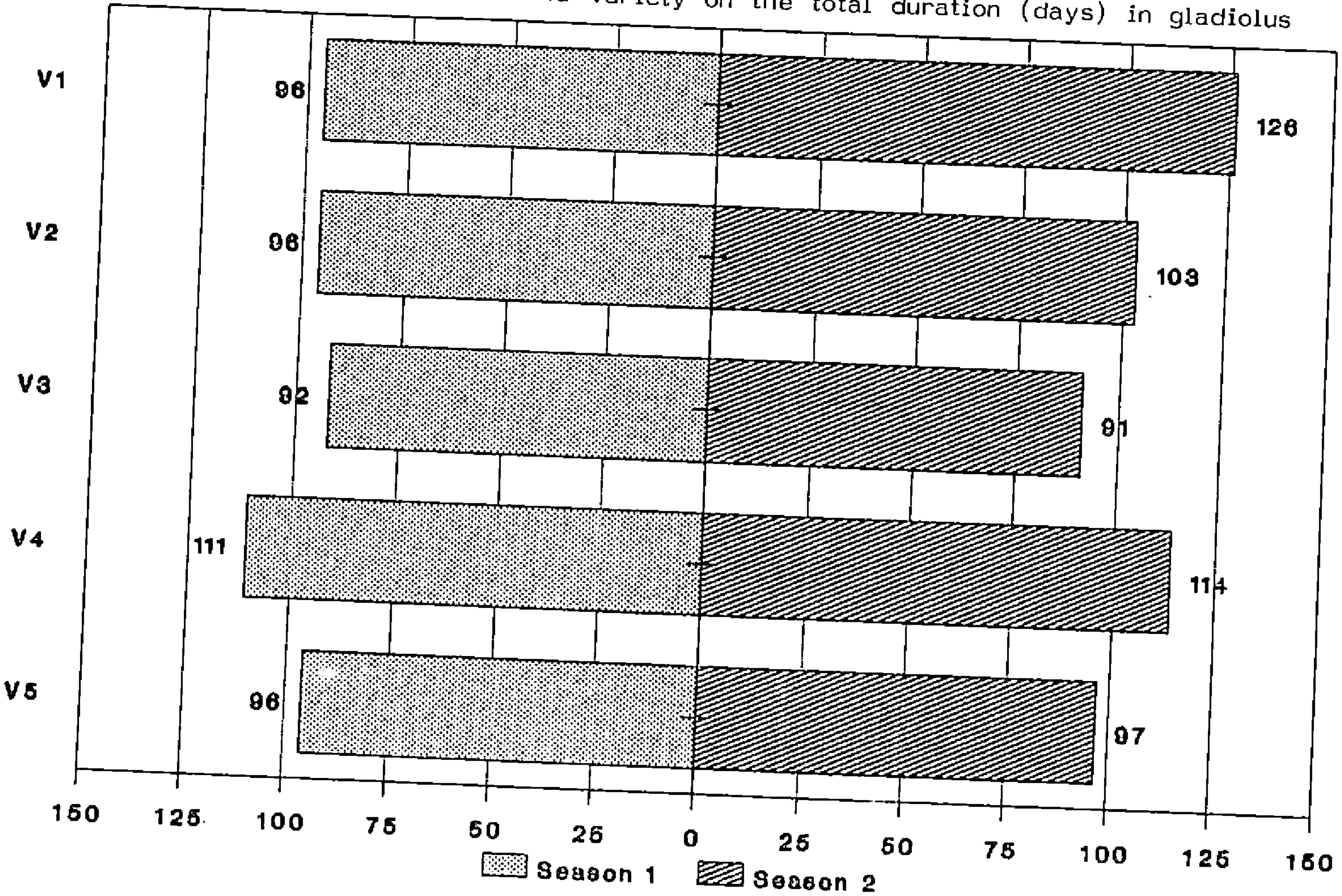


Table 21

Effect of treatments on the spike characters of gladiolus cv. Agnirekha during first season

Treatment		Length of spike (cm)	Diameter of spike (cm)	Length of rachis (cm)	Number of florets/ spike	Length of floret (cm)	Size of floret (cm)
T_1	Control	43.3	0.75	32.5	12.0	9.23	7.97
T_2	TIBA 150 ppm	47.0	0.67	28.7	14.0	8.80	8.03
T_3	TIBA 300 ppm	53.3	0.77	38.3	15.3	10.23	8.93
T_4	NAA 100 ppm	53.0	0.82	37.5	15.7	10.37	8.73
T_5	NAA 200 ppm	57.6	0.83	40.7	15.7	10.00	9.47
T_6	CCC 250 ppm	59.8	0.87	39.6	12.7	10.80	8.93
T_7	CCC 500 ppm	49.8	0.73	54.4	14.0	10.10	7.97
T_8	GA 50 ppm	56.3	0.87	39.8	17.3	9.97	8.80
T_9	GA 100 ppm	54.8	0.83	34.9	15.3	10.17	9.23
T_{10}	$Ca(NO_3)_2$ 0.5%	65.1	0.80	43.9	15.3	10.63	8.87
T_{11}	$Ca(NO_3)_2$ 1.0%	55.8	0.80	31.3	13.7	9.40	8.47
T_{12}	$CaSO_4$ 0.5%	52.5	0.77	29.4	13.7	10.33	8.87
T_{13}	$CaSO_4$ 1.0%	60.7	0.83	43.5	15.3	10.10	8.90
T_{14}	KNO_3 0.5%	54.3	0.77	37.3	14.0	9.90	8.47
T_{15}	KNO_3 1.0%	54.8	0.77	36.1	15.3	10.13	9.47
T_{16}	K_2SO_4 0.5%	65.7	0.82	47.9	17.0	10.37	9.13
T_{17}	K_2SO_4 1.0%	57.0	0.60	25.9	15.3	8.80	7.70
	CD (0.05)	9.4	NS	NS	2.3	NS	NS
	SEm±	3.3	0.06	4.85	0.81	0.45	0.62

During the second season (Table 22), spikes having maximum length (84.67 cm) was produced by T_4 (NAA 100 ppm) which was on par with T_{12} ($CaSO_4$ 0.5%), T_7 (CCC 500 ppm), T_8 (GA 50 ppm), T_1 (control) and T_{16} (K_2SO_4 0.5%). Minimum length (57.67 cm) was recorded in T_{10} ($Ca(NO_3)_2$ 0.5%).

4.2.1.2. American Beauty

In this variety too, the treatments significantly influenced the spike length in both the seasons. Spike having maximum length (73.60 cm) was produced by T_8 (GA 50 ppm) during the first season (Table 23) which was on par with T_2 (TIBA 150 ppm) and T_{13} ($CaSO_4$ 1.0%). Minimum length (51.0 cm) was recorded in T_4 (NAA 100 ppm).

During the second season (Table 24), T_5 (NAA 200 ppm) produced the longest spike (73.33 cm) which was on par with T_{14} (KNO_3 0.5%). T_6 (CCC 250 ppm), T_3 (TIBA 300 ppm), T_1 (control), T_{10} ($Ca(NO_3)_2$ 0.5%) and T_{16} (K_2SO_4 0.5%). T_{13} ($CaSO_4$ 1.0%) produced the shortest spike (38.33 cm).

4.2.1.3. Friendship

The treatments could exert significant influence on the spike length in both the seasons. Spike having maximum length (76.10 cm) was produced by T_{16} (K_2SO_4 0.5%) during the first season (Table 25)

Table 22

Effect of treatments on the spike characters of gladiolus cv. Agnirekha during second season

Treatment		Length of spike (cm)	Diameter of spike (cm)	Length of rachis (cm)	Number of florets/ spike	Length of floret (cm)	Size of floret (cm)
T_1	Control	78.00	0.80	47.33	14.00	11.33	9.67
T_2	TIBA 150 ppm	72.67	0.80	42.00	15.00	9.77	9.00
T_3	TIBA 300 ppm	71.33	0.90	45.33	14.00	11.33	9.70
T_4	NAA 100 ppm	84.67	0.80	51.33	14.00	11.77	9.60
T_5	NAA 200 ppm	71.00	0.77	49.00	14.67	11.07	9.24
T_6	CCC 250 ppm	74.33	0.70	48.33	13.33	11.13	9.50
T_7	CCC 500 ppm	80.33	0.73	53.00	14.33	11.13	9.60
T_8	GA 50 ppm	79.00	0.73	43.00	13.00	9.83	9.23
T_9	GA 100 ppm	70.33	0.73	47.00	15.33	11.33	9.90
T_{10}	$Ca(NO_3)_2$ 0.5%	57.67	0.63	33.67	11.00	10.33	8.33
T_{11}	$Ca(NO_3)_2$ 1.0%	71.00	0.77	45.33	15.00	9.80	8.33
T_{12}	$CaSO_4$ 0.5%	81.33	0.70	48.00	15.00	11.27	9.47
T_{13}	$CaSO_4$ 1.0%	73.00	0.90	40.33	17.00	9.77	8.63
T_{14}	KNO_3 0.5%	69.00	0.72	38.33	12.67	10.17	8.33
T_{15}	KNO_3 1.0%	69.67	0.72	40.00	13.33	9.87	8.00
T_{16}	K_2SO_4 0.5%	75.67	0.83	44.33	14.67	10.43	8.67
T_{17}	K_2SO_4 1.0%	73.00	0.67	47.33	13.33	9.83	8.50
	CD (0.05)	8.92	0.09	6.94	1.96	NS	NS
	SEm±	3.10	0.03	2.42	0.68	0.46	0.41

Table 23
Effect of treatments on the spike characters of gladiolus cv. American Beauty during first season

Treatment		Length of spike (cm)	Diameter of spike (cm)	Length of rachis (cm)	Number of florets/ spike	Length of floret (cm)	Size of floret (cm)
T_1	Control	55.3	0.83	39.4	13.3	10.00	10.00
T_2	TIBA 150 ppm	69.9	0.93	10.8	15.7	10.83	11.10
T_3	TIBA 300 ppm	61.1	0.77	10.8	14.0	10.77	10.60
T_4	NAA 100 ppm	51.0	0.80	33.6	13.7	10.53	10.73
T_5	NAA 200 ppm	61.3	0.75	10.8	14.0	10.80	10.53
T_6	CCC 250 ppm	62.7	0.97	10.4	14.3	10.37	9.87
T_7	CCC 500 ppm	59.5	0.83	43.7	14.0	10.43	10.93
T_8	GA 50 ppm	73.6	1.03	56.3	16.7	11.03	11.70
T_9	GA 100 ppm	65.5	0.93	49.7	15.7	10.33	11.07
T_{10}	$Ca(NO_3)_2$ 0.5%	59.3	0.90	48.4	16.0	10.97	11.60
T_{11}	$Ca(NO_3)_2$ 1.0%	53.1	0.77	10.9	12.7	10.97	11.33
T_{12}	$CaSO_4$ 0.5%	63.2	0.90	10.1	14.3	10.13	10.43
T_{13}	$CaSO_4$ 1.0%	66.1	0.83	47.0	14.7	10.47	10.57
T_{14}	KNO_3 0.5%	62.1	0.87	43.3	15.7	10.23	11.23
T_{15}	KNO_3 1.0%	51.4	0.90	35.7	13.0	10.20	10.17
T_{16}	K_2SO_4 0.5%	64.6	0.90	47.2	15.3	10.27	10.03
T_{17}	K_2SO_4 1.0%	65.0	1.07	44.9	16.0	10.33	11.23
	CD (0.050	7.3	NS	9.9	1.8	NS	NS
	SEm±	2.5	0.65	3.43	0.62	0.37	0.54

Table 25

Effect of treatments on the spike characters of gladiolus cv. Friendship during first season

Treatment		Length of spike (cm)	Diameter of spike (cm)	Length of rachis (cm)	Number of florets/ spike	Length of floret (cm)	Size of floret (cm)
T_1	Control	61.5	0.9	46.6	14.0	11.90	9.10
T_2	TIBA 150 ppm	49.7	0.77	31.0	11.7	10.47	9.77
T_3	TIBA 300 ppm	71.9	0.93	47.8	14.0	11.17	10.83
T_4	NAA 100 ppm	55.3	0.77	38.1	12.7	11.23	10.63
T_5	NAA 200 ppm	54.7	0.73	38.5	13.0	10.03	9.87
T_6	CCC 250 ppm	50.7	0.73	32.3	11.3	10.37	9.60
T_7	CCC 500 ppm	58.4	0.90	41.6	14.3	11.47	11.50
T_8	GA 50 ppm	75.4	0.92	55.0	16.0	11.83	11.57
T_9	GA 100 ppm	74.2	0.95	51.1	15.0	11.40	12.00
T_{10}	$Ca(NO_3)_2$ 0.5%	52.6	0.80	37.4	11.0	9.77	10.20
T_{11}	$Ca(NO_3)_2$ 1.0%	65.7	0.83	43.7	15.0	11.37	9.73
T_{12}	$CaSO_4$ 0.5%	61.4	0.83	40.0	13.7	11.10	11.23
T_{13}	$CaSO_4$ 1.0%	73.4	0.93	55.7	16.0	11.30	11.57
T_{14}	KNO_3 0.5%	67.9	0.83	45.1	14.3	11.60	11.73
T_{15}	KNO_3 1.0%	60.7	0.83	44.1	14.0	11.47	11.03
T_{16}	K_2SO_4 0.5%	76.1	0.93	55.0	15.3	11.93	11.10
T_{17}	K_2SO_4 1.0%	46.0	0.77	31.1	11.0	10.27	9.97
	CD (0.05)	15.8	0.15	12.4	3.2	NS	NS
	SEm±	5.4	0.05	4.3	1.1	0.75	0.62

Table 24

Effect of treatments on the spike character of gladiolus cv. American Beauty during second season

Treatment		Length of spike (cm)	Diameter of spike (cm)	Length of rachis (cm)	Number of florets/ spike	Length of floret (cm)	Size of floret (cm)
T_1	Control	53.33	0.82	45.00	14.00	10.00	9.40
T_2	TIBA 150 ppm	40.00	0.65	19.00	7.00	8.50	8.27
T_3	TIBA 300 ppm	62.33	0.58	32.00	12.33	9.43	9.13
T_4	NAA 100 ppm	57.00	0.73	29.67	10.67	9.17	9.07
T_5	NAA 200 ppm	73.33	0.80	43.67	13.67	9.00	9.00
T_6	CCC 250 ppm	65.33	0.95	45.00	12.67	9.53	9.27
T_7	CCC 500 ppm	41.33	0.82	24.33	8.67	8.47	9.23
T_8	GA 50 ppm	55.00	0.93	36.33	13.33	9.73	9.90
T_9	GA 100 ppm	51.33	0.85	35.67	14.00	9.90	9.20
T_{10}	$Ca(NO_3)_2$ 0.5%	59.00	0.87	38.67	13.00	9.50	9.73
T_{11}	$Ca(NO_3)_2$ 1.0%	48.33	0.78	25.00	11.67	9.43	8.40
T_{12}	$CaSO_4$ 0.5%	47.33	0.65	24.00	7.00	9.10	9.33
T_{13}	$CaSO_4$ 1.0%	38.33	0.60	18.00	8.00	9.37	9.43
T_{14}	KNO_3 0.5%	66.00	0.82	46.00	12.33	10.40	9.53
T_{15}	KNO_3 1.0%	48.00	0.77	31.33	10.67	10.20	9.07
T_{16}	K_2SO_4 0.5%	58.67	0.82	40.00	12.67	9.17	9.77
T_{17}	K_2SO_4 1.0%	52.67	0.73	33.67	11.67	9.17	9.43
	CD (0.05)	15.97	0.12	10.94	2.80	NS	NS
	SEm±	5.56	0.04	3.81	0.98	0.47	0.30

Table 25

Effect of treatments on the spike characters of gladiolus cv. Friendship during first season

	Treatment	Length of spike (cm)	Diameter of spike (cm)	Length of rachis (cm)	Number of florets/ spike	Length of floret (cm)	Size of floret (cm)
T_1	Control	61.5	0.9	46.6	14.0	11.90	9.10
T_2	TIBA 150 ppm	49.7	0.77	31.0	11.7	10.47	9.77
T_3	TIBA 300 ppm	71.9	0.93	47.8	14.0	11.17	10.83
T_4	NAA 100 ppm	55.3	0.77	38.1	12.7	11.23	10.63
T_5	NAA 200 ppm	54.7	0.73	38.5	13.0	10.03	9.87
T_6	CCC 250 ppm	50.7	0.73	32.3	11.3	10.37	9.60
T_7	CCC 500 ppm	58.4	0.90	41.6	14.3	11.47	11.50
T_8	GA 50 ppm	75.4	0.92	55.0	16.0	11.83	11.57
T_9	GA 100 ppm	74.2	0.95	51.1	15.0	11.40	12.00
T_{10}	$Ca(NO_3)_2$ 0.5%	52.6	0.80	37.4	11.0	9.77	10.20
T_{11}	$Ca(NO_3)_2$ 1.0%	65.7	0.83	43.7	15.0	11.37	9.73
T_{12}	$CaSO_4$ 0.5%	61.4	0.83	40.0	13.7	11.10	11.23
T_{13}	$CaSO_4$ 1.0%	73.4	0.93	55.7	16.0	11.30	11.57
T_{14}	KNO_3 0.5%	67.9	0.83	45.1	14.3	11.60	11.73
T_{15}	KNO_3 1.0%	60.7	0.83	44.1	14.0	11.47	11.03
T_{16}	K_2SO_4 0.5%	76.1	0.93	55.0	15.3	11.93	11.10
T_{17}	K_2SO_4 1.0%	46.0	0.77	31.1	11.0	10.27	9.97
	CD (0.05)	15.8	0.15	12.4	3.2	NS	NS
	SEm±	5.4	0.05	4.3	1.1	0.75	0.62

which was on par with T_8 (GA 50 ppm), T_9 (GA 100 ppm), T_{13} ($CaSO_4$ 1.0%), T_3 (TIBA 300 ppm), T_{14} (KNO_3 0.5%) and T_{11} ($Ca(NO_3)_2$ 1.0%). The minimum length (46.0 cm) was recorded in T_{17} (K_2SO_4 1.0%).

During the second season (Table 26), T_3 (TIBA 300 ppm) produced the longest spike (79.00 cm) and T_{15} (KNO_3 1.0%) the shortest (46.33 cm). T_3 (TIBA 300 ppm) was found to be on par with T_{17} (K_2SO_4 1.0%), T_6 (CCC 250 ppm), T_1 (control) and T_8 (GA 50 ppm).

4.2.1.4. Mansoer Red

Effect of treatments was significant in this variety during both the seasons. T_{12} ($CaSO_4$ 0.5%) produced the longest spike (72.40 cm) during the first season (Table 27) which was on par with T_8 (GA 50 ppm), T_{14} (KNO_3 0.5%), T_7 (CCC 500 ppm), T_{16} (K_2SO_4 0.5%), T_{13} ($CaSO_4$ 1.0%), T_{17} (K_2SO_4 1.0%), T_5 (NAA 200 ppm), T_{11} ($Ca(NO_3)_2$ 1.0%), T_9 (GA 100 ppm) and T_4 (NAA 100 ppm). T_6 (CCC 250 ppm) produced the shortest spike (42.40 cm).

During the second season (Table 28), the longest spike (76.67 cm) was produced by T_6 (CCC 250 ppm) which was on par with T_{16} (K_2SO_4 0.5%), T_8 (GA 50 ppm), T_1 (control). T_{11} ($Ca(NO_3)_2$ 1.0%), T_9 (GA 100 ppm) and T_7 (CCC 500 ppm). The

Table 26

Effect of treatments on the spike characters of gladiolus cv. Friendship during second season

Treatment		Length of spike (cm)	Diameter of spike (cm)	Length of rachis (cm)	Number of florets/ spike	Length of floret (cm)	Size of floret (cm)
T_1	Control	70.33	0.72	44.33	12.00	11.03	10.07
T_2	TIBA 150 ppm	56.67	0.61	33.33	10.00	10.30	9.87
T_3	TIBA 300 ppm	79.00	0.72	46.33	13.67	11.10	10.90
T_4	NAA 100 ppm	52.67	0.50	30.00	7.33	10.50	9.03
T_5	NAA 200 ppm	56.00	0.50	34.33	9.00	10.93	10.10
T_6	CCC 250 ppm	73.00	0.73	51.00	15.00	11.50	10.87
T_7	CCC 500 ppm	64.67	0.72	40.00	12.67	10.83	10.40
T_8	GA 50 ppm	67.00	0.72	40.67	13.67	11.53	10.50
T_9	GA 100 ppm	58.33	0.70	39.00	12.67	11.30	10.40
T_{10}	$Ca(NO_3)_2$ 0.5%	56.67	0.72	33.33	10.67	11.20	10.53
T_{12}	$Ca(NO_3)_2$ 1.0%	62.33	0.73	40.00	11.67	10.00	10.00
T_{13}	$CaSO_4$ 0.5%	51.33	0.68	39.00	11.33	11.57	10.00
T_{13}	$CaSO_4$ 1.0%	51.33	0.60	33.00	9.67	10.00	10.33
T_{14}	KNO_3 0.5%	52.67	0.72	32.33	11.00	10.70	10.03
T_{15}	KNO_3 1.0%	46.33	0.70	29.33	10.00	10.70	9.60
T_{16}	K_2SO_4 0.5%	59.00	0.63	34.00	12.67	10.87	9.00
T_{17}	K_2SO_4 1.0%	75.67	0.73	51.67	13.67	11.30	10.17
	CD (0.050	12.95	0.11	8.40	2.68	NS	NS
	SEm±	4.50	0.04	2.93	0.94	0.38	0.33

Table 27

Effect of treatments on the spike characters of gladiolus cv. Mansoer Red during first season

Treatment		Length of spike (cm)	Diameter of spike (cm)	Length of rachis (cm)	Number of florets/ spike	Length of floret (cm)	Size of floret (cm)
T_1	Control	47.5	0.62	33.7	13.0	8.97	7.83
T_2	TIBA 150 ppm	46.0	0.63	32.7	14.3	8.77	7.60
T_3	TIBA 300 ppm	45.0	0.65	33.7	14.0	8.97	7.83
T_4	NAA 100 ppm	59.7	0.75	40.8	15.0	9.97	8.03
T_5	NAA 200 ppm	61.3	0.77	41.6	15.7	10.37	9.20
T_6	CCC 250 ppm	42.4	0.68	34.4	12.7	8.83	9.00
T_7	CCC 500 ppm	64.2	0.72	44.0	16.7	10.30	8.10
T_8	GA 50 ppm	71.2	0.87	43.6	17.3	11.00	8.73
T_9	GA 100 ppm	61.2	0.77	46.3	15.7	10.37	8.40
T_{10}	$Ca(NO_3)_2$ 0.5%	51.3	0.48	38.1	14.0	9.17	7.47
T_{11}	$Ca(NO_3)_2$ 1.0%	61.3	0.77	43.2	16.3	10.13	8.59
T_{12}	$CaSO_4$ 0.5%	72.4	0.87	53.3	18.3	10.63	8.53
T_{13}	$CaSO_4$ 1.0%	63.3	0.78	50.0	16.3	10.73	7.77
T_{14}	KNO_3 0.5%	64.7	0.73	40.3	16.3	9.97	8.27
T_{15}	KNO_3 1.0%	55.5	0.73	42.3	15.0	10.20	8.10
T_{16}	K_2SO_4 0.5%	63.8	0.78	46.1	17.0	10.47	9.03
T_{17}	K_2SO_4 1.0%	63.0	0.73	50.8	16.3	10.33	7.47
	CD (0.050	16.2	NS	NS	3.0	NS	NS
	SEm±	5.6	0.45	4.7	1.0	0.57	0.79

Table 27

Effect of treatments on the spike characters of gladiolus cv. Mansoer Red during first season

Treatment		Length of spike (cm)	Diameter of spike (cm)	Length of rachis (cm)	Number of florets/ spike	Length of floret (cm)	Size of floret (cm)
T_1	Control	47.5	0.62	33.7	13.0	8.97	7.83
T_2	TIBA 150 ppm	46.0	0.63	32.7	14.3	8.77	7.60
T_3	TIBA 300 ppm	45.0	0.65	33.7	14.0	8.97	7.83
T_4	NAA 100 ppm	59.7	0.75	40.8	15.0	9.97	8.03
T_5	NAA 200 ppm	61.3	0.77	41.6	15.7	10.37	9.20
T_6	CCC 250 ppm	42.4	0.68	34.4	12.7	8.83	9.00
T_7	CCC 500 ppm	64.2	0.72	44.0	16.7	10.30	8.10
T_8	GA 50 ppm	71.2	0.87	43.6	17.3	11.00	8.73
T_9	GA 100 ppm	61.2	0.77	46.3	15.7	10.37	8.40
T_{10}	$Ca(NO_3)_2$ 0.5%	51.3	0.48	38.1	14.0	9.17	7.47
T_{11}	$Ca(NO_3)_2$ 1.0%	61.3	0.77	43.2	16.3	10.13	8.59
T_{12}	$CaSO_4$ 0.5%	72.4	0.87	53.3	18.3	10.63	8.53
T_{13}	$CaSO_4$ 1.0%	63.3	0.78	50.0	16.3	10.73	7.77
T_{14}	KNO_3 0.5%	64.7	0.73	40.3	16.3	9.97	8.27
T_{15}	KNO_3 1.0%	55.5	0.73	42.3	15.0	10.20	8.10
T_{16}	K_2SO_4 0.5%	63.8	0.78	46.1	17.0	10.47	9.03
T_{17}	K_2SO_4 1.0%	63.0	0.73	50.8	16.3	10.33	7.47
	CD (0.050	16.2	NS	NS	3.0	NS	NS
	SEm±	5.6	0.45	4.7	1.0	0.57	0.79

Table 28

Effect of treatments on the spike characters of gladiolus cv. Mansoer Red during second season

Treatment		Length of spike (cm)	Diameter of spike (cm)	Length of rachis (cm)	Number of florets/ spike	Length of floret (cm)	Size of floret (cm)
T_1	Control	74.00	0.70	46.33	12.00	11.27	8.33
T_2	TIBA 150 ppm	44.33	0.53	20.00	9.67	10.00	7.67
T_3	TIBA 300 ppm	48.67	0.63	26.67	10.00	10.20	8.40
T_4	NAA 100 ppm	49.33	0.67	31.00	8.67	10.20	8.80
T_5	NAA 200 ppm	54.33	0.67	31.00	8.67	10.13	8.00
T_6	CCC 250 ppm	76.67	0.73	45.33	13.67	10.80	8.73
T_7	CCC 500 ppm	69.67	0.63	48.00	10.00	10.83	8.67
T_8	GA 50 ppm	75.00	0.73	48.33	13.00	10.97	8.90
T_9	GA 100 ppm	71.33	0.77	44.67	14.67	10.13	8.10
T_{10}	$Ca(NO_3)_2$ 0.5%	65.67	0.63	40.67	9.00	11.17	8.13
T_{11}	$Ca(NO_3)_2$ 1.0%	73.00	0.73	45.67	11.67	10.50	8.90
T_{12}	$CaSO_4$ 0.5%	66.00	0.73	37.67	11.00	10.33	8.03
T_{13}	$CaSO_4$ 1.0%	64.00	0.63	35.33	8.67	10.33	8.33
T_{14}	KNO_3 0.5%	64.00	0.70	41.33	12.00	10.80	8.33
T_{15}	KNO_3 1.0%	52.67	0.65	30.33	10.00	10.73	8.20
T_{16}	K_2SO_4 0.5%	76.33	0.73	48.00	12.33	10.50	8.80
T_{17}	K_2SO_4 1.0%	52.33	0.53	33.33	9.00	10.90	7.47
	CD (0.05)	9.11	0.09	8.60	2.26	NS	NS
	SEm±	3.17	0.03	3.00	0.79	0.41	0.36

minimum spike length (44.33 cm) was recorded in T_2 (TIBA 150 ppm).

4.2.1.5. True Yellow

The influence of the treatments on the length of spike was insignificant in this variety during the first season (Table 29). The longest spike (77.67 cm) was produced by T_6 (CCC 250 ppm) during the second season which was on par with T_7 (CCC 500 ppm), T_8 (GA 50 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%), T_{11} ($Ca(NO_3)_2$ 1.0%), T_{14} (KNO_3 0.5%), T_{15} (KNO_3 1.0%), T_5 (NAA 200 ppm), T_3 (TIBA 300 ppm) and T_{12} ($CaSO_4$ 0.5%). T_1 (control) produced the shortest (50.00 cm) spike (Table 30).

In the case of spike length also, the effect of season was prominant only in Agnirekha and True Yellow. In both the varieties the length of spike was more during the second season (Fig. 5). Among the varieties, V_3 (Friendship) had the longest spike (62.00 cm) during the first season and V_1 (Agnirekha) replaced it during the second season (74.00 cm). The minimum length was recorded by V_5 (True Yellow) during the first season (49.00 cm) and by V_2 (American Beauty) during the second season (54.00 cm).

Table 29

Effect of treatments on the spike characters of gladiolus cv. True Yellow during first season

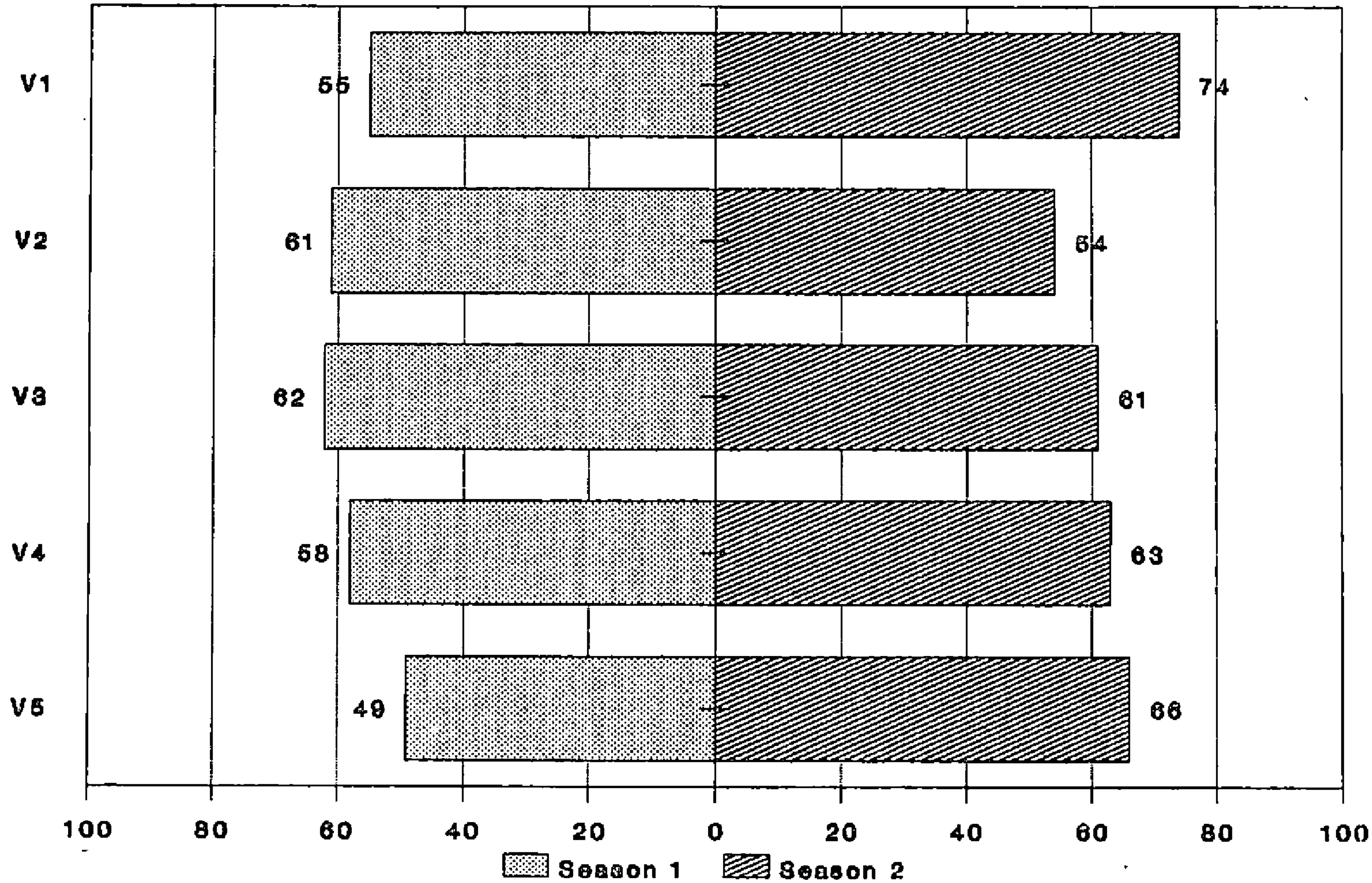
Treatment		Length of spike (cm)	Diameter of spike (cm)	Length of rachis (cm)	Number of florets/ spike	Length of floret (cm)	Size of floret (cm)
T_1	Control	51.8	0.77	33.8	7.7	10.80	11.10
T_2	TIBA 150 ppm	53.9	0.87	39.00	10.0	10.97	10.57
T_3	TIBA 300 ppm	51.1	0.87	36.4	9.7	11.37	10.30
T_4	NAA 100 ppm	55.9	0.85	39.1	10.7	10.20	10.27
T_5	NAA 200 ppm	47.1	0.68	30.8	9.7	11.10	10.30
T_6	CCC 250 ppm	44.4	0.80	34.6	9.0	10.47	10.73
T_7	CCC 500 ppm	55.3	0.83	38.4	10.3	11.20	11.80
T_8	GA 50 ppm	50.8	0.83	35.7	10.3	10.67	10.53
T_9	GA 100 ppm	43.6	6.70	29.3	9.7	11.37	11.13
T_{10}	$Ca(NO_3)_2$ 0.5%	50.4	0.75	36.0	10.0	11.37	10.80
T_{11}	$Ca(NO_3)_2$ 1.0%	47.3	0.73	30.6	8.7	11.00	10.53
T_{12}	$CaSO_4$ 0.5%	47.8	0.88	35.6	9.3	9.97	10.33
T_{13}	$CaSO_4$ 1.0%	54.3	0.83	38.7	9.7	11.13	10.63
T_{14}	KNO_3 0.5%	53.8	0.83	39.5	10.3	11.50	11.50
T_{15}	KNO_3 1.0%	43.9	0.77	31.2	9.3	10.50	9.87
T_{16}	K_2SO_4 0.5%	37.6	0.57	23.7	6.7	8.90	9.80
T_{17}	K_2SO_4 1.0%	46.0	0.70	34.2	7.7	10.47	10.40
	CD (0.05)	NS	NS	NS	1.4	NS	NS
	S Em±	5.89	0.06	4.3	0.4	0.67	0.53

Table 30

Effect of treatments on the spike characters of gladiolus cv. True Yellow during second season

Treatment		Length of spike (cm)	Diameter of spike (cm)	Length of rachis (cm)	Number of florets/ spike	Length of floret (cm)	Size of floret (cm)
T_1	Control	50.00	0.72	29.67	7.67	9.00	9.50
T_2	TIBA 150 ppm	63.00	0.67	37.00	7.33	10.40	9.73
T_3	TIBA 300 ppm	68.00	0.67	48.67	11.00	10.83	10.50
T_4	NAA 100 ppm	62.00	0.50	26.00	7.33	9.87	8.57
T_5	NAA 200 ppm	69.33	0.60	48.67	9.00	10.07	10.57
T_6	CCC 250 ppm	77.67	0.62	45.33	11.00	10.57	9.97
T_7	CCC 500 ppm	75.00	0.70	45.67	8.67	10.40	9.03
T_8	GA 50 ppm	72.67	0.57	42.67	9.00	10.23	10.07
T_9	GA 100 ppm	59.67	0.60	33.33	8.00	10.27	9.03
T_{10}	$Ca(NO_3)_2$ 0.5%	72.67	0.60	51.67	10.00	10.00	10.00
T_{11}	$Ca(NO_3)_2$ 1.0%	72.67	0.78	44.00	13.00	10.00	10.83
T_{12}	$CaSO_4$ 0.5%	65.67	0.62	38.33	9.00	10.00	9.73
T_{13}	$CaSO_4$ 1.0%	57.67	0.52	24.67	8.00	10.13	9.33
T_{14}	KNO_3 0.5%	70.00	0.53	39.00	8.00	9.00	9.33
T_{15}	KNO_3 1.0%	70.00	0.70	44.67	10.67	10.57	10.00
T_{16}	K_2SO_4 0.5%	57.00	0.53	31.00	6.67	10.77	9.90
T_{17}	K_2SO_4 1.0%	54.33	0.60	32.00	7.00	10.67	9.13
	CD (0.05)	13.03	0.16	11.85	2.45	NS	NS
	SEm±	4.53	0.05	4.13	0.86	0.42	0.54

Fig. 5. Effect of season and variety on spike length (cm) in gladiolus



4.2.2. Diameter of spike

4.2.2.1. Agnirekha

The treatments failed to influence the diameter of spike in this variety during the first season (Table 21).

During the second season (Table 22), T_3 (TIBA 300 ppm) and T_{13} ($CaSO_4$ 1.0%) produced the maximum spike diameter (0.90 cm, each) which were on par with T_{16} (K_2SO_4 0.5%). Minimum diameter of spike (0.63 cm) was recorded in T_{10} ($Ca(NO_3)_2$ 0.5%).

4.2.2.2. American Beauty

In this variety also the treatments could not exert any significant influence on the diameter of spike during the first season (Table 23). During the second season (Table 24), spike of maximum diameter (0.95 cm) was produced by T_6 (CCC 250 ppm) and of minimum diameter (0.58 cm) by T_3 (TIBA 300 ppm). T_6 (CCC 250 ppm) was found to be on par with T_8 (GA 50 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%) and T_9 (GA 100 ppm).

4.2.2.3. Friendship

In both the seasons significant difference could be observed in the diameter of spike in this variety. T_9 (GA 100 ppm) produced spike with maximum diameter (0.95 cm) during the first season

(Table 25) which was on par with T_3 (TIBA 300 ppm), T_{13} ($CaSO_4$ 1.0%), T_{16} (K_2SO_4 0.5%), T_8 (GA 50 ppm), T_1 (control), T_7 (CCC 500 ppm), T_{11} ($Ca(NO_3)_2$ 1.0%). T_{12} ($CaSO_4$ 0.5%), T_{14} (KNO_3 0.5%) and T_{15} (KNO_3 1.0%). Minimum spike diameter (0.73 cm, each) was recorded in T_5 (NAA 200 ppm) and T_6 (CCC 250 ppm).

During the second season (Table 26), T_6 (CCC 250 ppm), T_{11} ($Ca(NO_3)_2$ 1.0%) and T_{17} (K_2SO_4 1.0%) produced spikes with maximum diameter (0.73 cm, each) which were on par with T_1 (control), T_3 (TIBA 300 ppm), T_7 (CCC 500 ppm), T_8 (GA 50 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%), T_{14} (KNO_3 0.5%), T_{15} (KNO_3 1.0%), T_{12} ($CaSO_4$ 0.5%) and T_{16} (K_2SO_4 0.5%). Spikes with minimum diameter (0.50 cm, each) were produced by T_4 (NAA 100 ppm) and T_5 (NAA 200 ppm).

4.2.2.4. Mansoer Red

In this variety, the treatments failed to significantly influence the diameter of spike during the first season (Table 27).

During the second season (Table 28), T_9 (GA 100 ppm) produced spike with maximum diameter (0.77 cm) which was on par with T_6 (CCC 250 ppm), T_8 (GA 50 ppm), T_{11} ($Ca(NO_3)_2$ 1.0%), T_{12} ($CaSO_4$ 0.5%), T_{16} (K_2SO_4 0.5%) and T_1 (control). T_2 (TIBA

150 ppm) and T_{17} (K_2SO_4 1.0%) produced spikes with minimum diameter (0.53 cm, each).

4.2.2.5. True Yellow

The influence of the treatments on the diameter of spike was insignificant in this variety also during the first season (Table 29).

During the second season (Table 30), T_{11} ($Ca(NO_3)_2$ 1.0%) produced spike with maximum diameter (0.78 cm) which was on par with T_1 (control), T_7 (CCC 500 ppm), T_{15} (KNO_3 1.0%), T_2 (TIBA 150 ppm) and T_3 (TIBA 300 ppm). Spike with minimum diameter (0.50 cm) was produced by T_4 (NAA 100 ppm).

4.2.3. Length of rachis

4.2.3.1. Agnirekha

Influence of the treatments on the length of rachis was insignificant in this variety, during the first season (Table 21).

During the second season (Table 22) the treatments significantly influenced this character. Longest rachis (53.00 cm) was produced by T_7 (CCC 500 ppm) which was on par with T_4 (NAA 100 ppm), T_5 (NAA 200 ppm), T_6 (CCC 250 ppm), T_{12} ($CaSO_4$ 0.5%), T_1 (control), T_{17} (K_2SO_4 1.0%) and T_9 (GA 100 ppm). Shortest rachis (33.67 cm) was produced by T_{10} ($Ca(NO_3)_2$ 0.5%).

4.2.3.2. American Beauty

In this variety, the treatments exerted significant influence on the length of rachis during both the seasons. During the first season (Table 23), longest rachis (56.30 cm) was produced by T_8 (GA 50 ppm) which was on par with T_{13} ($CaSO_4$ 1.0%), T_{17} (K_2SO_4 1.0%), T_7 (CCC 500 ppm) and T_{14} (KNO_3 0.5%). Shortest rachis (10.10 cm) was recorded in T_{12} ($CaSO_4$ 0.5%).

During the second season (Table 24), T_{14} (KNO_3 0.5%) produced the longest rachis (46.01 cm) which was on par with T_1 (control), T_6 (CCC 250 ppm), T_5 (NAA 200 ppm), T_{16} (K_2SO_4 0.5%), T_{10} $(CaNO_3)_2$ 0.5%), T_8 (GA 50 ppm) and T_9 (GA 100 ppm). T_{13} ($CaSO_4$ 1.0%) produced the shortest (18.00 cm) rachis.

4.2.3.3. Friendship

The treatments exerted significant influence on the length of rachis during both the seasons in this variety. During the first season (Table 25), T_{13} ($CaSO_4$ 1.0%) produced the longest rachis (55.70 cm) which was on par with T_8 (GA 50 ppm), T_{16} (K_2SO_4 0.5%), T_9 (GA 100 ppm), T_3 (TIBA 300 ppm), T_1 (control), T_{14} (KNO_3 0.5%), T_{15} (KNO_3 1.0%) and T_{11} ($Ca(NO_3)_2$ 1.0%). Shortest rachis (31.00 cm) was produced by T_2 (TIBA 150 ppm).

During the second season (Table 26), T_{17} (K_2SO_4 1.0%) produced the longest rachis (51.67 cm) which was on par with T_6 (CCC 250 ppm), T_3 (TIBA 300 ppm) and T_1 (control). T_{15} (KNO_3 1.0%) produced the shortest rachis (29.33 cm).

4.2.3.4. Mansoer Red

The influence of the treatments on the length of rachis was insignificant during the first season (Table 27).

During the second season (Table 28), longest rachis (48.33 cm) was produced by T_8 (GA 50 ppm) which was on par with T_7 (CCC 500 ppm), T_{16} (K_2SO_4 0.5%), T_1 (control), T_{11} ($Ca(NO_3)_2$ 1.0%), T_6 CCC (250 ppm), T_9 (GA 100 ppm), T_{14} (KNO_3 0.5%) and T_{10} ($Ca(NO_3)_2$ 0.5%). Shortest rachis (20.00 cm) was produced by T_2 (TIBA 150 ppm).

4.2.3.5. True Yellow

The treatments failed to influence the length of rachis in this variety during the first season (Table 29).

During the second season (Table 30) the longest rachis (51.17 cm) was produced by T_{10} ($Ca(NO_3)_2$ 0.5%) which was on par with T_3 (TIBA 300 ppm), T_5 (NAA 200 ppm), T_7 (CCC 500 ppm), T_6 (CCC 250 ppm), T_{15} (KNO_3 1.0%), T_{11} ($Ca(NO_3)_2$ 1.0%) and T_8 (GA

50 ppm). The rachis was the shortest (24.67 cm) in T_{13} ($CaSO_4$ 1.0%).

4.2.4. Number of florets per spike

4.2.4.1. Agnirekha

The influence of the treatments on the number of florets per spike was significant in this variety during both the seasons. During the first season (Table 21), T_8 (GA 50 ppm) was found to be the best treatment which produced 17.3 florets per spike and T_1 (control) was found to be the least effective treatment (12.0 florets/spike). T_8 (GA 50 ppm) was on par with T_{16} (K_2SO_4 0.5%), T_4 (NAA 100 ppm), T_5 (NAA 200 ppm), T_9 (GA 100 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%), T_3 (TIBA 300 ppm), T_{13} ($CaSO_4$ 1.0%), T_{15} (KNO_3 1.0%) and T_{17} (K_2SO_4 1.0%).

During the second season (Table 22), T_{13} ($CaSO_4$ 1.0%) emerged as the best treatment, recording 17.0 florets and was on par with T_9 (GA 100 ppm). T_{10} ($Ca(NO_3)_2$ 0.5%) produced the lowest number of florets (11.0) per spike.

4.2.4.2. American Beauty

In both the seasons, the treatments exerted significant influence on the number of florets per spike. During the first season (Table 23), T_8 (GA 50 ppm) produced the maximum number of florets per spike (16.7) which was on par with T_{10} ($Ca(NO_3)_2$ 0.5%), T_{17} (K_2SO_4 1.0%), T_2 (TIBA 150 ppm), T_9 (GA 100 ppm), T_{14} (KNO_3 0.5%) and T_{16} (K_2SO_4 0.5%). T_{11} ($Ca(NO_3)_2$ 1.0%) produced the lowest number of florets (12.7).

During the second season (Table 24), T_1 (control) and T_9 (GA 100 ppm) exhibited superior performance (14.0 florets each/ spike) which were on par with T_5 (NAA 200 ppm), T_8 (GA 50 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%), T_6 (CCC 250 ppm), T_{16} (K_2SO_4 0.5%), T_3 (TIBA 300 ppm), T_{14} (KNO_3 0.5%), T_{11} ($Ca(NO_3)_2$ 1.0%) and T_{17} (K_2SO_4 1.0%). T_2 (TIBA 150 ppm) and T_{12} ($CaSO_4$ 0.5%) produced the least number of florets (7.0/spike, each).

4.2.4.3. Friendship

In this variety, the treatments exerted significant influence on the number of florets per spike in both the seasons. During the first season (Table 25), T_{13} ($CaSO_4$ 1.0%) and T_8 (GA 50 ppm) produced the highest number of florets per spike (16.0) which were on par with T_{16} (K_2SO_4 0.5%), T_9 (GA 100 ppm), T_{11} ($Ca(NO_3)_2$ 1.0%), T_7 (CCC 500 ppm), T_{14} (KNO_3 0.5%), T_1 (control), T_3 (TIBA 300 ppm), T_{15} (KNO_3 1.0%), T_{12} ($CaSO_4$ 0.5%) and T_5 (NAA 200 ppm). T_{10} ($Ca(NO_3)_2$ 0.5%) and T_{17}(K_2SO_4 1.0%) were found to be the inferior treatments (11.0 florets, each per spike). T_6 (CCC 250 ppm) was found to be the best treatment during the

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second season (Table 26) which gave the highest number of florets (15.0). This was on par with (T_3 (TIBA 300 ppm), T_8 (GA 50 ppm), T_{17} (K_2SO_4 1.0%), T_7 (CCC 500 ppm), T_9 (GA 100 ppm) and T_{16} (K_2SO_4 0.5%). T_4 (NAA 100 ppm) produced the lowest number of florets (7.3) per spike.

4.2.4.4. Mansoer Red

Significant difference could be observed in the number of florets in this variety during both the seasons. During the first season (Table 27), T_{12} ($CaSO_4$ 0.5%) was found to be the best treatment which produced 18.3 florets per spike and was on par with T_8 (GA 50 ppm), T_{16} (K_2SO_4 0.5%), T_7 (CCC 500 ppm), T_{11} ($Ca(NO_3)_2$ 1.0%), T_{13} ($CaSO_4$ 1.0%), T_{14} (KNO_3 0.5%), T_{17} (K_2SO_4 1.0%), T_5 (NAA 200 ppm) and T_9 (GA 100 ppm). T_6 (CCC 250 ppm) produced spikes with the lowest number of florets (12.7).

During the second season (Table 28), T_9 (GA 100 ppm) recorded the maximum number of florets per spike (14.7) which was on par with T_6 (CCC 250 ppm) and T_8 (GA 50 ppm). T_4 (NAA 100 ppm), T_5 (NAA 200 ppm) and T_{13} ($CaSO_4$ 1.0%) recorded the least number of florets (8.7, each).

4.2.4.5. True Yellow

During the both the seasons the influence of the treatments on the number of florets per spike produced in this variety was significant.

During the first season (Table 29), T_4 (NAA 100 ppm) emerged as the best treatment (10.7 florets/spike) which was on par with T_7 (CCC 500 ppm), T_8 (GA 50 ppm), T_{14} (KNO_3 0.5%), T_2 (TIBA 150 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%), T_3 (TIBA 300 ppm), T_5 (NAA 200 ppm), T_9 (GA 100 ppm) and T_{13} ($CaSO_4$ 1.0%). Minimum number of florets (6.7) was recorded in T_{16} (K_2SO_4 0.5%). T_{11} ($Ca(NO_3)_2$ 1.0%) exhibited superior performance (13.0 florets) during the second season (Table 30), which was on par with T_3 (TIBA 300 ppm), T_6 (CCC 250 ppm) and T_{15} (KNO_3 1.0%). T_{16} (K_2SO_4 0.5%) was found to be inferior (6.7 florets).

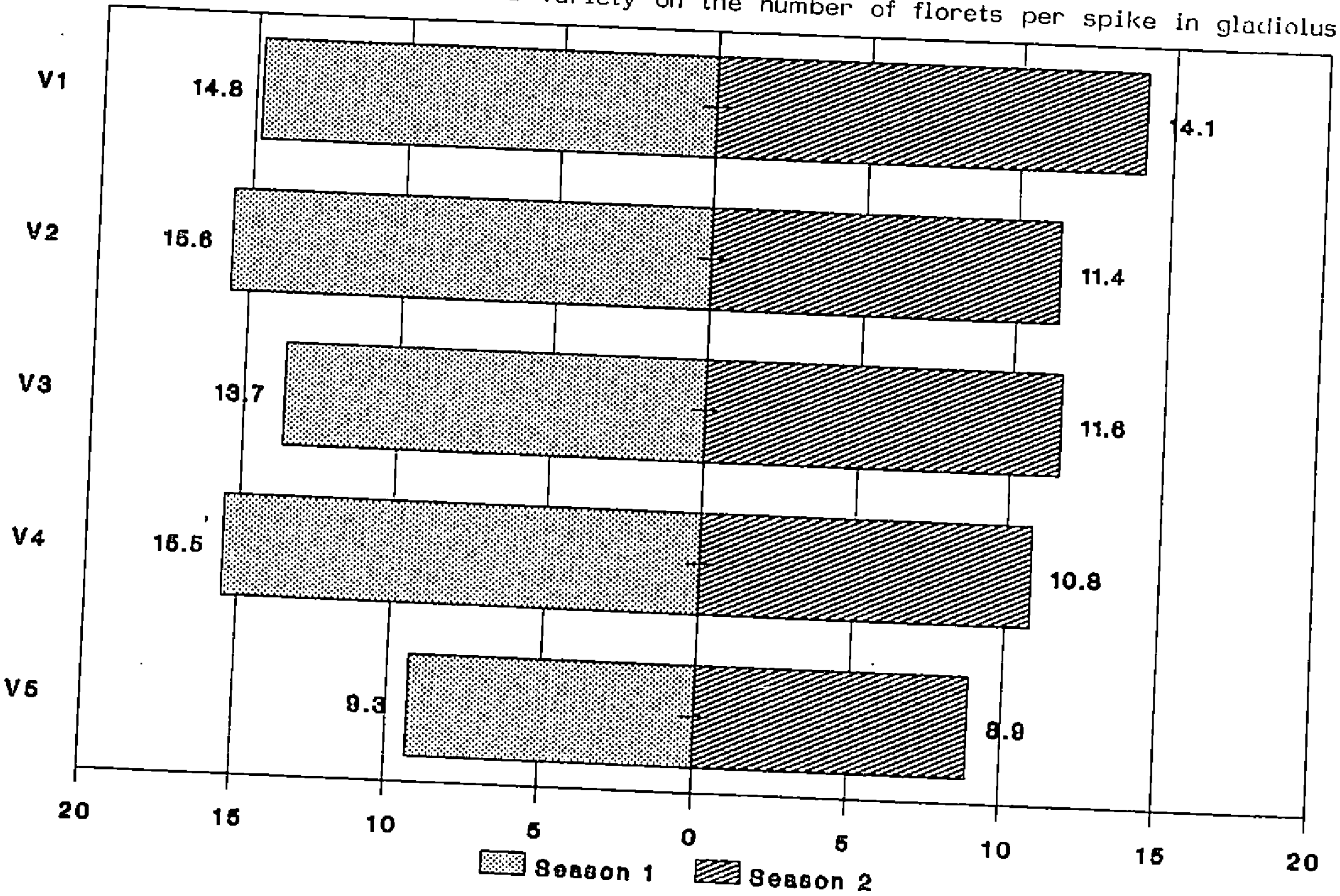
When the effect of seasons was considered irrespective of treatments, the number of florets per spike was more during the first season (Fig. 6). As regards the varieties, V_2 (American Beauty) performed well with 15.6 florets per spike during the first season and V_1 (Agnirekha) with 14.1 florets/spike during the second season. V_5 (True Yellow) was inferior in both the seasons (9.3 and 8.9 florets, respectively, in the first and second seasons).

4.2.5. Length of floret

4.2.5.1. Agnirekha

The influence of the treatments on the length of floret was

Fig. 6. Effect of season and variety on the number of florets per spike in gladiolus



insignificant in this variety during both the seasons (Table 21 and 22).

4.2.5.2. American Beauty

In this variety, the treatments could not exert significant influence on the length of floret, in both the seasons (Table 23 and 24).

4.2.5.3. Friendship

The influence of treatments on the length of floret was insignificant in this variety, in both the seasons (Table 25 and 26).

4.2.5.4. Mansoer Red

During both seasons the treatments failed to influence the length of floret in this variety (Table 27 and 28).

4.2.5.5. True Yellow

The influence of the treatments on the length of floret was insignificant in this variety also, during both the seasons (Table 29 and 30).

4.3. Post harvest observations

4.3.1. Fresh weight of spike

4.3.1.1. Agnirekha

The influence of growth regulators and nutrients on the fresh weight of spike was insignificant in this variety during the first season (Table 31). During the second season (Table 32) the maximum weight (31.95 g) was recorded in T_4 (NAA 100 ppm) which was on par with T_{13} ($CaSO_4$ 1.0%), T_6 (CCC 250 ppm), T_{16} (K_2SO_4 0.5%), T_1 (control), T_5 (NAA 200 ppm) and T_9 (GA 100 ppm). T_3 (TIBA 300 ppm) recorded the minimum weight (15.57 g).

4.3.1.2. American Beauty

In this variety also, the treatments failed to influence the fresh weight of spikes during the first season (Table 33). During the second season (Table 34) fresh weight was the maximum (35.77 g) in T_{11} ($Ca(NO_3)_2$ 1.0%), which was on par with T_3 (TIBA 300 ppm), T_6 (CCC 250 ppm), T_1 (control), T_{17} (K_2SO_4 1.0%), T_2 (TIBA 150 ppm), T_{15} (KNO_3 1.0%), T_{12} ($CaSO_4$ 0.5%), T_{13} ($CaSO_4$ 1.0%), T_4 (NAA 100 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%) and T_7 (CCC 500 ppm). Minimum fresh weight (18.07 g) was recorded in T_{14} (KNO_3 0.5%).

4.3.1.3. Friendship

The treatments could not produce significant influence in

4.2.6. Size of floret

4.2.6.1. Agnirekha

In both the seasons, the treatments could not produce any significant influence on the size of floret in this variety (Table 21 and 22).

4.2.6.2. American Beauty

The influence of the treatments on the size of floret was insignificant during both the seasons, as is evident from the data presented in Table 23 and 24.

4.2.6.3. Friendship

In this variety, the treatments failed to influence the size of floret during both the seasons (Table 25 and 26).

4.2.6.4. Mansoer Red

Effect of the treatments on the size of floret was insignificant in this variety during both the seasons (Table 27 and 28).

4.2.6.5. True Yellow

The influence of the treatments on the size of floret was insignificant during both the seasons in this variety too (Table 29 and 30).

4.3. Post harvest observations

4.3.1. Fresh weight of spike

4.3.1.1. Agnirekha

The influence of growth regulators and nutrients on the fresh weight of spike was insignificant in this variety during the first season (Table 31). During the second season (Table 32) the maximum weight (31.95 g) was recorded in T_4 (NAA 100 ppm) which was on par with T_{13} ($CaSO_4$ 1.0%), T_6 (CCC 250 ppm), T_{16} (K_2SO_4 0.5%), T_1 (control), T_5 (NAA 200 ppm) and T_9 (GA 100 ppm). T_3 (TIBA 300 ppm) recorded the minimum weight (15.57 g).

4.3.1.2. American Beauty

In this variety also, the treatments failed to influence the fresh weight of spikes during the first season (Table 33). During the second season (Table 34) fresh weight was the maximum (35.77 g) in T_{11} ($Ca(NO_3)_2$ 1.0%), which was on par with T_3 (TIBA 300 ppm), T_6 (CCC 250 ppm), T_1 (control), T_{17} (K_2SO_4 1.0%), T_2 (TIBA 150 ppm), T_{15} (KNO_3 1.0%), T_{12} ($CaSO_4$ 0.5%), T_{13} ($CaSO_4$ 1.0%), T_4 (NAA 100 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%) and T_7 (CCC 500 ppm). Minimum fresh weight (18.07 g) was recorded in T_{14} (KNO_3 0.5%).

4.3.1.3. Friendship

The treatments could not produce significant influence in

Table 31

Effect of treatments on the vase characters of gladiolus cv. Agnirekha during first season

Treatment		Weight of spike (g)	Vase life (days)	Percentage of fully opened florets	Percentage of partially opened florets	Percentage of unopened florets	Longevity of floret (days)	Number of florets opened at a time	Nature of bending		Water uptake (ml)
									From which day in vase	From which floret	
T_1	Control	25.7	6.33	56.67	16.67	26.66	2.28	3.33	5.33	5.67	50.83
T_2	TIBA 150 ppm	19.9	8.00	64.00	2.67	33.33	2.92	4.33	6.33	5.33	56.00
T_3	TIBA 300 ppm	18.3	6.33	45.00	7.67	47.33	3.60	3.67	5.06	11.33	28.00
T_4	NAA 100 ppm	18.8	7.00	54.50	4.00	41.50	2.05	3.00	6.50	11.50	25.00
T_5	NAA 200 ppm	19.5	7.00	62.33	5.00	32.66	2.13	3.00	4.33	7.67	43.67
T_6	CCC 250 ppm	16.0	4.50	41.50	12.00	46.50	2.00	3.50	4.00	12.00	58.00
T_7	CCC 500 ppm	17.9	6.67	61.33	2.33	36.33	2.54	3.33	6.00	8.33	31.33
T_8	GA 50 ppm	12.8	6.00	51.33	9.00	39.66	2.66	4.33	5.06	12.00	30.00
T_9	GA 100 ppm	19.4	7.33	50.00	2.67	47.00	3.03	3.00	6.33	7.67	42.00
T_{10}	$Ca(NO_3)_2$ 0.5%	22.9	6.50	70.00	9.00	21.00	2.05	2.50	6.00	9.50	47.28
T_{11}	$Ca(NO_3)_2$ 1.0%	15.2	6.67	57.67	5.00	37.33	2.52	3.33	4.33	7.67	25.33
T_{12}	$CaSO_4$ 0.5%	15.2	8.00	57.33	3.00	39.66	3.23	3.33	8.00	11.67	39.67
T_{13}	$CaSO_4$ 1.0%	26.2	6.67	58.33	15.33	26.33	3.10	4.00	6.33	12.00	48.67
T_{14}	KNO_3 0.5%	25.4	7.67	57.67	12.00	30.33	2.90	4.00	7.00	8.33	46.60
T_{15}	KNO_3 1.0%	13.8	6.67	64.00	0.00	36.00	2.08	3.00	6.66	11.33	41.67
T_{16}	K_2SO_2 0.5%	15.9	5.67	58.67	9.00	32.33	2.64	3.00	5.66	7.67	33.67
T_{17}	K_2SO_4 1.0%	16.9	6.67	49.33	8.33	42.33	2.83	3.00	6.66	11.00	29.00
	CD (0.05)	NS	1.13	NS	NS	NS	NS	0.64	NS	NS	NS
	SEm±	2.99	0.39	6.67	3.87	5.28	0.38	0.22	3.01	3.20	9.69

Table 32

Effect of treatments on the vase characters of gladiolus cv. Agnirekha during second season

Treatment	Weight of spike (g)	Vase life (days)	Percentage of fully opened florets	Percentage of partially opened florets	Percentage of unopened florets	Longevity of floret (days)	Number of florets opened at a time	Nature of bending		Water uptake (ml)
								From which day in vase	From which floret	
T_1 Control	25.11	8.33	67.67	5.67	26.67	2.83	3.00	8.33	7.31	26.67
T_2 TIBA 150 ppm	19.67	8.00	45.33	25.33	29.33	2.73	2.33	5.00	4.00	17.00
T_3 TIBA 300 ppm	15.57	8.33	41.33	42.67	16.00	2.60	2.33	5.55	4.62	19.33
T_4 NAA 100 ppm	31.95	11.33	74.33	4.33	21.33	8.11	3.00	7.66	5.59	40.00
T_5 NAA 200 ppm	24.63	11.00	48.00	23.00	29.00	2.78	3.33	7.30	5.59	25.33
T_6 CCC 250 ppm	26.83	10.33	46.67	34.33	19.00	3.01	3.00	7.61	5.66	32.33
T_7 CCC 500 ppm	23.60	10.00	44.67	44.67	10.67	2.60	2.67	7.28	5.89	37.33
T_8 GA 50 ppm	18.33	7.33	66.67	4.33	29.00	3.68	2.67	5.75	9.55	26.67
T_9 GA 100 ppm	24.43	8.33	66.33	8.33	25.33	3.57	3.00	5.32	3.00	31.00
T_{10} $Ca(NO_3)_2$ 0.5%	23.13	9.33	68.33	5.00	26.67	3.11	3.00	7.00	4.00	32.00
T_{11} $Ca(NO_3)_2$ 1.0%	23.70	8.33	74.33	7.33	18.33	2.68	2.67	8.14	9.55	23.67
T_{12} $CaSO_4$ 0.5%	22.90	8.00	56.67	16.00	27.33	2.54	2.67	6.75	8.23	14.33
T_{13} $CaSO_4$ 1.0%	29.40	9.00	70.67	14.33	15.00	2.79	2.33	2.00	4.40	35.00
T_{14} KNO_3 0.5%	20.51	8.00	51.00	6.00	43.00	2.78	2.67	5.00	3.96	28.67
T_{15} KNO_3 1.0%	19.52	8.00	59.00	15.00	26.00	3.00	3.00	6.64	4.00	25.33
T_{16} K_2SO_4 0.5%	26.73	6.67	61.33	6.33	32.33	2.91	3.00	5.55	10.55	29.00
T_{17} K_2SO_4 1.0%	23.00	8.33	56.00	32.00	12.00	3.13	2.67	6.49	6.64	38.33
CD (0.05)	7.76	1.46	20.47	8.45	NS	NS	NS	NS	NS	11.31
SEm±	2.71	0.51	7.13	2.95	6.35	0.23	0.32	0.20	0.24	3.94

Table 33

Effect of treatments on the vase characters of gladiolus cv. American Beauty during first season

Treatment		Weight of spike (g)	Vase life (days)	Percentage of fully opened florets	Percentage of partially opened florets	Percentage of unopened florets	Longevity of floret (days)	Number of florets opened at a time	Nature of bending		Water uptake (ml)
									From which day in vase	From which floret	
T_1	Control	32.2	5.67	24.33	28.00	47.66	2.93	2.00	5.00	3.33	46.83
T_2	TIBA 150 ppm	29.3	6.00	26.67	39.33	34.00	2.66	1.00	6.00	11.67	43.67
T_3	TIBA 300 ppm	28.7	7.67	57.33	5.67	37.00	3.16	3.00	7.33	8.33	44.50
T_4	NAA 100 ppm	29.7	7.50	50.50	18.00	31.50	3.60	2.50	7.00	4.00	47.50
T_5	NAA 200 ppm	32.5	8.33	39.67	25.67	34.66	3.90	2.33	7.00	8.33	62.33
T_6	CCC 250 ppm	34.8	7.33	43.33	20.33	36.33	3.46	3.00	7.00	8.00	79.00
T_7	CCC 500 ppm	39.8	7.67	37.00	23.00	40.00	3.20	2.00	6.00	8.00	75.00
T_8	GA 50 ppm	39.7	8.67	55.00	15.33	29.66	3.76	4.00	7.00	4.33	86.67
T_9	GA 100 ppm	19.6	8.50	7.00	42.67	50.33	2.16	4.67	8.33	11.33	50.00
T_{10}	$Ca(NO_3)_2$ 0.5%	32.7	6.67	41.00	19.33	39.66	3.06	2.67	6.00	5.00	50.00
T_{11}	$Ca(NO_3)_2$ 1.0%	29.5	5.33	19.33	39.00	41.66	2.66	1.00	5.00	4.33	46.00
T_{12}	$CaSO_4$ 0.5%	29.7	6.00	39.00	25.00	36.00	3.15	2.50	5.33	10.00	73.00
T_{13}	$CaSO_4$ 1.0%	42.7	8.67	36.33	29.33	34.33	3.23	1.67	8.50	7.67	73.33
T_{14}	KNO_3 0.5%	26.6	6.67	44.67	29.67	25.67	4.30	2.67	6.67	3.67	51.33
T_{15}	KNO_3 1.0%	24.2	7.33	56.67	15.67	27.67	3.30	2.67	7.33	4.33	66.33
T_{16}	K_2SO_4 0.5%	32.6	4.00	6.50	43.00	50.50	2.25	2.50	4.00	4.50	56.50
T_{17}	K_2SO_4 1.0%	29.3	7.00	49.00	17.67	33.33	3.56	4.00	7.00	8.67	75.67
	CD (0.05)	NS	1.93	NS	NS	NS	NS	1.32	NS	NS	18.75
	SEm±	4.45	0.67	12.60	7.67	6.37	0.51	0.46	2.32	2.36	6.53

Table 34
Effect of treatments on the vase characters of gladiolus cv. American Beauty during second season

Treatment		Weight of spike (g)	Vase life (days)	Percentage of fully opened florets	Percentage of partially opened florets	Percentage of unopened florets	Longevity of floret (days)	Number of florets opened at a time	Nature of bending: from which day in vase	Nature of bending: from which floret	Water uptake (ml)
T_1	Control	34.31	8.33	36.67	19.33	44.00	3.37	3.00	6.71	9.33	35.33
T_2	TIBA 150 ppm	32.63	4.33	47.33	7.67	45.00	3.70	3.00	3.88	7.92	30.67
T_3	TIBA 300 ppm	35.53	6.33	37.67	8.00	54.33	2.60	2.33	6.00	9.32	28.00
T_4	NAA 100 ppm	31.47	8.33	37.67	21.00	38.00	3.20	1.67	6.98	8.92	29.33
T_5	NAA 200 ppm	25.08	2.67	18.67	31.00	50.00	2.07	1.67	2.00	9.00	22.33
T_6	CCC 250 ppm	35.42	7.00	35.67	19.67	45.00	3.13	2.67	6.88	6.99	26.67
T_7	CCC 500 ppm	28.06	5.00	23.67	21.67	54.33	3.27	2.00	5.00	9.00	26.67
T_8	GA 50 ppm	18.71	5.00	24.33	22.00	57.00	3.80	1.67	4.23	8.23	19.67
T_9	GA 100 ppm	19.40	5.67	28.67	21.00	55.33	1.80	1.67	4.29	8.25	11.67
T_{10}	$Ca(NO_3)_2$ 0.5%	28.27	8.00	45.67	17.33	37.00	5.80	3.00	7.59	9.00	27.69
T_{11}	$Ca(NO_3)_2$ 1.0%	35.77	5.33	19.33	25.33	55.33	4.17	1.33	4.86	6.27	21.33
T_{12}	$CaSO_4$ 0.5%	31.97	6.33	20.33	25.00	54.67	3.00	2.00	6.33	7.61	27.33
T_{13}	$CaSO_4$ 1.0%	31.77	7.00	31.33	10.67	52.00	3.77	2.67	6.96	8.96	11.33
T_{14}	KNO_3 0.5%	18.07	6.33	33.00	13.33	53.67	3.60	1.67	5.14	6.43	15.00
T_{15}	KNO_3 1.0%	32.24	6.00	25.00	30.00	44.33	3.80	2.33	5.29	7.52	29.00
T_{16}	K_2SO_4 0.5%	20.85	5.00	36.67	11.33	51.33	3.17	2.00	5.00	9.00	15.00
T_{17}	K_2SO_4 1.0%	33.81	6.00	37.00	23.00	39.67	2.80	2.33	5.40	8.97	28.67
	CD (0.05)	9.86	2.24	NS	13.80	11.98	1.80	NS	NS	NS	12.80
	SEm±	3.43	0.78	6.57	4.80	4.17	0.63	0.61	0.24	0.27	4.46

this variety during the first season (Table 35). During the second season, treatments exerted significant influence (Table 36). Maximum fresh weight (42.43 g) was exhibited by T_6 (CCC 250 ppm) which was on par with T_9 (GA 100 ppm). T_5 (NAA 200 ppm) recorded the minimum fresh weight (15.77 g).

4.3.1.4. Mansoer Red

The treatments influenced the fresh weight of spike significantly in this variety during both the seasons. During the first season (Table 37) significant superiority was shown by T_6 (CCC 250 ppm) which recorded a fresh weight of 50.60 g. T_5 (NAA 200 ppm) recorded the least fresh weight of 13.10 g. Fresh weight was the maximum (47.70 g) in T_1 (control) during the second season (Table 38) which was on par with T_7 (CCC 500 ppm) and T_{17} (K_2SO_4 1.0%). T_{15} (KNO_3 1.0%) recorded the minimum fresh weight (12.25 g).

4.3.1.5. True Yellow

The treatments could not significantly influence the fresh weight during the first season in this variety (Table 39). During the second season (Table 40), maximum fresh weight (28.05 g) was recorded in T_{14} (KNO_3 0.5%) which was on par with T_8 (GA 50 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%), T_2 (TIBA 150 ppm), T_{12} ($CaSO_4$ 0.5%),

Table 35

Effect of treatments on the vase characters of gladiolus cv. Friendship during first season

Treatment		Weight of spike (g)	Vase life (days)	Percentage of fully opened florets	Percentage of partially opened florets	Percentage of unopened florets	Longevity of floret (days)	Number of florets opened at a time	Nature of bending		Water uptake (ml)
									From which day in vase	From which floret	
T_1	Control	24.5	5.33	32.50	17.50	50.50	2.10	2.00	5.00	3.67	41.50
T_2	TIBA 150 ppm	25.2	5.33	45.00	9.00	46.00	3.54	3.00	5.00	9.50	47.00
T_3	TIBA 300 ppm	31.4	6.67	41.67	12.33	46.00	3.21	3.33	6.33	8.33	40.83
T_4	NAA 100 ppm	28.5	7.00	43.50	6.00	50.50	2.83	4.00	7.00	10.50	43.00
T_5	NAA 200 ppm	38.5	8.00	48.50	6.50	45.50	2.79	3.00	7.00	5.50	48.00
T_6	CCC 250 ppm	28.7	7.00	40.00	10.00	50.00	3.00	2.50	7.00	9.50	40.00
T_7	CCC 500 ppm	35.4	8.00	62.50	0.00	37.50	3.28	4.50	6.00	5.00	81.00
T_8	GA 50 ppm	24.1	7.67	59.67	11.67	38.67	2.99	3.67	7.00	5.00	46.17
T_9	GA 100 ppm	23.1	7.67	53.00	10.67	36.33	3.09	3.33	7.33	7.67	57.00
T_{10}	$Ca(NO_3)_2$ 0.5%	22.1	6.33	34.50	8.50	57.00	3.57	3.00	6.00	10.50	23.50
T_{11}	$Ca(NO_3)_2$ 1.0%	41.2	9.00	42.33	9.33	48.33	2.76	2.67	5.00	4.50	78.50
T_{12}	$CaSO_4$ 0.5%	30.3	7.00	47.00	9.67	43.33	3.30	3.33	6.33	7.67	46.67
T_{13}	$CaSO_4$ 1.0%	36.3	6.50	29.00	10.50	60.50	3.50	2.50	5.50	9.50	44.00
T_{14}	KNO_3 0.5%	33.8	7.00	39.67	10.33	50.00	3.13	3.00	6.66	7.33	54.33
T_{15}	KNO_3 1.0%	27.7	6.00	35.00	14.50	50.50	2.85	1.00	5.53	8.00	45.67
T_{16}	K_2SO_4 0.5%	36.9	9.00	41.50	0.00	58.50	3.59	4.00	7.00	5.50	50.50
T_{17}	K_2SO_4 1.0%	30.4	6.50	33.50	18.50	48.00	3.22	3.50	6.00	10.50	30.50
	CD (0.05)	NS	1.25	9.31	NS	NS	0.35	0.87	NS	NS	NS
	SEm±	2.77	0.43	3.24	3.48	6.09	0.12	0.30	2.91	3.13	11.17

Table 36

Effect of treatments on the vase characters of gladiolus cv. Friendship during second season

Treatment	Weight of spike (g)	Vase life (days)	Percentage of fully opened florets	Percentage of partially opened florets	Percentage of unopened florets	Longevity of floret (days)	Number of florets opened at a time	Nature of bending		Water uptake (ml)
								From which day in vase	From which floret	
T_1 Control	21.64	5.67	28.33	20.00	51.33	3.00	2.00	4.55	7.92	21.33
T_2 TIBA 150 ppm	33.67	8.00	43.67	11.67	44.67	3.90	3.00	4.97	8.92	39.00
T_3 TIBA 300 ppm	35.54	5.00	30.67	15.33	53.33	2.70	3.00	4.00	9.00	39.33
T_4 NAA 100 ppm	28.56	7.00	32.33	17.67	50.00	3.03	2.33	6.00	6.99	32.00
T_5 NAA 200 ppm	15.77	6.00	27.67	11.33	61.00	3.83	2.00	4.94	9.00	22.00
T_6 CCC 250 ppm	42.43	7.67	42.67	16.00	41.32	3.67	3.00	6.00	8.25	20.00
T_7 CCC 500 ppm	28.33	5.67	28.33	11.67	60.00	2.50	1.67	5.97	6.27	34.67
T_8 GA 50 ppm	20.84	6.67	51.67	15.00	30.00	3.73	2.00	6.07	7.61	27.61
T_9 GA 100 ppm	39.52	4.33	19.33	23.33	50.00	3.99	1.67	4.00	6.43	27.31
T_{10} $Ca(NO_3)_2$ 0.5%	34.50	6.00	26.33	22.00	51.67	3.23	2.33	5.97	8.96	29.67
T_{11} $Ca(NO_3)_2$ 1.0%	27.33	6.33	38.00	20.33	41.00	3.20	3.00	5.90	7.52	27.67
T_{12} $CaSO_4$ 0.5%	31.37	8.00	48.00	7.67	43.67	3.00	3.00	5.66	8.92	37.33
T_{13} $CaSO_4$ 1.0%	18.73	6.00	37.33	10.33	52.00	2.70	1.67	5.07	6.99	24.00
T_{14} KNO_3 0.5%	18.53	6.00	37.00	15.00	41.67	3.33	2.00	5.59	9.00	14.67
T_{15} KNO_3 1.0%	31.68	7.33	45.33	21.00	34.67	3.43	4.00	5.00	7.61	55.00
T_{16} K_2SO_4 0.5%	26.42	8.00	34.00	14.33	50.67	3.80	2.67	4.97	7.52	30.00
T_{17} K_2SO_4 1.0%	35.16	6.00	31.33	18.31	50.00	2.23	2.67	5.40	8.23	49.67
CD (0.05)	4.93	1.98	11.47	8.22	11.69	NS	1.09	NS	NS	8.74
SEm±	1.71	0.69	3.99	2.86	4.07	0.40	0.37	0.21	0.24	3.05

Table 37

Effect of treatments on the vase characters of gladiolus cv. Mansoer Red during first season

Treatment		Weight of spike (g)	Vase life (days)	Percentage of fully opened florets	Percentage of partially opened florets	Percentage of unopened florets	Longevity of floret (days)	Number of florets opened at a time	Nature of bending		Water uptake (ml)
									From which day in vase	From which floret	
T_1	Control	18.4	8.00	67.50	0	32.50	3.70	4.00	7.50	4.50	43.00
T_2	TIBA 150 ppm	20.4	8.50	45.50	18.50	36.00	3.35	3.00	8.50	9.00	40.00
T_3	TIBA 300 ppm	25.4	8.50	59.50	13.00	27.50	3.20	3.00	8.50	9.00	42.00
T_4	NAA 100 ppm	28.0	8.00	59.50	14.50	26.00	3.20	4.50	4.00	4.50	57.50
T_5	NAA 200 ppm	13.1	7.00	59.50	13.00	27.50	3.25	5.50	7.00	8.50	26.00
T_6	CCC 250 ppm	50.6	8.50	69.50	2.50	28.00	2.95	6.00	7.00	4.50	50.50
T_7	CCC 500 ppm	13.3	9.00	58.00	14.50	27.50	2.45	2.00	8.50	3.50	38.00
T_8	GA 50 ppm	24.4	10.50	93.00	3.50	3.50	3.45	6.00	7.50	5.50	50.50
T_9	GA 100 ppm	28.7	10.00	72.67	10.33	17.00	2.36	3.67	4.00	2.33	76.67
T_{10}	$Ca(NO_3)_2$ 0.5%	15.0	7.50	72.50	18.50	9.00	3.40	4.50	4.50	4.00	32.50
T_{11}	$Ca(NO_3)_2$ 1.0%	34.4	11.00	81.50	6.00	12.50	3.70	7.00	6.50	5.00	51.00
T_{12}	$CaSO_4$ 0.5%	29.7	8.67	66.33	10.33	23.33	3.03	5.00	5.33	2.00	46.00
T_{13}	$CaSO_4$ 1.0%	31.8	9.67	74.67	1.67	23.67	3.70	5.67	9.33	7.67	53.67
T_{14}	KNO_3 0.5%	24.6	10.00	91.00	0.00	9.00	3.13	5.00	10.00	8.33	82.00
T_{15}	KNO_3 1.0%	34.9	9.00	66.50	8.50	25.00	3.30	6.00	4.53	3.00	68.00
T_{16}	K_2SO_4 0.5%	22.0	10.50	75.00	2.50	22.50	3.05	5.00	10.50	8.50	29.50
T_{17}	K_2SO_4 1.0%	28.6	8.33	73.67	5.67	20.67	3.16	6.00	7.66	7.33	54.33
	CD (0.05)	12.10	1.22	NS	NS	NS	NS	1.43	NS	NS	NS
	SEm±	4.2	0.42	7.61	3.97	6.54	0.32	0.50	2.37	3.03	13.25

Table 38
Effect of treatments on the vase characters of gladiolus cv. Mansoer Red during second season

Treatment	Weight of spike (g)	Vase life (days)	Percentage of fully opened florets	Percentage of partially opened florets	Percentage of unopened florets	Longevity of floret (days)	Number of florets opened at a time	Nature of bending		Water uptake (ml)
								From which day in vase	From which floret	
T_1 Control	47.70	4.67	40.00	30.67	32.33	2.20	3.67	4.00	8.33	14.33
T_2 TIBA 150 ppm	33.87	6.67	72.00	9.33	18.67	2.53	3.67	4.59	9.00	33.33
T_3 TIBA 300 ppm	25.51	7.67	76.00	8.67	14.67	2.73	3.00	4.97	7.33	22.33
T_4 NAA 100 ppm	24.03	7.33	75.33	10.67	14.00	2.77	3.67	6.92	5.50	22.00
T_5 NAA 200 ppm	22.73	7.33	80.67	10.33	9.00	1.81	2.33	4.28	7.67	25.00
T_6 CCC 250 ppm	30.68	7.67	76.00	3.00	21.00	2.69	3.67	6.14	4.00	28.00
T_7 CCC 500 ppm	41.07	9.00	87.00	8.33	4.67	3.33	4.00	9.00	8.33	37.33
T_8 GA 50 ppm	21.73	7.33	59.00	6.33	34.67	2.88	2.67	6.42	8.50	16.00
T_9 GA 100 ppm	22.17	8.00	79.00	7.33	13.33	2.60	3.00	7.65	7.33	28.33
T_{10} $Ca(NO_3)_2$ 0.5%	28.05	7.67	91.33	4.33	4.33	2.83	3.00	7.00	7.67	38.00
T_{11} $Ca(NO_3)_2$ 1.0%	22.96	6.00	67.67	8.33	23.33	1.96	2.00	5.14	5.00	14.67
T_{12} $CaSO_4$ 0.5%	21.58	8.67	72.00	17.00	10.67	2.53	2.33	8.00	7.33	25.33
T_{13} $CaSO_4$ 1.0%	27.93	7.00	72.00	14.00	14.00	2.93	2.33	6.67	5.00	24.67
T_{14} KNO_3 0.5%	17.92	8.00	60.67	47.33	14.00	3.36	3.67	7.67	7.33	18.00
T_{15} KNO_3 1.05%	12.25	6.00	60.00	19.67	20.33	2.48	3.00	6.00	4.50	14.33
T_{16} K_2SO_4 0.5%	15.33	8.00	74.33	21.00	4.67	3.51	4.67	7.67	5.00	16.67
T_{17} K_2SO_4 1.0%	39.13	7.33	81.00	7.67	11.33	2.67	4.00	6.67	8.33	35.00
CD (0.05)	11.93	1.82	NS	15.87	NS	0.40	1.17	NS	NS	9.72
SEm±	4.16	0.63	9.32	5.53	7.19	0.14	0.41	0.16	0.18	3.38

Table 39

Effect of treatments on the vase characters of gladiolus cv. True Yellow during first season

Treatment	Weight of spike (g)	Vase life (days)	Percentage of fully opened florets	Percentage of partially opened florets	Percentage of unopened florets	Longevity of floret (days)	Number of florets opened at a time	Nature of bending		Water uptake (ml)
								From which day in vase	From which floret	
T_1 Control	23.8	6.33	40.67	3.67	55.66	2.83	2.33	6.33	10.33	28.00
T_2 TIBA 150 ppm	26.7	6.33	63.00	7.33	29.66	2.96	2.33	6.00	7.00	47.00
T_3 TIBA 300 ppm	18.5	5.00	50.00	12.50	37.50	5.00	1.50	5.00	5.00	33.75
T_4 NAA 100 ppm	18.4	6.33	36.50	13.50	50.00	2.50	1.50	5.00	5.00	20.00
T_5 NAA 200 ppm	23.3	7.00	53.50	0.00	46.50	3.15	2.50	5.00	5.00	39.00
T_6 CCC 250 ppmm	25.6	8.00	31.50	16.00	52.50	2.90	2.50	7.50	8.00	45.00
T_7 CCC 500 ppm	30.6	7.67	61.33	0.00	38.66	3.03	3.00	7.66	8.00	46.00
T_8 GA 50 ppm	30.2	9.67	62.67	0.00	37.33	3.50	3.67	9.66	6.67	47.33
T_9 GA 100 ppm	23.8	7.67	49.33	0.00	49.66	3.50	3.67	7.00	10.33	23.67
T_{10} $Ca(NO_3)_2$ 0.5%	29.5	7.00	53.33	13.33	33.33	3.26	3.00	5.00	5.00	46.67
T_{11} $Ca(NO_3)_2$ 1.0%	26.4	8.00	61.50	5.00	33.50	2.70	2.50	5.00	5.00	31.00
T_{12} $CaSO_4$ 0.5%	28.8	7.33	46.00	8.00	46.00	2.96	2.33	6.66	7.00	52.33
T_{13} $CaSO_4$ 1.0%	22.5	7.33	69.00	0.00	31.00	3.13	2.67	6.66	7.00	41.00
T_{14} KNO_3	19.8	6.67	46.50	17.00	36.50	3.05	2.50	5.00	5.00	23.50
T_{15} KNO_3 1.0%	24.3	8.00	54.50	4.00	41.50	2.95	2.50	4.00	8.00	40.00
T_{16} K_2SO_4 0.5%	25.5	8.33	49.33	3.33	47.33	3.53	2.67	5.00	5.00	34.00
T_{17} K_2SO_4 1.0%	19.6	8.50	68.00	5.50	16.50	3.10	2.50	5.00	5.00	52.50
CD (0.05)	NS	1.16	NS	NS	NS	NS	0.86	NS	NS	NS
SEm±	2.71	0.40	8.62	3.90	7.71	0.26	0.29	2.70	3.30	9.32

Table 40

Effect of treatments on the vase characters of gladiolus cv. True Yellow during second season

Treatment	Weight of spike (g)	Vase life (days)	Percentage of fully opened florets	Percentage of partially opened florets	Percentage of unopened florets	Longevity of floret (days)	Number of florets opened at a time	Nature of bending		Water uptake (ml)
								From which day in vase	From which floret	
T_1 Control	19.55	5.33	42.67	15.37	41.67	2.20	1.67	5.25	9.55	15.33
T_2 TIBA 150 ppm	26.28	6.67	57.33	6.00	36.00	2.40	2.33	5.99	10.55	23.00
T_3 TIBA 300 ppm	22.85	5.67	37.33	17.33	45.00	2.73	1.33	5.07	10.55	29.33
T_4 NAA 100 ppm	14.09	2.00	28.67	29.33	42.00	1.60	1.67	2.00	5.00	12.33
T_5 NAA 200 ppm	14.08	2.67	18.00	30.67	51.33	2.50	1.67	2.33	3.89	13.33
T_6 CCC 250 ppm	20.70	6.00	55.67	12.67	32.00	2.27	1.33	5.83	11.55	20.33
T_7 CCC 500 ppm	22.47	3.67	67.67	21.00	12.00	2.77	1.67	2.28	10.65	26.33
T_8 GA 50 ppm	27.35	6.00	53.67	13.67	33.33	2.17	2.00	5.51	5.26	21.67
T_9 GA 100 ppm	16.90	6.00	62.00	26.67	11.33	3.13	2.33	5.15	7.98	24.33
T_{10} $Ca(NO_3)_2$ 0.5%	26.93	5.67	50.67	13.00	35.67	2.37	2.33	5.55	9.98	38.00
T_{11} $Ca(NO_3)_2$ 1.0%	20.89	6.00	40.00	15.67	44.00	2.53	2.33	5.98	10.55	26.00
T_{12} $CaSO_4$ 0.5%	25.65	4.33	35.33	23.67	40.67	2.20	1.33	3.70	8.52	27.67
T_{13} $CaSO_4$ 1.0%	23.20	4.67	28.67	21.00	50.00	2.93	2.33	4.00	15.00	37.00
T_{14} KNO_3 0.5%	28.05	7.00	49.00	12.67	38.33	2.50	2.00	6.94	9.30	27.00
T_{15} KNO_3 1.0%	14.50	6.00	57.33	7.33	35.00	2.97	2.00	5.00	10.55	18.00
T_{16} K_2SO_4 0.5%	17.25	5.00	39.33	11.00	50.00	2.27	2.33	4.55	10.64	26.00
T_{17} K_2SO_4 1.0%	17.87	4.67	46.67	16.67	33.00	2.43	1.67	4.00	5.00	27.67
CD (0.05)	7.75	NS	NS	NS	19.98	10.66	NS	NS	NS	12.80
SEm±	2.69	1.09	10.62	5.19	6.96	0.23	0.38	0.28	0.29	4.46

T_{13} ($CaSO_4$ 1.0%), T_3 (TIBA 300 ppm), T_7 (CCC 500 ppm), T_{11} ($Ca(NO_3)_2$ 1.0%) and T_6 (CCC 250 ppm). T_5 (NAA 200 ppm) recorded the minimum fresh weight (14.08 g).

As regards the fresh weight of spike, not much difference was seen between the seasons (Fig. 7). American Beauty and Friendship were the superior varieties in both the seasons (31 g and 30 g respectively, during the first season and 29 g, each, during the second season). Least spike weight (19 g) was recorded by V_1 (Agnirekha) during first season and V_5 (True Yellow) during the second season (21 g).

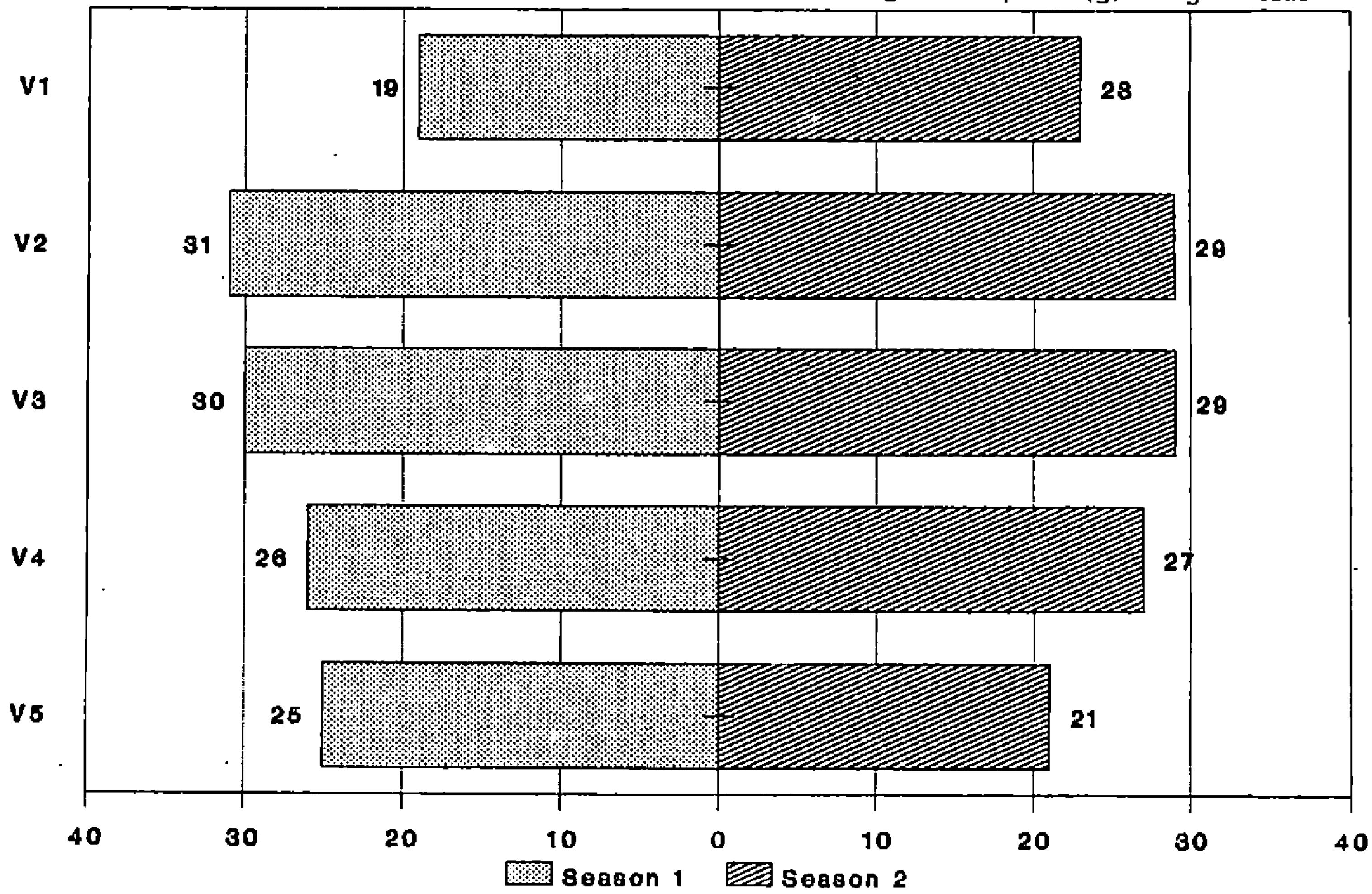
4.3.2. Vase life

4.3.2.1. Agnirekha

The influence of the treatments on the vase life was significant during both the seasons in this variety. During the first season (Table 31) vase life was found to be the maximum (8.00 days, each) in T_2 (TIBA 150 ppm) and T_{12} ($CaSO_4$ 0.5%), which were on par with T_{14} (KNO_3 0.5%), T_9 (GA 100 ppm), T_4 (NAA 100 ppm), T_5 (NAA 200 ppm), and T_7 (CCC 500 ppm). Minimum vase life (4.50 days) was shown by the treatment T_6 (CCC 250 ppm).

Maximum vase life (11.33 days) was recorded in T_4 (NAA 100 ppm) during the second season (Table 32) which was on par

Fig. 7. Effect of season and variety on fresh weight of spike (g) in gladiolus



with T_5 (NAA 200 ppm), T_6 (CCC 250 ppm) and T_7 (CCC 500 ppm). T_{16} (K_2SO_4 0.5%) recorded the minimum vase life (6.67 days).

4.3.2.2. American Beauty

The treatments significantly influenced the vase life of spikes in this variety during both the seasons. During the first season (Table 33) maximum vase life (8.67 days, each) was recorded in T_8 (GA 50 ppm) and T_{13} ($CaSO_4$ 1.0%), which were on par with T_9 (GA 100 ppm), T_5 (NAA 200 ppm), T_3 (TIBA 300 ppm), T_7 (CCC 500 ppm), T_4 (NAA 100 ppm), T_{15} (KNO_3 1.0%) and T_{17} (K_2SO_4 1.0%). Vase life was the minimum (4.00 days) in T_{16} (K_2SO_4 0.5%).

During the second season (Table 34), the vase life was the longest (8.33 days, each) in T_1 (control) and T_4 (NAA 100 ppm). These treatments were on par with T_{10} ($Ca(NO_3)_2$ 0.5%), T_6 (CCC 250 ppm), T_{13} ($CaSO_4$ 1.0%), T_3 (TIBA 300 ppm), T_{12} ($CaSO_4$ 0.5%) and T_{14} (KNO_3 0.5%). Shortest vase life (2.67 days) was recorded by T_5 (NAA 200 ppm).

4.3.2.3. Friendship

The treatments could significantly influence the vase life of spikes during both the seasons in this variety also. During the first season (Table 35) maximum vase life (9.00 days, each) was recorded in T_{11} ($Ca(NO_3)_2$ 1.0%) and T_{16} (K_2SO_4 0.5%), which were on par with T_5 (NAA 200 ppm) and T_7 (CCC 500 ppm). T_1 (control) and T_2 (TIBA 150 ppm) recorded the minimum vase life (5.33 days, each).

During the second season (Table 36) T_2 (TIBA 150 ppm), T_{12} ($CaSO_4$ 0.5%) and T_{16} (K_2SO_4 0.5%) recorded the maximum vase life (8.00 days, each), which were on par with T_6 (CCC 250 ppm), T_{15} (KNo_3 1.0%), T_4 (NAA 100 ppm), T_8 (GA 50 ppm) and T_{11} ($Ca(NO_3)_2$ 1.0%). Minimum vase life (4.33 days) was recorded by T_9 (GA 100 ppm).

4.3.2.4. Mansoer Red

The influence of the treatments on the vase life of spikes in this variety during both the seasons was significant. T_{11} ($Ca(NO_3)_2$ 1.0%) recorded the maximum vase life (11.00 days) during the first season (Table 37) which was on par with T_8 (GA 50 ppm), T_{16} (K_2SO_4 0.5%), T_9 (GA 100 ppm) and T_{14} (KNO_3 0.5%). Minimum vase life (7.00 days) was recorded by T_5 (NAA 200 ppm).

During the second season (Table 38), the vase life was found to be the maximum (9.00 days) in T_7 (CCC 500 ppm) and minimum (4.67 days) in T_1 (control). T_7 (CCC 500 ppm) was on par with T_{12} ($CaSO_4$ 0.5%), T_9 (GA 100 ppm), T_{14} (KNO_3 0.5%), T_{16} (K_2SO_4 0.5%), T_3 (TIBA 300 ppm), T_6 (CCC 250 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%),

T_4 (NAA 100 ppm), T_5 (NAA 200 ppm), T_8 (GA 50 ppm) and T_{17} (K_2SO_4 1.0%).

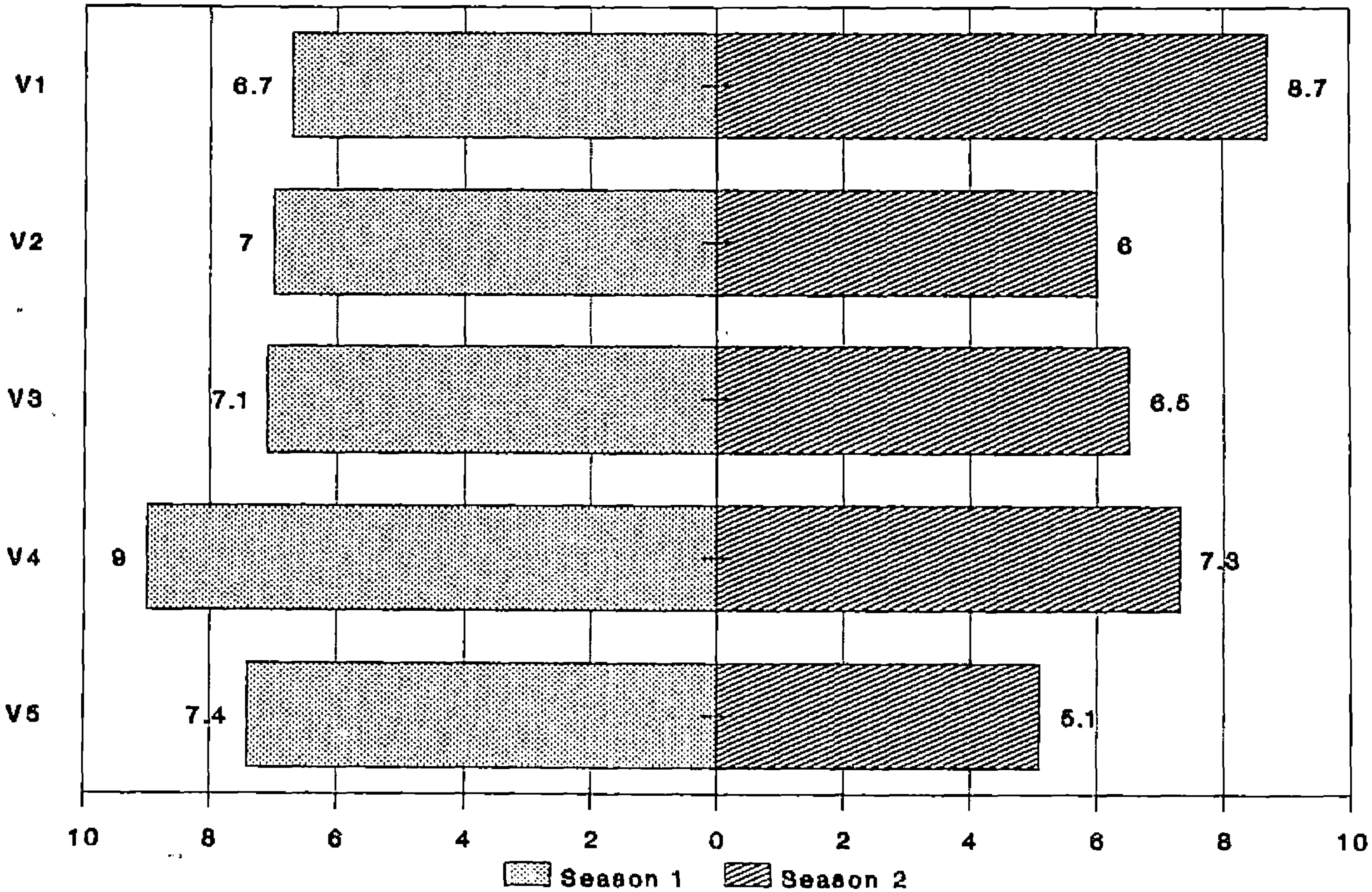
4.3.2.5. True Yellow

During the first season (Table 39) maximum vase life (9.67 days) was recorded by T_8 (GA 50 ppm) which was found significantly superior to all other treatments. Vase life was the shortest (5.00 days) in T_3 (TIBA 300 ppm).

The treatments could not produce significant influence on the vase life of spike in this variety during the second season (Table 40).

The response of varieties to seasons was not uniform with respect to vase life (Fig. 8). Two varieties, viz., V_4 (Mansoer Red) and V_5 (True Yellow), performed well during the first season. Much difference was not obtained in V_2 (American Beauty) and V_3 (Friendship). Among the varieties, V_4 (Mansoer Red) recorded maximum vase life (9.0 days) during the first season whereas V_1 (Agnirekha) ranked first during the second season (8.7 days). V_1 (Agnirekha) during the first season and V_5 (True Yellow) during the second season had the shortest vase life (6.7 days and 5.1 days, respectively).

Fig. 8. Effect of season and variety on vase life (days) in gladiolus



4.3.3. Percentage of fully opened, partially opened and unopened florets

4.3.3.1. Agnirekha

The influence of the treatments on the proportion of fully opened, partially opened and unopened florets was insignificant in this variety during the first season (Table 31).

Significant influence was observed on the percentage of fully opened and partially opened florets in vase during the second season (Table 32). T_4 (NAA 100 ppm) and T_{11} ($Ca(NO_3)_2$ 1.0%) recorded the maximum fully opened florets (74.33%), which were on par with T_{13} ($CaSO_4$ 1.0%), T_{10} ($Ca(NO_3)_2$ 0.5%), T_1 (control), T_8 (GA 50 ppm), T_9 (GA 100 ppm), T_{15} (KNO_3 1.0%), T_{12} ($CaSO_4$ 0.5%) and T_{17} (K_2SO_4 1.0%). T_3 (TIBA 300 ppm) recorded the minimum (41.33%).

In the case of partially opened florets, T_7 (CCC 500 ppm) recorded the maximum (44.67%) during the second season, which was on par with T_3 (TIBA 300 ppm). T_4 (NAA 100 ppm) and T_8 (GA 50 ppm) recorded the minimum percentage (4.33, each) of partially opened florets.

4.3.3.2. American Beauty

The treatments failed to influence any of these characters significantly during the first season in this variety (Table 33).

The treatments significantly influenced the percentage of partially opened and unopened florets in vase in this variety during the second season (Table 34). As regards the partially opened florets, the percentage was maximum (31.00) in T_5 (NAA 200 ppm) which was on par with T_{15} (KNO_3 1.0%), T_{11} ($Ca(NO_3)_2$ 1.0%), T_{12} ($CaSO_4$ 0.5%), T_{17} (K_2SO_4 1.0%), T_8 (GA 50 ppm), T_7 (CCC 500 ppm), T_4 (NAA 100 ppm), T_9 (GA 100 ppm), T_6 (CCC 250 ppm), T_1 (control) and T_{10} ($Ca(NO_3)_2$ 0.5%). The percentage was the minimum (7.67) in T_2 (TIBA 150 ppm).

In respect of unopened florets in vase, T_8 (Ga 50 ppm) recorded the maximum (57.00%), which was on par with T_9 (GA 100 ppm), T_{11} ($Ca(NO_3)_2$ 1.0%), T_{12} ($CaSO_4$ 0.5%), T_3 (TIBA 300 ppm), T_7 (CCC 500 ppm), T_{14} (KNO_3 0.5%), T_{13} ($CaSO_4$ 1.0%), T_{16} (K_2SO_4 0.5%) and T_5 (NAA 200 ppm). The minimum percentage of unopened florets (37.00) was recorded by T_{10} ($Ca(NO_3)_2$ 0.5%).

4.3.3.3. Friendship

The influence of the treatments on the proportion of fully opened florets in vase was significant in this variety during the first season (Table 35). It was found to be the maximum (62.50%) in T_7 (CCC 500 ppm) and the minimum (29.00%) in T_{13} ($CaSO_4$ 1.0%). The treatment T_7 (CCC 500 ppm) was found to be on par with T_8 (GA 50 ppm).

During the second season, the treatments exerted significant influence on the percentage of fully opened, partially opened and unopened florets (Table 36). Maximum percentage of fully opened florets (51.67) was recorded by T_8 (GA 50 ppm), which was on par with T_{12} ($CaSO_4$ 0.5%), T_{15} (KNO_3 1.0%), T_2 (TIBA 150 ppm) and T_6 (CCC 250 ppm). T_9 (GA 100 ppm) recorded the minimum (19.33%).

The percentage of partially opened florets in vase was the maximum (23.33) in T_9 (GA 100 ppm) which was on par with T_{10} ($Ca(NO_3)_2$ 0.5%), T_{15} (KNO_3 1.0%), T_{11} ($Ca(NO_3)_2$ 1.0%), T_1 (control), T_{17} (K_2SO_4 1.0%), T_4 (NAA 100 ppm), T_6 (CCC 250 ppm) and T_3 (TIBA 300 ppm). T_{12} ($CaSO_4$ 0.5%) recorded the minimum (7.67%).

T_5 (NAA 200 ppm) recorded the maximum percentage (61.00) of unopened florets in vase, which was on par with T_7 (CCC 500 ppm), T_3 (TIBA 300 ppm), T_{13} ($CaSO_4$ 1.0%), T_{10} ($Ca(NO_3)_2$ 0.5%), T_1 (control), T_{16} (K_2SO_4 0.5%), T_4 (NAA 100 ppm), T_9 (GA 100 ppm) and T_{17} (K_2SO_4 1.0%). The minimum percentage (30.00) was recorded by T_8 (GA 50 ppm).

4.3.3.4. Mansoer Red

The treatments failed to influence the above characters significantly during the first season (Table 37).

During the second season the treatments influenced the percentage of partially opened florets only (Table 38). Here the maximum percentage (47.33) was recorded in T_{14} (KNO_3. 0.5%), which was significantly superior to all other treatments. T_6 (CCC 250 ppm) recorded the minimum (3.00%).

4.3.3.5. True Yellow

The influence was not significant on the fully opened, partially opened and unopened florets in vase during the first season in this variety (Table 39).

During the second season, the treatments significantly influenced only the percentage of unopened florets in vase (Table 40). Here T_5 (NAA 200 ppm) recorded the maximum (51.33%) and T_9 (GA 100 ppm) the minimum (11.33%). T_5 was on par with all treatments, except T_7 (CCC 500 ppm) and T_9 (GA 100 ppm).

4.3.4. Longevity of individual floret

4.3.4.1. Agnirekha

The influence of the treatments on the longevity of individual floret was insignificant in this variety in both the seasons (Table 31 and 32).

4.3.4.2. American Beauty

The influence of the treatments on the longevity of individual floret was insignificant in this variety during the first season (Table 33).

During the second season (Table 34), the longevity was found to be the maximum (5.80 days) in T_{10} ($Ca(NO_3)_2$ 0.5%) and minimum (1.80 days) in T_9 (GA 100 ppm); T_{10} ($Ca(NO_3)_2$ 0.5%) was on par with T_{11} ($Ca(NO_3)_2$ 1.0%).

4.3.4.3. Friendship

In this variety, there was significant influence of the treatments on the longevity of individual floret during the first season (Table 35). Longevity of individual floret was found to be the maximum (3.59 days) in T_{16} (K_2SO_4 0.5%) and the minimum (2.10 days) in T_1 (control). T_{16} was on par with T_{10} ($Ca(NO_3)_2$ 0.5%), T_2 (TIBA 150 ppm), T_{13} ($CaSO_4$ 1.0%), T_{12} ($CaSO_4$ 0.5%) and T_7 (CCC 500 ppm).

The influence of the treatments was insignificant during the second season (Table 36).

4.3.4.4. Mansoer Red

The treatments did not significantly influence the longevity of individual floret during the first season in this variety (Table 37).

During the second season (Table 38), T_{16} (K_2SO_4 0.5%) recorded the maximum longevity (3.51 days) which was on par with T_{14} (KNO_3 0.5%) and T_7 (CCC 500 ppm). T_5 (NAA 200 ppm) recorded the minimum longevity (1.81 days).

4.3.4.5. True Yellow

In this variety also, the treatments could not significantly influence the longevity of floret during the first season (Table 39). During the second season (Table 40) T_9 (GA 100 ppm) recorded the maximum longevity (3.13 days) and T_4 (NAA 100 ppm), the minimum (1.60 days). T_9 (GA 100 ppm) was found to be on par with T_{15} (KNO_3 1.0%), T_{13} ($CaSO_4$ 1.0%), T_7 (CCC 500 ppm), T_3 (TIBA 300 ppm), T_{11} ($Ca(NO_3)_2$ 1.0%), T_5 (NAA 200 ppm) and T_{14} (KNO_3 0.5%).

4.3.5. Number of florets opened at a time

4.3.5.1. Agnirekha

The influence of the treatments on the number of florets opened at a time was significant in this variety during the first season (Table 31). T_2 (TIBA 150 ppm) and T_8 (GA 50 ppm) recorded the maximum number of florets opened at a time (4.33, each) and T_{10} ($Ca(NO_3)_2$ 0.5%) recorded the minimum (2.50). T_2 (TIBA 150 ppm) and T_8 (GA 50 ppm) were on par with T_{13} ($CaSO_4$ 1.0%) and T_{14} (KNO_3 0.5%).

The influence of the treatments on the number of florets opened at a time was insignificant in this variety during the second season (Table 32).

4.3.5.2. American Beauty

In this variety also, the influence of the treatments was significant during the first season only (Table 33). Maximum number of florets opened at a time (4.67) was recorded in T_9 (GA 100 ppm) which was on par with T_8 (GA 50 ppm) and T_{17} (K_2SO_4 1.0%). Minimum number of florets opened at a time (1.00, each) was recorded in T_2 (TIBA 150 ppm) and T_{11} ($Ca(NO_3)_2$ 1.0%).

The influence of the treatments on the number of florets opened at a time in the vase during the second season was insignificant (Table 34).

4.3.5.3. Friendship

The treatments exerted significant influence on the number of florets opened at a time in this variety during both the seasons. During the first season (Table 35) the number was the maximum (4.50 florets) in T_7 (CCC 500 ppm) and the minimum (1.00 floret) in T_{15} (KNO_3 1.0%). T_7 (CCC 500 ppm) was on par with T_4 (NAA 100 ppm), T_{16} (K_2SO_4 0.5%) and T_8 (GA 50 ppm).

During the second season (Table 36), T_{15} (KNO_3 1.0%) recorded the maximum (4.00) and T_7 (CCC 500 ppm) and T_9 (GA 100 ppm) the minimum (1.67, each) florets. T_{15} was on par with T_2 (TIBA 150 ppm), T_3 (TIBA 300 ppm), T_6 (CCC 250 ppm), T_{11} ($Ca(NO_3)_2$ 1.0%) and T_{12} ($CaSO_4$ 0.5%).

4.3.5.4. Mansoer Red

The influence of treatments on the number of florets opened at a time was significant during both the seasons in this variety.

Treatment T_{11} ($Ca(NO_3)_2$ 1.0%) gave the highest mean value (7.00 florets), during the first season (Table 37) which was on par with T_6 (CCC 250 ppm), T_8 (GA 50 ppm), T_{15} (KNO_3 1.0%), T_{17} (K_2SO_4 1.0%) and T_{13} ($CaSO_4$ 1.0%). T_7 (CCC 500 ppm) turned out to be the least effective treatment which produced only two opened florets at a time.

During the second season (Table 38) maximum number of florets (4.67) was produced by T_{16} (K_2SO_4 0.5%) which was on par with T_7 (CCC 500 ppm), T_{17} (K_2SO_4 1.0%), T_1 (control), T_2 (TIBA 150 ppm), T_4 (NAA 100 ppm), T_6 (CCC 250 ppm) and T_{14} (KNO_3 0.5%). T_{11} ($Ca(NO_3)_2$ 1.0%) recorded the minimum (2.00 florets).

4.3.5.5. True Yellow

The influence of the treatments on the number of florets opened at a time was significant in this variety during the first season (Table 39). It was the maximum (3.67 florets, each) in T_8 (GA 50 ppm) and T_9 (GA 100 ppm) and the minimum (1.50 florets, each) in T_3 (TIBA 300 ppm) and T_4 (NAA 100 ppm). T_8 (GA 50 ppm) and T_9 (GA 100 ppm) were found to be on par with T_7 (CCC 500 ppm) and T_{10} ($Ca(NO_3)_2$ 0.5%).

The influence of the treatments was insignificant in this variety during the second season (Table 40).

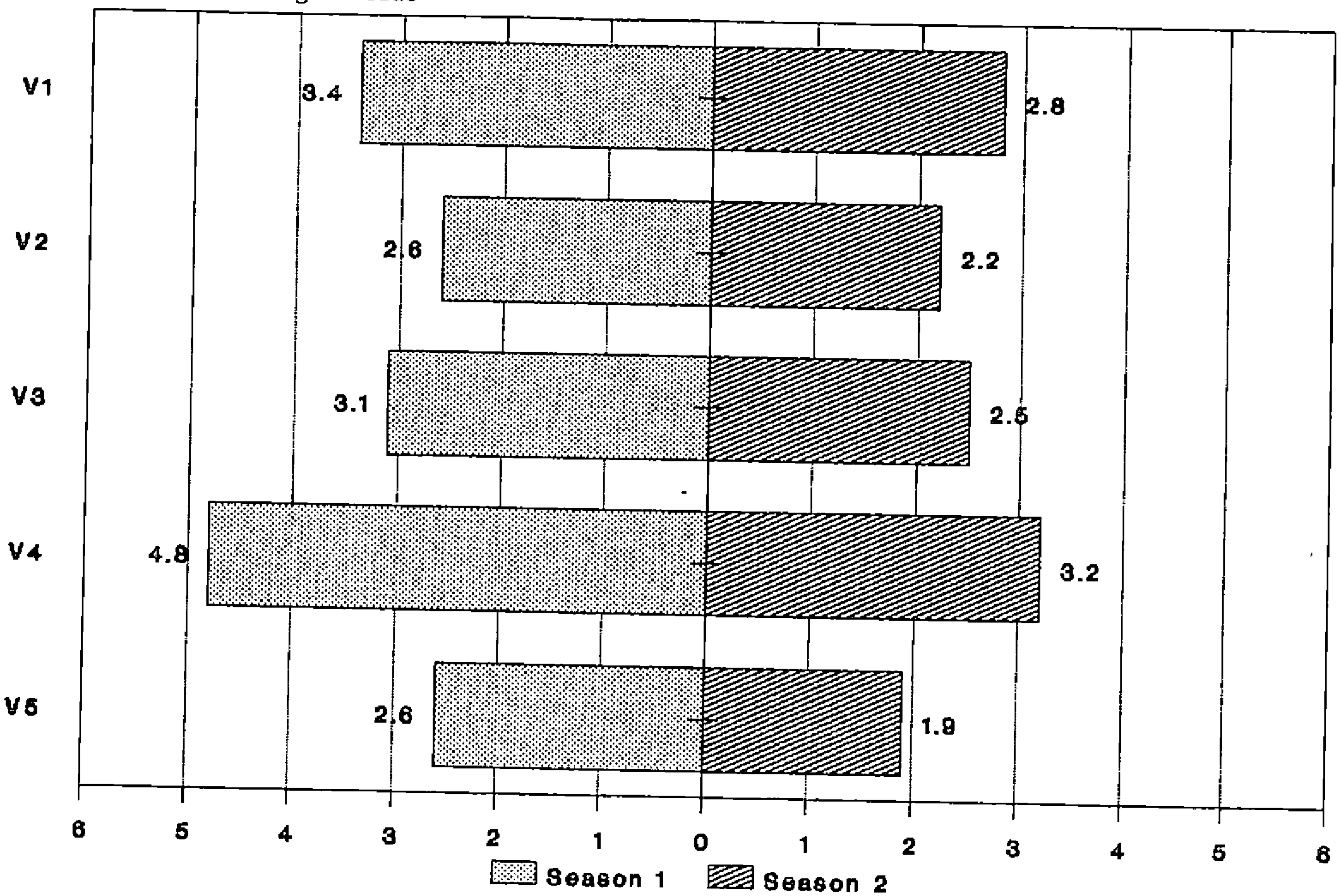
The number of florets opened at a time was found to be better for all the five varieties during the first season (Fig. 9). Number of florets opened at a time was more (4.8) in V_4 (Mansoer Red) and the minimum (2.6) in V_2 (American Beauty) during the first season. During the second season also, better performance was obtained in Mansoer Red (3.2 florets). Here V_5 (True Yellow) recorded the minimum number (1.9 florets).

4.3.6. Nature of bending

4.3.6.1. Agnirekha

The influence of the treatments on the nature of bending was insignificant in this variety during both the seasons (Table 31 and 32).

Fig. 9. Effect of season and variety on the number of florets opened at a time in gladiolus



4.3.6.2. American Beauty

The treatments could not significantly influence the bending nature during both the seasons in this variety (Table 33 and 34).

4.3.6.3. Friendship

In this variety, there was no significant influence of the treatments on the nature of bending of the spikes in vase during both the seasons (Table 35 and 36).

4.3.6.4. Mansoer Red

The influence of the treatments on the nature of bending was insignificant in this variety during both the seasons (Table 37 and 38).

4.3.6.5. True Yellow

The treatments failed to influence the bending nature of spike in vase in this variety during both the seasons (Table 39 and 40).

4.3.7. Water uptake

4.3.7.1. Agnirekha

The influence of treatments on water uptake was insignificant during the first season in this variety (Table 31).

During the second season (Table 32), the maximum amount of water uptake (40.00 ml) was recorded by T_4 (NAA 100 ppm) which was on par with T_{17} (K_2SO_4 1.0%), T_7 (CCC 500 ppm), T_{13} ($CaSO_4$ 1.0%), T_6 (CCC 250 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%), T_9 (GA 100 ppm) and T_{16} (K_2SO_4 0.5%). T_{12} (($CaSO_4$ 0.5%) recorded the minimum uptake (14.33 ml).

4.3.7.2. American Beauty

The influence of the treatments on water uptake was significant in this variety during both the seasons. During the first season (Table 33) maximum water uptake (86.67 ml) was recorded in T_8 (GA 50 ppm) and the minimum (43.67 ml) in T_2 (TIBA 150 ppm). T_8 (GA 50 ppm) was on par with T_6 (CCC 250 ppm), T_{17} (K_2SO_4 1.0%), T_7 (CCC 500 ppm), T_{13} ($CaSO_4$ 1.0%) and T_{12} ($CaSO_4$ 0.5%).

During the second season (Table 34), T_1 (control) recorded the maximum uptake (35.33 ml) which was on par with T_2 (TIBA 150 ppm), T_4 (NAA 100 ppm), T_{15} (KNO_3 1.0%), T_{17} (K_2SO_4 1.0%), T_3 (TIBA 300 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%), T_{12} ($CaSO_4$ 0.5%), T_6 (CCC 250 ppm) and T_7 (CCC 500 ppm). T_{13} ($CaSO_4$ 1.0%) recorded the minimum uptake (11.33 ml).

4.3.7.3. Friendship

The treatments failed to influence the water uptake in this variety during the first season (Table 35).

During the second season (Table 36) the maximum water uptake (55.0 ml) was recorded by T_{15} (KNO_3 1.0%) and minimum (14.67 ml) by T_{14} (KNO_3 0.5%). T_{15} (KNO_3 1.0%) was on par with T_{12} (K_2SO_4 1.0%).

4.3.7.4. Mansoer Red

Influence of the treatments on the amount of water uptake was insignificant in this variety during the first season (Table 37).

During the second season (Table 38), T_{10} ($Ca(NO_3)_2$ 0.5%) recorded the maximum water uptake (38.00 ml) which was on par with T_7 (CCC 500 ppm), T_{17} (K_2SO_4 1.0%), T_2 (TIBA 150 ppm) and T_9 (GA 100 ppm). T_1 (control) and T_{15} (KNO_3 1.0%) recorded the minimum water uptake (14.33 ml, each).

4.3.7.5. True Yellow

In this variety also, the treatments failed to significantly influence the water uptake during the first season (Table 39).

During the second season (Table 40), the maximum water uptake (38.00 ml) was recorded in T_{10} ($Ca(NO_3)_2$ 0.5%) which was on par with T_{13} ($CaSO_4$ 1.0%), T_3 (TIBA 300 ppm), T_{12} ($CaSO_4$ 0.5%), T_{17} (K_2SO_4 1.0%), T_{14} (KNO_3 0.5%), T_7 (CCC 500 ppm), T_{11} ($Ca(NO_3)_2$ 1.0%) and T_{16} (K_2SO_4 0.5%). T_4 (NAA 100 ppm) recorded the minimum quantity (12.33 ml).

4.4. Corm and cormel yield

4.4.1. Corm weight

4.4.1.1. Agnirekha

The treatments significantly influenced the corm weight during both the seasons. Corm weight was found to be the maximum (33.46 g) in T_5 (NAA 200 ppm) during the first season (Table 41) which was on par with T_6 (CCC 250 ppm), T_1 (control), T_3 (TIBA 300 ppm), T_4 (NAA 100 ppm), T_{16} (K_2SO_4 0.5%) and T_{13} ($CaSO_4$ 1.0%). Minimum corm weight (11.95 g) was recorded in T_{17} (K_2SO_4 1.0%).

During the second season (Table 42), T_{17} (K_2SO_4 1.0%) produced the heaviest corms, weighing 46.34 g, which was significantly superior to all other treatments. T_{10} ($Ca(NO_3)_2$ 0.5%) recorded the minimum weight (8.25 g).

4.4.1.2. American Beauty

Influence of the treatments on the weight of corms in this variety was significant during both the seasons. During the first season (Table 43), it was the maximum (82.99 g) in T_8 (GA 50 ppm) and was on par with T_{17} (K_2SO_4 1.0%), T_{13} ($CaSO_4$ 1.0%), T_{14} (KNO_3 0.5%) and T_{10} ($Ca(NO_3)_2$ 0.5%). Corm weight was found to be the minimum (30.29 g) in T_4 (NAA 100 ppm).

Maximum corm weight (45.97 g) was recorded in T_{11} ($Ca(NO_3)_2$ 1.0%) during the second season (Table 44) which was

Table 41
Effect of treatments on the corm and cormel yield of gladiolus cv. Agnirekha during first season

Treatment		Weight of corm (g)	Size of corm (cc)	Number of cormels	Weight of cormels (g)
T_1	Control	28.99	22.33	5.33	7.10
T_2	TIBA 150 ppm	17.93	18.00	3.33	5.15
T_3	TIBA 300 ppm	28.90	24.33	11.33	9.97
T_4	NAA 100 ppm	28.27	28.00	6.67	9.60
T_5	NAA 200 ppm	33.46	29.33	8.67	11.97
T_6	CCC 250 ppm	32.60	33.67	10.00	12.57
T_7	CCC 500 ppm	19.75	19.50	12.00	14.54
T_8	GA 50 ppm	18.32	19.00	10.33	10.03
T_9	GA 100 ppm	19.22	19.00	6.33	7.33
T_{10}	$Ca(NO_3)_2$ 0.5%	21.91	20.00	7.33	10.19
T_{11}	$Ca(NO_3)_2$ 1.0%	12.84	14.50	4.67	3.70
T_{12}	$CaSO_4$ 0.5%	17.30	19.00	2.33	3.37
T_{13}	$CaSO_4$ 1.0%	27.54	27.00	14.33	17.65
T_{14}	KNO_3 0.5%	19.12	18.00	9.67	13.46
T_{15}	KNO_3 1.0%	20.40	19.67	8.67	9.95
T_{16}	K_2SO_4 0.5%	27.95	23.50	11.33	14.62
T_{17}	K_2SO_4 1.0%	11.95	12.50	3.33	3.43
	CD (0.05)	10.25	7.82	4.76	6.07
	SEm±	3.57	2.72	1.66	2.11

Table 42
Effect of treatments on the corm and cormel yield of gladiolus cv. Agnirekha during second season

Treatment		Weight of corm (g)	Size of corm (cc)	Number of cormels	Weight of cormels (g)
T_1	Control	23.75	19.67	10.33	4.39
T_2	TIBA 150 ppm	31.00	17.33	9.33	2.86
T_3	TIBA 300 ppm	21.51	19.67	7.33	1.00
T_4	NAA 100 ppm	18.72	13.67	5.33	1.61
T_5	NAA 200 ppm	17.41	16.67	9.33	2.10
T_6	CCC 250 ppm	23.29	17.00	10.33	1.21
T_7	CCC 500 ppm	14.75	10.00	9:00	3.00
T_8	GA 50 ppm	17.17	13.67	11.00	4.61
T_9	GA 100 ppm	17.15	13.00	13.33	2.75
T_{10}	$Ca(NO_3)_2$ 0.5%	8.25	7.00	2.67	2.45
T_{11}	$Ca(NO_3)_2$ 1.0%	19.11	11.67	4.00	1.78
T_{12}	$CaSO_4$ 0.5%	15.89	25.33	4.33	1.61
T_{13}	$CaSO_4$ 1.0%	19.15	14.00	5.67	2.62
T_{14}	KNO_3 0.5%	17.65	12.67	9.33	5.37
T_{15}	KNO_3 1.0%	15.83	7.67	8.33	2.99
T_{16}	K_2SO_4 0.5%	24.49	16.67	7.33	2.99
T_{17}	K_2SO_4 1.0%	46.34	29.00	9.33	3.89
	CD (0.05)	9.65	7.57	5.40	1.50
	SEm±	3.36	2.63	1.87	0.52

Table 43
Effect of treatments on the corm and cormel yield of gladiolus cv. American Beauty during first season

Treatment		Weight of corm (g)	Size of corm (cc)	Number of cormels	Weight of cormels (g)
T_1	Control	43.96	43.20	22.00	4.35
T_2	TIBA 150 ppm	52.07	54.00	42.00	6.23
T_3	TIBA 300 ppm	59.74	58.58	46.33	7.33
T_4	NAA 100 ppm	30.29	29.33	10.67	5.09
T_5	NAA 200 ppm	62.09	62.67	15.67	4.80
T_6	CCC 250 ppm	26.03	27.33	28.00	4.44
T_7	CCC 500 ppm	31.58	28.71	31.67	6.27
T_8	GA 50 ppm	82.99	85.50	29.67	11.42
T_9	GA 100 ppm	55.40	50.00	61.00	10.38
T_{10}	$Ca(NO_3)_2$ 0.5%	66.87	61.67	37.67	7.88
T_{11}	$Ca(NO_3)_2$ 1.0%	54.80	51.33	52.67	8.54
T_{12}	$CaSO_4$ 0.5%	49.96	49.00	55.33	8.30
T_{13}	$CaSO_4$ 1.0%	72.70	74.67	39.00	13.64
T_{14}	KNO_3 0.5%	69.52	66.67	68.00	19.73
T_{15}	KNO_3 1.0%	49.65	44.17	32.67	6.43
T_{16}	K_2SO_4 0.5%	49.83	49.00	49.33	12.36
T_{17}	K_2SO_4 1.0%	80.05	80.00	52.00	21.07
	CD (0.05)	20.02	20.41	21.32	6.44
	SEm±	6.97	7.10	5.26	2.24

Table 44
Effect of treatments on the corm and cormel yield of gladiolus cv. American Beauty during second season

Treatment		Weight of corm (g0	Size of corm (cc)	Number of cormels	Weight of cormels (g)
T_1	Control	20.53	21.33	2.33	0.64
T_2	TIBA 150 ppm	21.85	18.33	3.33	0.86
T_3	TIBA 300 ppm	26.09	17.67	2.00	1.07
T_4	NAA 100 ppm	11.77	9.33	1.33	0.68
T_5	NAA 200 ppm	15.12	14.67	2.33	1.07
T_6	CCC 250 ppm	29.46	23.67	3.00	0.44
T_7	CCC 500 ppm	14.86	14.00	1.67	0.87
T_8	GA 50 ppm	25.65	19.00	2.00	0.46
T_9	GA 100 ppm	27.82	20.00	4.33	1.68
T_{10}	$Ca(NO_3)_2$ 0.5%	25.94	19.33	4.67	1.62
T_{11}	$Ca(NO_3)_2$ 1.05%	45.97	39.67	4.33	1.72
T_{12}	$CaSO_4$ 0.5%	34.80	29.00	2.67	0.61
T_{13}	$CaSO_4$ 1.0%	19.83	17.00	2.00	0.37
T_{14}	KNO_3 0.5%	20.56	15.67	1.67	0.52
T_{15}	KNO_3 1.0%	17.92	19.00	1.33	0.46
T_{16}	K_2SO_4 0.5%	19.81	14.67	3.33	1.80
T_{17}	K_2SO_4 1.0%	17.45	15.33	3.00	1.36
	CD (0.05)	12.84	11.63	NS	0.81
	SEm±	4.47	4.05	0.87	0.29

on par with T_{12} ($CaSO_4$ 0.5%). T_4 (NAA 100 ppm) recorded the minimum weight (11.77 g).

4.4.1.3. Friendship

Influence of the treatments on the weight of corms in this variety was significant during the first season (Table 45). Treatment T_4 (NAA 100 ppm) produced the heaviest corms weighing 70.20 g, on an average. T_{13} ($CaSO_4$ 1.0%), T_{11} ($Ca(NO_3)_2$ 1.0%) and T_8 (GA 50 ppm) were on par with T_4 (NAA 100 ppm). T_{10} ($Ca(NO_3)_2$ 0.5%) showed minimum weight (13.37 g).

The treatments failed to produce significant effect during the second season (Table 46).

4.4.1.4. Mansoer Red

Influence of the treatments on the weight of corms was significant during the first season in the variety (Table 47). Maximum corm weight (52.86 g) was recorded in T_{12} ($CaSO_4$ 0.5%) which was on par with T_{17} (K_2SO_4 1.0%) and T_{11} ($Ca(NO_3)_2$ 1.0%). Corm weight was the minimum (14.09 g) in T_{14} (KNO_3 0.5%).

Influence of the treatments on the weight of corms was insignificant during the second season (Table 48).

4.4.1.5. True Yellow

The treatments significantly influenced the weight of corms

Table 45
Efect of treatments on the corm and cormel yield of gladiolus cv. Friendship during first season

Treatment		Weight of corm (g)	Size of corm (cc)	Number of cormels	Weight of cormels (g)
T_1	Control	23.75	26.50	2.33	0.27
T_2	TIBA 150 ppm	30.05	32.00	7.67	1.61
T_3	TIBA 300 ppm	35.57	32.33	60.00	7.49
T_4	NAA 100 ppm	70.20	71.00	10.00	2.00
T_5	NAA 200 ppm	14.69	21.00	4.33	2.21
T_6	CCC 250 ppm	28.69	32.00	22.00	3.03
T_7	CCC 500 ppm	31.51	29.67	93.33	17.57
T_8	GA 50 ppm	55.61	48.33	25.00	13.48
T_9	GA 100 ppm	35.68	37.33	91.33	12.13
T_{10}	$Ca(NO_3)_2$ 0.5%	13.37	13.00	6.33	2.71
T_{11}	$Ca(NO_3)_2$ 1.0%	55.74	48.00	39.67	10.39
T_{12}	$CaSO_4$ 0.5%	35.67	37.67	30.33	0.76
T_{13}	$CaSO_4$ 1.0%	66.87	59.00	37.67	14.92
T_{14}	KNO_3 0.5%	37.09	39.33	25.70	1.97
T_{15}	KNO_3 1.0%	47.09	42.33	36.00	4.55
T_{16}	K_2SO_4 0.5%	36.23	36.00	99.00	15.67
T_{17}	K_2SO_4 1.0%	34.67	36.67	21.67	4.42
	CD (0.05)	17.61	15.11	46.41	7.70
	SEm±	6.13	5.26	16.15	2.68

Table 46
Effect of treatments on the corm and cormel yield of gladiolus cv. Friendship during second season

Treatment		Weight of corm (g)	Size of corm (cc)	Number of cormels	Weight of cormels (g)
T_1	Control	17.30	21.67	60.33	1.17
T_2	TIBA 150 ppm	10.76	10.00	8.00	0.96
T_3	TIBA 300 ppm	24.29	13.00	3.33	0.81
T_4	NAA 100 ppm	13.06	12.00	6.67	0.92
T_5	NAA 200 ppm	25.46	22.67	7.67	1.55
T_6	CCC 250 ppm	20.75	16.00	6.67	1.09
T_7	CCC 500 ppm	33.15	41.33	14.67	2.17
T_8	GA 50 ppm	23.47	18.33	23.00	3.55
T_9	GA 100 ppm	18.17	20.33	12.33	1.06
T_{10}	$Ca(NO_3)_2$ 0.5%	19.91	15.00	15.33	1.09
T_{11}	$Ca(NO_3)_2$ 1.0%	21.86	20.67	10.00	1.91
T_{12}	$CaSO_4$ 0.5%	29.07	23.67	9.67	1.19
T_{13}	$CaSO_4$ 1.0%	12.43	14.67	11.00	1.60
T_{14}	KNO_3 0.5%	14.71	13.67	12.67	1.45
T_{15}	KNO_3 1.0%	38.19	32.00	29.33	5.09
T_{16}	K_2SO_4 0.5%	19.85	17.00	10.67	1.72
T_{17}	K_2SO_4 1.0%	24.73	19.33	22.00	5.04
	CD (0.05)	NS	NS	9.74	2.47
	SEm±	8.03	6.02	3.40	0.86

Table 47
Effect of treatments on the corm and cormel yield of gladiolus cv. Mansoer Red during first season

Treatment		Weight of corm (g)	Size of corm (cc)	Number of cormels	Weight of cormels (g)
T_1	Control	14.37	14.00	9.67	1.95
T_2	TIBA 150 ppm	30.00	28.50	6.67	0.99
T_3	TIBA 300 ppm	34.50	32.00	13.33	3.59
T_4	NAA 100 ppm	25.58	22.50	12.00	4.20
T_5	NAA 200 ppm	23.88	24.00	13.33	3.02
T_6	CCC 250 ppm	21.29	17.67	15.33	4.84
T_7	CCC 500 ppm	23.40	23.00	12.00	3.59
T_8	GA 50 ppm	20.78	19.00	24.33	5.39
T_9	GA 100 ppm	26.13	24.67	14.33	5.61
T_{10}	$Ca(NO_3)_2$ 0.5%	24.19	24.33	48.67	10.73
T_{11}	$Ca(NO_3)_2$ 1.0%	44.55	44.67	15.67	4.32
T_{12}	$CaSO_4$ 0.5%	52.86	49.00	28.00	8.93
T_{13}	$CaSO_4$ 1.0%	24.55	24.00	19.33	4.93
T_{14}	KNO_3 0.5%	14.09	14.00	24.00	7.51
T_{15}	KNO_3 1.0%	18.27	19.00	6.00	2.20
T_{16}	K_2SO_4 0.5%	17.25	14.50	22.0_	5.32
T_{17}	K_2SO_4 1.0%	47.97	44.67	38.67	24.70
	CD (0.05)	16.39	14.63	16.36	6.56
	SEm±	5.71	5.09	5.58	2.28

Table 48
Effect of treatments on the corm and cormel yield of gladiolus cv. Mansoer Red during second season

Treatment		Weight of corm (g)	Size of corm (cc)	Number of cormels	Weight of cormels (g)
T_1	Control	15.89	15.67	8.67	7.41
T_2	TIBA 150 ppm	5.27	3.33	2.00	0.62
T_3	TIBA 300 ppm	10.49	9.67	4.00	3.38
T_4	NAA 100 ppm	17.33	10.00	6.67	2.81
T_5	NAA 200 ppm	22.59	20.00	5.33	5.94
T_6	CCC 250 ppm	20.66	13.67	6.00	6.83
T_7	CCC 500 ppm	22.36	15.00	4.67	4.43
T_8	GA 50 ppm	11.27	6.00	4.33	3.41
T_9	GA 100 ppm	14.72	11.33	3.67	3.67
T_{10}	$Ca(NO_3)_2$ 0.5%	15.76	9.67	6.00	3.72
T_{11}	$Ca(NO_3)_2$ 1.0%	23.39	17.00	4.67	2.50
T_{12}	$CaSO_4$ 0.5%	14.93	13.33	4.67	2.90
T_{13}	$CaSO_4$ 1.0%	15.45	16.00	8.33	2.28
T_{14}	KNO_3 0.5%	19.20	12.00	6.33	4.83
T_{15}	KNO_3 1.0%	16.55	15.67	3.00	3.53
T_{16}	K_2SO_4 0.5%	8.81	9.33	5.00	2.94
T_{17}	K_2SO_4 1.0%	14.06	11.67	4.00	2.68
	CD (0.05)	NS	NS	NS	NS
	SEm±	4.58	3.39	1.56	1.32

during both the seasons in this variety. During the first season (Table 49), treatment T_{12} ($CaSO_4$ 0.5%) produced the heaviest corms (88.23 g). It was on par with T_{15} (KNO_3 1.0%), T_3 (TIBA 300 ppm), T_{17} (K_2SO_4 1.0%), T_1 (control), T_{11} ($Ca(NO_3)_2$ 1.0%) and T_2 (TIBA 150 ppm). T_9 (GA 100 ppm) showed the minimum weight (29.77 g).

During the second season (Table 50), T_5 (NAA 200 ppm) recorded the maximum weight (64.98 g) which was on par with T_{11} ($Ca(NO_3)_2$ 1.0%), T_6 (CCC 250 ppm), T_7 (CCC 500 ppm), T_{14} (KNO_3 0.5%), T_{10} ($Ca(NO_3)_2$ 0.5%) and T_8 (GA 50 ppm). The minimum weight (15.66 g) was recorded by T_{17} (K_2SO_4 1.0%).

The effect of seasons was very conspicuous on corm weight in all the varieties (Fig. 10). First season was better in this case also. Among the varieties, V_5 (True Yellow) produced the heaviest corms (61 g and 40 g, during the first and second seasons, respectively). V_1 (Agnirekha) recorded minimum corm weight (23 g) during the first season and V_4 (Mansoer Red) recorded the minimum (16 g) during the second season.

4.4.2. Corm size

4.4.2.1. Agnirekha

The effect of treatments on corm size (volume) was significant in this variety during both the seasons. Maximum corm size (33.67 cc) was recorded in T_6 (CCC 250 ppm) during the first season (Table 41) which was on par with T_5 (NAA 200 ppm), T_4

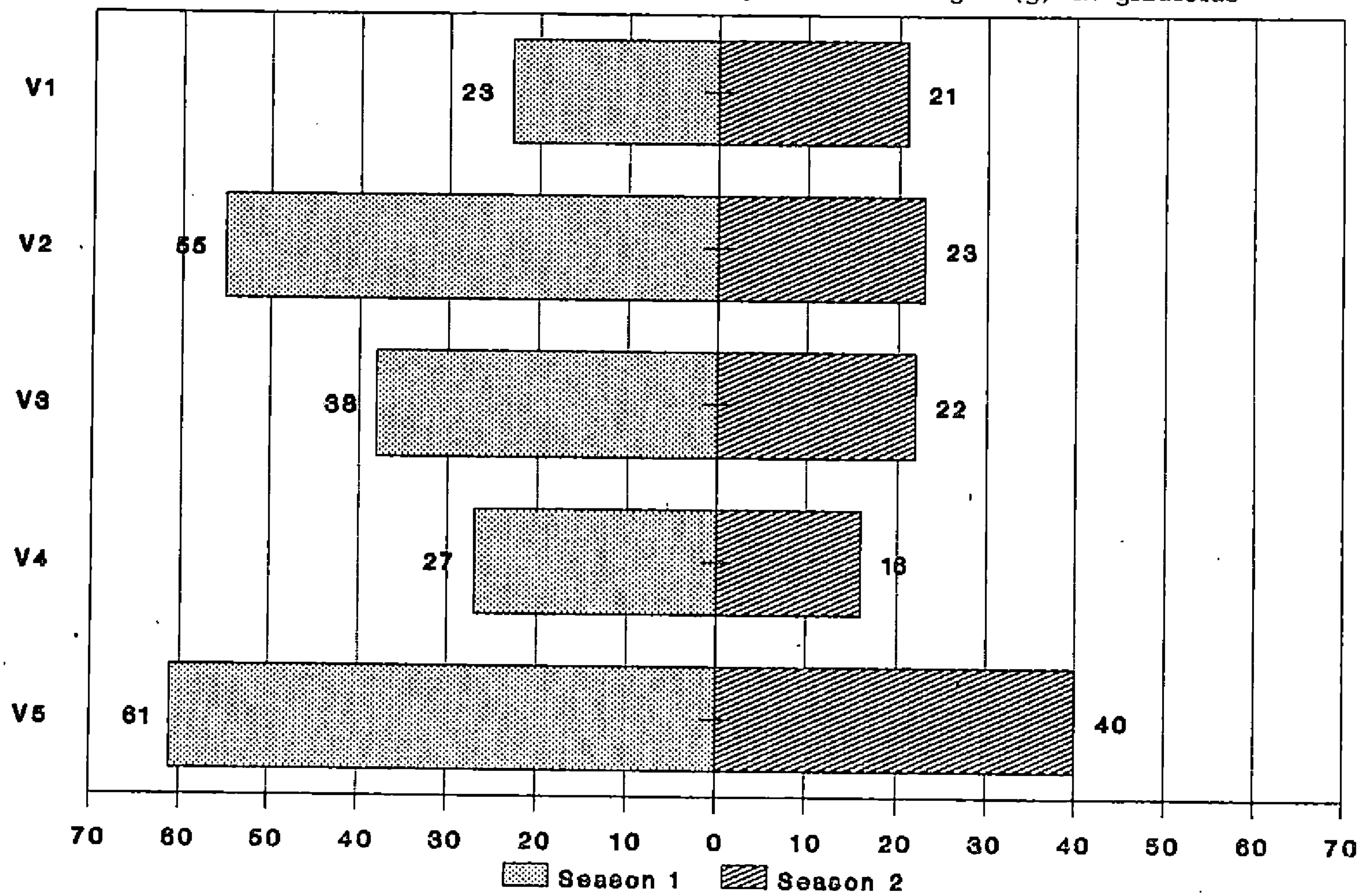
Table 49
Effect of treatments on the corm and cormel yield of gladiolus cv. True Yellow during first season

Treatment		Weight of corm (g)	Size of corm (cc)	Number of cormels	Weight of cormels (g)
T_1	Control	74.94	69.00	7.00	3.73
T_2	TIBA 150 ppm	67.76	64.67	12.00	2.56
T_3	TIBA 300 ppm	79.73	79.00	13.00	5.21
T_4	NAA 100 ppm	38.62	35.33	1.00	0.26
T_5	NAA 200 ppm	48.43	44.33	7.33	4.85
T_6	CCC 250 ppm	54.32	53.33	18.00	9.55
T_7	CCC 500 ppm	47.25	48.33	9.67	2.47
T_8	GA 50 ppm	64.36	61.67	10.00	2.09
T_9	GA 100 ppm	29.77	30.67	2.67	0.43
T_{10}	$Ca(NO_3)_2$ 0.5%	62.44	58.50	17.67	4.04
T_{11}	$Ca(NO_3)_2$ 1.0%	69.04	68.00	12.00	7.80
T_{12}	$CaSO_4$ 0.5%	88.23	89.33	31.00	17.16
T_{13}	$CaSO_4$ 1.0%	48.05	44.50	2.00	0.49
T_{14}	KNO_3 0.5%	76.51	72.50	8.33	4.17
T_{15}	KNO_3 1.0%	80.67	78.67	13.00	9.66
T_{16}	K_2SO_4 0.5%	34.95	34.67	18.67	10.47
T_{17}	K_2SO_4 1.0%	77.64	72.67	11.33	5.47
	CD (0.05)	20.71	19.48	9.09	5.89
	SEm±	7.21	6.78	3.16	2.05

Table 50
Effect of treatments on the corm and cormel yield of gladiolus cv. True Yellow during second season

Treatment		Weight of corm (g)	Size of corm (cc)	Number of cormels	Weight of cormels (g)
T_1	Control	17.42	17.00	4.00	2.14
T_2	TIBA 150 ppm	30.72	34.67	3.67	1.68
T_3	TIBA 300 ppm	36.96	34.67	4.00	0.71
T_4	NAA 100 ppm	39.06	29.67	3.67	1.89
T_5	NAA 200 ppm	64.98	59.67	24.33	3.48
T_6	CCC 250 ppm	57.87	53.67	29.00	2.63
T_7	CCC 500 ppm	54.36	49.67	14.67	2.32
T_8	GA 50 ppm	44.99	39.67	23.00	4.00
T_9	GA 100 ppm	41.14	36.00	28.67	4.60
T_{10}	$Ca(NO_3)_2$ 0.5%	49.45	37.33	19.67	3.43
T_{11}	$Ca(NO_3)_2$ 1.0%	64.39	58.67	22.67	3.99
T_{12}	$CaSO_4$ 0.5%	26.06	26.00	6.00	1.09
T_{13}	$CaSO_4$ 1.0%	35.62	34.33	4.67	1.21
T_{14}	KNO_3 0.5%	51.75	48.33	18.33	2.81
T_{15}	KNO_3 1.0%	21.39	18.00	4.67	1.37
T_{16}	K_2SO_4 0.5%	34.65	34.00	7.67	0.59
T_{17}	K_2SO_4 1.0%	15.66	14.00	4.67	1.74
	CD (0.05)	21.65	22.39	15.99	NS
	SEm±	7.54	7.79	5.56	1.00

Fig. 10. Effect of season and variety on corm weight (g) in gladiolus



(NAA 100 ppm) and T_{13} ($CaSO_4$ 1.0%). Corm size was the minimum (12.50 cc) in T_{17} (K_2SO_4 1.0%).

During the second season (Table 42) maximum size (29.00 cc) was recorded in T_{17} (K_2SO_4 1.0%) and minimum (7.00 cc) in T_{10} ($Ca(NO_3)_2$ 0.5%). T_{17} (K_2SO_4 1.0%) was on par with T_{12} ($CaSO_4$ 0.5%).

4.4.2.2. American Beauty

The treatments significantly influenced the size of corms during both the seasons in this variety. During the first season (Table 43), T_8 (GA 50 ppm) produced the largest corms (85.50 cc) which was on par with T_{17} (K_2SO_4 1.0%), T_{13} ($CaSO_4$ 1.0%) and T_{14} (KNO_3 0.5%). Size of corms was found to be the minimum (27.33 cc) in T_6' (CCC 250 ppm).

During the second season (Table 44), T_{11} ($Ca(NO_3)_2$ 1.0%) recorded the maximum (39.67 cc) corm size which was on par with T_{12} ($CaSO_4$ 0.5%). The smallest sized corms (9.33 cc) were produced by T_4 (NAA 100 ppm).

4.4.2.3. Friendship

The treatments exerted significant influence on the corm size during the first season only (Table 45). Maximum corm size (71.00 cc) was recorded in T_4 (NAA 100 ppm) and the minimum (13.00 cc) in T_{10} ($Ca(NO_3)_2$ 0.5%). T_4 (NAA 100 ppm) was on par with T_{13} ($CaSO_4$ 1.0%).

Influence of the treatments on the corm size was insignificant during the second season (Table 46).

4.4.2.4. Mansoer Red

The treatments produced significant influence on the corm size in this variety during the first season (Table 47). Treatment T_{12} ($CaSO_4$ 0.5%) recorded the maximum corm size (49.00 cc) and T_1 (control) and T_{14} (KNO_3 0.5%), the minimum (14.00 cc, each). T_{12} ($CaSO_4$ 0.5%) was found to be on par with T_{17} (K_2SO_4 1.0%) and T_{11} ($Ca(NO_3)_2$ 1.0%).

The treatments failed to significantly influence the size of corms during the second season in this variety (Table 48).

4.4.2.5. True Yellow

The treatments exerted significant influence on the corm size in the variety during both the seasons. During the first season (Table 49) maximum corm size (89.33 cc) was recorded in T_{12} ($CaSO_4$ 0.5%) which was on par with T_3 (TIBA 300 ppm), T_{15} (KNO_3 1.0%), T_{17} (K_2SO_4 1.0%) and T_{14} (KNO_3 0.5%). Corm size was the smallest (30.67 cc) in T_9 (GA 100 ppm).

During the second season (Table 50), T_5 (NAA 200 ppm) recorded the maximum size (59.67 cc) and T_{17} (K_2SO_4 1.0%), the minimum (14.00 cc). T_5 was on par with T_{11} ($Ca(NO_3)_2$ 1.0%), T_6 (CCC 250 ppm), T_7 (CCC 500 ppm), T_{14} (KNO_3 0.5%), T_8 (GA 50 ppm) and T_{10} ($Ca(NO_3)_2$ 0.5%).

4.4.3. Number of cormels per plant

4.4.3.1. Agnirekha

The treatments had significant influence on the number of cormels during both the seasons. Maximum number of cormels (14.33) was recorded in T_{13} ($CaSO_4$ 1.0%) during the first season (Table 41) which was on par with T_7 (CCC 500 ppm), T_3 (TIBA 300 ppm), T_{16} (K_2SO_4 0.5%), T_8 (GA 50 ppm), T_6 (CCC 250 ppm) and T_{14} (KNO_3 0.5%). Number of cormels was the minimum (2.33) in T_{12} ($CaSO_4$ 0.5%).

During the second season (Table 42), T_9 (GA 100 ppm) produced the maximum number of cormels (13.33), which was on par with T_8 (GA 50 ppm), T_1 (control), T_6 (CCC 250 ppm), T_2 (TIBA 150 ppm), T_5 (NAA 200 ppm), T_{14} (KNO_3 0.5%), T_{17} (K_2SO_4 1.0%), T_7 (CCC 500 ppm) and T_{15} (KNO_3 1.0%). T_{10} ($Ca(NO_3)_2$ 0.5%) produced the minimum number of cormels (2.67).

4.4.3.2. American Beauty

Influence of the treatments on the number of cormels was significant in this variety during the first season (Table 43). T_{14} (KNO_3 0.5%) recorded the maximum number (68.00) and T_4 (NAA 100 ppm) the minimum (10.67). T_{14} (KNO_3 0.5%) was found to be on par with T_9 (GA 100 ppm), T_{12} ($CaSO_4$ 0.5%), T_{11} ($Ca(NO_3)_2$ 1.0%), T_{17} (K_2SO_4 1.0%) and T_{16} (K_2SO_4 0.5%).

The treatments failed to exert significant influence on the number of cormels in the variety during the second season (Table 44).

4.4.3.3. Friendship

Influence of the treatments on the number of cormels was significant during both the seasons in this variety. During the first season (Table 45), maximum number of cormels (99.00) was recorded in T_{16} (K_2SO_4 0.5%) and minimum (2.33) in T_1 (control). T_{16} (K_2SO_4 0.5%) was on par with T_9 (GA 100 ppm), T_7 (CCC 500 ppm) and T_3 (TIBA 300 ppm).

During the second season (Table 46), significant superior influence was exhibited by T_1 (control) which produced 60.33 cormels on an average. T_3 (TIBA 300 ppm) produced the minimum number (3.33).

4.4.3.4. Mansoer Red

The treatments significantly influenced the number of cormels in the variety during the first season (Table 47). The number of cormels was found to be the maximum (48.67) in T_{10} ($Ca(NO_3)_2$ 0.5%) which was on par with T_{17} (K_2SO_4 1.0%). Minimum number of cormels (6.00) was recorded in T_{15} (KNO_3 1.0%).

Influence of the treatments on the number of cormels was insignificant in this variety during the second season, as is evident form Table 48.

4.4.3.5. True Yellow

The influence of treatments on the number of cormels in this variety was significant in both the seasons. T_{12} ($CaSO_4$ 0.5%) recorded the maximum (31.00) and T_4 (NAA 100 ppm) the minimum (1.00) during the first season (Table 49). T_{12} was significantly superior to all other treatments.

During the second season (Table 50), the maximum number of cormels (29.00) was produced by T_6 (CCC 250 ppm) which was on par with T_9 (GA 100 ppm), T_5 (NAA 200 ppm), T_8 (GA 50 ppm), T_{11} ($Ca(NO_3)_2$ 1.0%), T_{10} ($Ca(NO_3)_2$ 0.5%), T_{14} (KNO_3 0.5%) and T_7 (CCC 500 ppm). Treatments T_2 (TIBA 150 ppm) and T_4 (NAA 100 ppm) recorded the minimum number of cormels (3.67, each).

4.4.4. Weight of cormels

4.4.4.1. Agnirekha

Influence of the treatments on the weight of cormels in this variety was significant in both the seasons. It was found to be the maximum (17.65 g) in T_{13} ($CaSO_4$ 1.0%) during the first season (Table 41) which was on par with T_{16} (K_2SO_4 0.5%), T_7 (CCC 500 ppm), T_{14} (KNO_3 0.5%), T_6 (CCC 250 ppm) and T_5 (NAA 200 ppm). Weight of cormels was the minimum (3.43 g) in T_{17} (K_2SO_4 1.0%).

Treatment T_{14} (KNO_3 0.5%) recorded the maximum weight (5.37 g) during the second season (Table 42) which was on par with T_8 (GA 50 ppm), T_1 (control) and T_{17} (K_2SO_4 1.0%). T_3 (TIBA 300 ppm) recorded the minimum weight (1.00 g).

4.4.4.2. American Beauty

In this variety, there was significant influence of the treatments on the weight of cormels during both the seasons. During the first season (Table 43) treatment T_{17} (K_2SO_4 1.0%) recorded the maximum weight (21.07 g) and T_1 (control) the minimum (4.35 g). T_{17} (K_2SO_4 1.0%) was on par with T_{14} (KNO_3 0.5%).

Maximum weight of cormels (1.80 g) was recorded in T_{16} (K_2SO_4 0.5%) during the second season (Table 44) which was on par with T_{11} ($Ca(NO_3)_2$ 1.0%), T_9 (GA 100 ppm), T_{10} ($Ca(NO_3)_2$ 0.5%), T_{17} (K_2SO_4 1.0%), T_3 (TIBA 300 ppm) and T_5 (NAA 200 ppm). Least weight (0.37 g) was recorded in T_{13} ($CaSO_4$ 1.0%).

4.4.4.3. Friendship

Influence of the treatments on the weight of cormels was significant in this variety also during both the seasons. During the first season (Table 45), weight of cormels was found to be the maximum (17.57 g) in T_7 (CCC 500 ppm). T_{16} (K_2SO_4 0.5%), T_{13} ($CaSO_4$ 1.0%), T_8 (GA 50 ppm), T_9 (GA 100 ppm) and T_{11} ($Ca(NO_3)_2$ 1.0%) were on par with this. Minimum weight (0.27 g) was recorded in T_1 (control).

During the second season (Table 46), T_{15} (KNO_3 1.0%), produced the maximum weight (5.09 g) which was on par with T_{17} (K_2SO_4 1.0%) and T_8 (GA 50 ppm). Treatment T_3 (TIBA 300 ppm) recorded the minimum weight (0.81 g).

4.4.4.4. Monsoer Red

Significant differences could be observed in the weight of cormels in this variety during the first season (Table 47). Treatment T_{17} (K_2SO_4 1.0%) was superior to all others in influencing the weight of cormels (24.70 g). Minimum weight (0.99 g) was recorded by the treatment T_2 (TIBA 150 ppm).

Influence of the treatments on the weight of cormels was insignificant in this variety during the second season (Table 48).

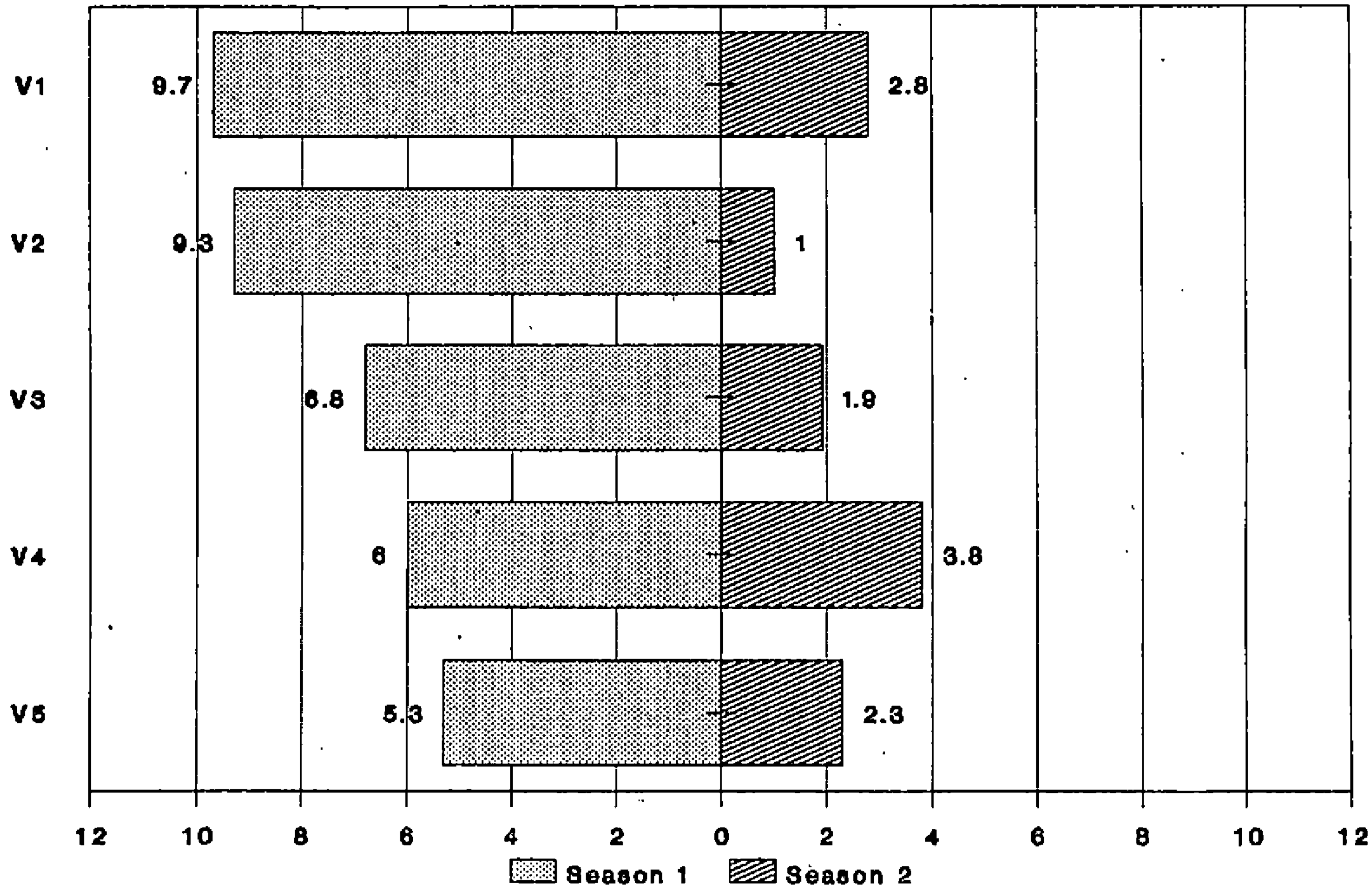
4.4.4.5. True Yellow

Influence of the treatments on the weight of cormels in this variety was significant during the first season (Table 49). Maximum weight (17.16 g) was recorded in T_{12} ($CaSO_4$ 0.5%) which was significantly superior to all other treatments. T_4 (NAA 100 ppm) recorded the minimum weight (0.26 g).

Influence of the treatments on the weight of cormels was insignificant in this variety during the second season (Table 50).

Superior influence of the first season on the weight of cormels was evident from the Fig. 11. Here all the varieties performed well. V_1 (Agnirekha) produced maximum weight of cormels (9.7 g) during the first season, whereas V_4 (Mansoer Red) was the superior variety (3.8 g) during the second season. V_5 (True Yellow) in the first season (5.3 g) and V_3 (American Beauty) in the second season (1.0 g) were the least effective varieties.

Fig. 11. Effect of season and variety on the weight of cormels (g) in gladiolus



Discussion

DISCUSSION

Results generated from the studies conducted to examine the effect of growth regulators and nutrients on the spike qualities of gladiolus are discussed hereunder.

Gladiolus is said to be the queen of bulbous flowers and is rated as the most popular cut flower in the world, especially from the commercial point of view (Hamilton, 1976). There is not a flower to surpass its beauty in cut flower industry due to the long spikes, which can remain fresh even upto twelve days, and the striking colours. The present experiments were aimed at examining the effect of growth regulators and nutrients on spike qualities, including the vase characters of gladiolus. Five varieties, viz., Agnirekha, American Beauty, Friendship, Mansoer Red and True Yellow were used for the study. TIBA, NAA, CCC and GA were the growth regulators and $Ca(NO_3)_2$, $CaSO_4$, KNO_3 and K_2SO_4 were the nutrients tried.

The flowering and yield of any crop is a reflection of its growth during the pre-flowering stage. In a crop like gladiolus, where the cut flowers form the main consumable product, a healthy and vigorous pre-flowering period is an important contributing factor. Being a monocotyledonous plant, plant height in combination with the leaf characters constitute the main vegetative parameters that influence the spike characters.

Though plant height need not have a direct correlation with the yield, its importance in a monocotyledonous crop lies in that the number of leaves produced by the plant is related to the stem length. The internodal length may also play a role in single stemmed plants; but in gladiolus, since the stem is beneath the soil, this does not manifest detectable difference. In fact, the height of the plant is a net result of the number of leaves produced and the length of the leaves in this crop. As such, the factors that influence the number of leaves produced and the length of leaves also influence the plant height. However, its relevance lies in the fact that, gladiolus being a shallow rooted plant, an increase in height makes it more susceptible to damage caused by wind, especially when it is in bloom.

From this experiment it was found that K_2SO_4 at both the concentrations (0.5% and 1.0%) and GA at the higher concentration (100 ppm) gave the best results regarding plant height. In Agnirekha, K_2SO_4 at 0.5% resulted in maximum plant height during the first season, at eight weeks after planting. During the second season, K_2SO_4 at 1.0% excelled the other treatments at both the stages. In American Beauty too K_2SO_4 (1.0%) gave the best result. It was superior in Mansoer Red also during the second season.

GA 100 ppm was found to produce maximum height in Friendship during the first season and in True Yellow during the second season. The positive effect of K may be due to its effect on regulating water conditions within the plant cell and also due to its action as an accelerator of enzymes. The role of higher level of mineral nutrition, including Muriate of Potash, in improving the plant height, has also been reported by Lemeni and Lemeni (1965). The important function of GA is cell elongation which causes stem elongation in genetically dwarf plants also (Phinney, 1956). Many findings have supported its function in increasing the plant height in gladiolus (Tonecki, 1979; Battacharjee, 1984; Dua et al., 1984 and Mukhopadhyay and Bankar, 1987). $CaSO_4$ (0.5%) produced maximum height in Friendship during the second season. Growth retardants TIBA and CCC and salts of Ca recorded least height. The dwarfing effect was prominent at higher concentrations of TIBA and CCC. The effect of CCC might be due to its action as an antigibberellin which is extensively exploited to control shoot growth.

Of all the vegetative parameters, the number of leaves and their size form the prominent factors that influence the growth and yield of a crop. This is more so in monocotyledonous plants where the number of leaves that are produced so as to initiate flowering is rather fixed in most of the cases. This points to the quantity of photosynthates that are accumulated by the plant and hence influence the floral characters too. Spike production is also depended upon the leaf characters.

The results pertaining to the effect of different treatments on the number of leaves showed that there was differential response with respect to the varieties tried in the present study. Most of the varieties did not respond to the treatments. TIBA at 300 ppm excelled the other treatments in Friendship and CCC at 250 ppm, in True Yellow, during the first season. These were found to be on par with several other treatments including GA 100 ppm and salts of Ca and K. Dua et al. (1984) had reported the effect of GA_3 in increasing the number of leaves. Significant differences in the number of leaves with NPK treatment were observed by Kosugi and Kondo (1961). Woltz (1954) also reported that the leaf production was most affected by N, P and K deficiencies.

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

In the case of leaf area, response of the varieties to the treatments was not alike. Treatments with K_2SO_4 caused a significant increase in leaf area in Agnirekha and American Beauty. Here also these varieties followed the same trend as that of plant height. Salts of Ca at 0.5% caused an increase in leaf area in Mansoer Red and True Yellow during the first season. The increase in leaf area as a result of increase in the number of leaves was observed in Friendship with TIBA at 300 ppm. But during the second season, NAA at 100 ppm was found to increase the leaf area in this variety. Increase in leaf length by treatment with 100 ppm NAA has also been reported by Tonecki (1979). During the second season, in True Yellow, 100 ppm GA was superior. In most of the varieties the superior treatments were found to be on par with GA. The effect of GA may be due to its action on cell division (Sachs et al., 1959) and cell enlargement (Haber and Luippold, 1960).

Duration from planting to spike emergence indicates the early or delayed flowering. In the study under report, earlier flowering was observed with K_2SO_4 at the lower concentration (0.5%) during the first season. At the higher concentration (1.0%) it reduced the time taken for the appearance of flower spike in all the varieties during the second season, except in True Yellow. KNO_3 at 0.5% caused earlier flowering in American Beauty during the first season. The role of K in flowering was reported by many scientists. A delay in flowering due to K deficiency was reported by Woltz (1954). Flowering upto 100% was reported with K treatment in Peter Pears, Hunting Song, Cordula, Flower Song and Trader Horn by Aouichaoui and Tissaoui (1989). $CaSO_4$ at 0.5% in Mansoer Red and the control treatment in Agnirekha also accelerated flowering during the first season. GA 100 ppm caused earlier flowering in Friendship during the first season and in True Yellow during the second season, though at the lower concentration it increased the duration significantly in Agnirekha and American Beauty. GA is a well known flower inducing growth regulator. The stimulating effects of Gibberellins in flower development have also been described by Wittwer and Bukovac (1957). Earlier flowering in gladiolus with GA was observed by many workers (Auge, 1982; IIHR, 1984 and Mukhopadhyay and Bankar, 1987).

Differential response of varieties was observed to the treatments in the case of duration from spike emergence to opening. Two varieties, viz., Mansoer Red and True Yellow, responded to the treatments during the first season and all the varieties, except True Yellow, during the second season. Duration was found to be the shortest in treatments with salts of Ca and K, in general, as seen in the case of duration from planting to spike emergence. Treatment with GA was found to increase the duration in American Beauty, Mansoer Red and True Yellow. TIBA at higher concentration lengthened the duration in Agnirekha whereas CCC at both the concentrations lengthened the duration in American Beauty. Delayed flower opening exhibited by these growth retardants may be due to the overall slower rate of development.

Inflorescence characters are the most significant factors which determine the suitability of gladiolus as a cut flower. Spike length, number of florets per spike and many other characters like length and size of the floret, decide the beauty and acceptability of the spike. Florets in a spike open one after another, starting from the lower most floret. Thus, one particular spike may last for a week to about a month, depending upon the environmental conditions. This in turn is determined by the number of florets per spike and the life of individual floret.

The treatments could significantly influence all the varieties in the case of blooming period. GA at 100 ppm exhibited longest blooming period in Agnirekha, American Beauty and True Yellow, during the first season. In increasing the blooming period in American Beauty NAA 200 ppm was on par with GA 100 ppm during the first season. Lengthened life of spike with GA_3 at 10 and 100 ppm was reported by Battacharjee (1984). The superiority of NAA has also been reported by Sharga (1979). In contrast to this result, NAA at the lower concentration (100 ppm) produced the shortest blooming period in American Beauty, Friendship and

Mansoer Red in the present studies. Treatment with CCC produced the shortest blooming period in Agnirekha and Mansoer Red. Bhattacharjee (1984) also reported that the application of CCC at 1000, 2500 and 5000 ppm had produced no significant effect. Treatment with $Ca(NO_3)_2$ lengthened the blooming period in Mansoer Red during the first season and American Beauty during the second season. Salts of K lengthened blooming period in Agnirekha and in True Yellow during the second season.

Duration from planting to the end of blooming period gives the total duration. Treatments with K_2SO_4, especially at the higher concentration (1.0%), and GA at 100 ppm reduced the total duration in most of the varieties. Varietal and seasonal variations were seen with respect to the longest duration. In Agnirekha, the shortest duration was observed in the treatment CCC 250 ppm, during the first season and in K_2SO_4 1.0% during the second season. In American Beauty also K_2SO_4 at 1.0% resulted in the minimum duration whereas it was GA at 100 ppm in Friendship. $CaSO_4$ at 0.5% produced the shortest duration in Mansoer Red during the first season and K_2SO_4 at 1.0% during the second season. In True Yellow K_2SO_4 at 0.5% produced the minimum duration during the first season and GA 100 ppm during the second season.

Generally long spikes hold more number of florets. They make a bold effect in vase when used as the height and centre of a design. But increase in length makes it more susceptable to breaking/bending of the floral stem when placed in the vase.

The spike length in the study was significantly influenced by the treatments. But the response of varieties to the treatments was not similar. K_2SO_4 at 0.5% was found to produce more spike length in Agnirekha and Friendship during the first season. On the other hand $CaSO_4$ at 0.5% increased the spike length in Mansoer Red. The effect of nutrients on the length of spike in gladiolus was reported by several scientists. Potassium and calcium deficiencies were found to result in shorter spikes (Woltz, 1954). Jenkins (1961) observed increased height of spikes following side dressings of K_2SO_4.

Gibberellic acid at 50 ppm was found to be the best treatment in American Beauty during the first season in increasing the spike length. In most of the varieties salts of Ca and GA 50 ppm closely followed the superior treatments in influencing this character. The effect of GA in increasing the spike length was reported by Battacharjee (1984) and Mukhopadhyay and Banker (1987). Treatment with NAA was superior in Agnirekha and American Beauty during the second season. Sharga (1979) also reported the effect of NAA in increasing the spike length. TIBA at 300 ppm in Friendship and CCC at the lower concentration (250 ppm) in Mansoer Red and True Yellow increased the spike length during the second season. The dwarfing effect of CCC is prominent mostly at the higher concentration because relatively high concentrations of CCC are required to inhibit growth.

Diameter determines the stiffness and strength of the spike. This contributes to the bending of the spike, a character reckoned as undesirable in gladiolus. In the present studies it was seen that the diameter of the spike was maximum in treatment with growth retardants, in most of the varieties. The effect was more pronounced during the second season. In Agnirekha, TIBA at 300 ppm and $CaSO_4$ at 1.0% produced the maximum diameter. In the case of American Beauty and Friendship, CCC at 250 ppm was superior. The increased diameter may be as a result of the dwarfing effect. GA at the higher concentration produced the maximum diameter in Friendship during the first season and in Mansoer Red during the second season. In True Yellow, the maximum diameter was produced in the treatment with $Ca(NO_3)_2$ at 1.0%.

Length of the rachis reflects the number of florets as well as the spacing between the florets. The arrangement of the florets on the spike may sometimes be such that hardly any gap is left, thus enhancing the beauty of the spike. In the present study when the length of rachis, as influenced by the different treatments, was considered, response was not uniform. The treatments could influence the length of rachis in two varieties, namely, American Beauty and Friendship, during the first season and in all the varieties during the second season. GA at 50 ppm increased the length of rachis in American Beauty during the first season and in Mansoer Red during the second season. Salts of Ca were found to be the superior treatments in Friendship during the first season and in True Yellow during the second season whereas salts of K produced the longest rachis in American beauty and Friendship during the second season. In these cases also GA treatment was found to be on par with the superior ones. When taken together, GA had an edge over the other treatments in increasing the length of rachis. The findings of Battacharjee (1984) are also on similar lines. TIBA at 150 ppm exhibited minimum length of rachis, in two varieties, viz., in Friendship during the first season and in Mansoer Red during the second season. CCC at 500 ppm, on the other hand, produced the maximum length in Agnirekha.

Of all the spike characteristics, number of florets per spike is the most important factor that directly influence the beauty of the spike. In general, regarding the number of florets, GA treatment was found to be superior. At 50 ppm it produced the highest number of florets in Agnirekha, American Beauty and Friendship during the first season, whereas the maximum number of florets was produced in American Beauty and Mansoer Red during the second season when 100 ppm concentration was used. $CaSO_4$ at 1.0% was found to be superior in Friendship during the first season and in Agnirekha and True Yellow during the second season. $CaSO_4$ at 0.5% produced maximum number of florets in Mansoer Red during the first season. Most of the superior treatments were, immediately followed by GA treatment. The decisive role of nutrients and growth regulators is evident from the cross section of the data furnished above. The positive influence of GA in increasing the number of florets is also reported by Battacharjee (1984) and Dua et al. (1984). Ca deficiency resulting in lowered floret count was reported by Woltz (1954). It was only in Friendship that CCC 250 ppm had produced more number of florets during the second season.

Length of the floret is an important character, in that, it contributes to the size of the floret. When diameter, which is taken as the size of the floret, increases, the tendency for overlapping of nearest florets increases. This in turn enhances the beauty of the flower spike. Various workers have reported the effect of nutrients and growth regulators on the size of floret (Battacharjee, 1984; Dua et al., 1984 and Sarova, 1954). However, in the present study, the treatments could not exert any significant influence on the length and size of floret in any of the varieties tried.

Fresh weight of the spike indicates its size and freshness. Fresh spike weighs more because of its high water content. Weight of spike decreases day by day as it loses its turgidity. When the fresh weight of spike as influenced by the different treatments was considered, a differential response was observed. Response was seen in all varieties during the second season. In Mansoer Red the response was significant in both the seasons. CCC at the lower concentration (250 ppm) recorded maximum fresh weight in Mansoer Red during the first season and in Friendship during the second season. In other varieties also CCC 250 ppm was found to be on par with the superior treatments. NAA at the higher concentration (200 ppm) produced the minimum fresh weight in Mansoer Red during the first season and in Friendship and True Yellow during the second season. On the other hand, the lower concentration (100 ppm) of NAA produced the maximum fresh weight in Agnirekha during the first season. During the second season $Ca(NO_3)_2$ at 1.0% produced maximum fresh weight, in American Beauty and KNO_3 0.5%, in True Yellow. The importance of fertilizer elements on the weight of flower spike is also reported by Guttay and Krone (1957) and Woltz (1954). In Mansoer Red, during the second season, the maximum fresh weight was exhibited by the control treatment, which was immediately followed by CCC 500 ppm.

The long keeping quality of flower spike makes gladiolus one of the most important cut flowers for interior decoration. The longevity of cut flowers is associated with the maintenance of fresh weight. In the present study it was observed that the response of the varieties was not uniform regarding the vase life. GA treatment, at both the concentrations, was found to produce maximum vase life in American Beauty and in True Yellow during the first season and was on par with the other superior treatments in Agnirekha, American Beauty, Friendship and in Mansoer Red. The superiority of GA (10 and 100 ppm) in increasing the vase life has also been reported by Bhattacharjee (1984). TIBA at 150 ppm produced the longest vase life in Agnirekha during the first season and in Friendship during the second season. CCC was found to be superior in Mansoer Red during the second season. It was on par with the superior treatments in Agnirekha, during the second season and with American Beauty and Friendship during both the seasons. The increased vase life resulting from the application of growth inhibitors may be due to their action on lowering the rate of development. NAA at 100 ppm increased the vase life in Agnirekha and in American Beauty during the second season whereas NAA at 200 ppm exhibited shortest vase life in Mansoer Red during the first season and in American Beauty during the second season. The longest vase life was recorded by $Ca(NO_3)_2$ at 1.0% in Friendship and Mansoer Red and $CaSO_4$ at 0.5% in Agnirekha, during the first season, $CaSO_4$ at 0.5% during the second season and $CaSO_4$ at 1.0% during the first season produced the longest vase life in Friendship and in American Beauty, respectively. The effect of K_2SO_4 at 0.5% in prolonging vase life was exhibited only in Friendship during both the seasons. It produced no effect in other varieties. Jayaselan

(1983) had also reported that KNO_3 solution (at 2%) had no effect on vase life in gladiolus.

The florets of a spike open in a sequence from base to the tip. Occasionally the florets fail to open. More number of fully opened florets is an indication of the quality of the spike. In the present study, the percentage of fully opened florets was the maximum in plants treated with CCC at 500 ppm, immediately followed by GA at 50 ppm, during the first season and with GA 50 ppm during the second season, in Friendship. In Agnirekha, it was the maximum with NAA at 100 ppm and $Ca(NO_3)_2$ at 1.0% during the second season.

In the case of percentage of partially opened florets also, CCC, NAA and GA were superior. CCC at 500 ppm produced more partially opened florets in Agnirekha, NAA 200 ppm in American Beauty and GA 100 ppm in Friendship, during the second season. In Mansoer Red, KNO_3 at 0.5% produced the maximum percentage of partially opened florets during the second season. The percentage of unopened florets was the minimum with GA 100 ppm in True Yellow; with GA 50 ppm in Friendship and with $Ca(NO_3)_2$ 0.5% in American Beauty, during the second season. GA at 50 ppm produced more of unopened florets in American Beauty whereas in Friendship and True Yellow it was replaced by NAA at 200 ppm, during the second season. The open florets may last for two to four days. The conditions and the factors which induce moisture stress in tissues accelerate the ageing which eventually cause senescence and death of the flowers. The longevity of individual floret contributes to the vase life of spike.

Significant influence regarding the longevity of individual floret was observed in the present study in all the varieties during the second season and in Friendship alone, during the first season. K_2SO_4 at 0.5% recorded the maximum longevity in Friendship during the first season and in Mansoer Red, during the second season, $Ca(NO_3)_2$ at 0.5% was superior in American Beauty during the second season. GA at 100 ppm recorded the maximum longevity in True Yellow, followed by KNO_3 at 1.0%. In enhancing longevity, the effect of the nutrients was more pronounced than that of growth regulators.

One important feature of the spike which contributes to the attractiveness is the number of florets that open at a time. When the number of florets opened at a time increases, the appearance of the spike also increases. This is one of the factors which determinesthe quality of gladiolus.

In the studies reported, the maximum number of open florets at a time was recorded by the GA treatment. In three varieties, viz., Agnirekha, American Beauty and True Yellow GA excelled other growth regulators and also nutrients during the second season.

$Ca(NO_3)_2$ exhibited the highest values in Mansoer Red during the second season. CCC at 500 ppm produced the maximum number of opened florets in Friendship during the first season, but it was found to be inferior in Friendship during the second season. In Mansoer Red also this treatment was inferior during the first season.

The tendency for breaking/bending the floral stem 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 the floral axis. Bending/breaking occurs at different positions on the floral stem. The effect of Ca and K in strengthening the spike has been reported by many scientists. Fink (1953) suggested that spraying plants with two per cent calcium nitrate reduced the percentage of spikes broke and toppled over. According to Magie (1951), soft spikes, caused by insufficient K to balance the N supply, were prevented by spraying, as they developed, with 5 lb potassium sulphate or carbonate in 100 gal water. Breaking over of flower spikes with low level of Ca in the nutrient solution was also reported by Woltz (1954). However, in the present study, influence of the treatments on the nature of bending was insignificant in all the varieties.

The rate of water loss from the spikes must be equal to the rate of water uptake in order to maintain a favourable water balance in the spike for a longer period. This in turn influences the vase life. In the present studies it was found that the treatments exerted significant response in all the varieties with respect to water uptake during the second season. In American Beauty, the response was evident in both the seasons. Maximum water uptake was recorded by GA at 50 ppm in American Beauty during the first season and NAA at 100 ppm in Agnirekha during the second season. During the second season the control treatment was found to be superior in American Beauty. $Ca(NO_3)_2$ at 0.5% exhibited superiority in Mansoer Red and True Yellow and KNO_3 at 1.0% in Friendship, during the second season.

In galdiolus the size of the corm influences the growth, development, production and quality of spikes. Hence the size of corm has high economic value. A differential response of varieties to treatments was exhibited in the case of corm weight too in the study under report. NAA at 100 ppm produced the heaviest corms in Friendship during the first season. At 200 ppm it produced the heaviest corms in Agnirekha during the first season and in True Yellow during the second season. $CaSO_4$ at 0.5% was found to produce the heaviest corms in Mansoer Red and in True Yellow during the first season. At 1.0% concentration it was found to be superior in American Beauty during the second season.

In American Beauty GA at 50 ppm improved the corm weight during the first season. Battacharjee (1984), in his experiment on the effect of growth regulating chemicals on gladiolus, also opined that GA_3 at 10 and 100 ppm improved the corm weight. The findings of Dua et al. (1984) are also in line with this result. K_2SO_4 at the higher concentration produced the heaviest corm in Agnirekha during the second season whereas the same treatment reduced the corm weight in Agnirekha during the first season and in True Yellow, during the second season. The increase in corm weight with the side dressings of K has also been reported by Jenkins (1961). But another report (Armitage, undated) says that the fertilizer has less effect on corm yield and rates of P and K above 80 and 50 kg/ha, respectively, was detrimental. Improvement in quality of corms with balanced manuring, especially with K, was reported by Becker and Wetzel (1939).

Corm size and corm weight are positively correlated. Heavy corms exhibit large size. Thus the treatments found to be superior in corm weight were superior in corm size also. The reports available on the effect of nutrients on the corm size of gladiolus are however, inconsistant. Armitage (undated) reported that fertilization rates had a less marked effect on corm size. On the contrary, in another report, all fertilizer treatments were found to increase corm size (Showshan et al., 1980). Increased corm size with GA treatment was reported by Battacharjee (1984) and Dua et al. (1984). In the present study too the results were inconsistant. In general, $CaSO_4$ and K_2SO_4 were superior in both the seasons. These nutrients also caused poor performance elsewhere. The treatments significantly influenced all the varieties during the first season and only three varieties during the second season.

Gladiolus can also be propagated through cormels. The number of cormels produced in a corm may vary from zero to over hundred, depending upon many factors like variety, season, cultural practices etc. Number of cormels was found to be affected mostly by the nutrients in the present study. $Ca(NO_3)_2$ at 0.5% produced more number of cormels in Mansoer Red and $CaSO_4$ in Agnirekha and in True Yellow, during the first season. KNO_3 at 0.5% produced the maximum number of cormels in American Beauty and K_2SO_4 at 0.5% in Friendship, during the first season. The effect of Ca and K was reported by many scientists. Production of increased number of cormels by the application of lime was reported by Fernandes and Lima (1974). Battacharjee (1981) reported that the application of P and K and rising levels of each element improved cormel production. Balanced manuring, especially with K, resulted in the increased yield of cormels, as reported by Becker and Wetzel (1939). GA at 100 ppm was found to be immediately followed by the superior treatments in the case of American Beauty and Friendship during the first season. It also produced more number of cormels in Agnirekha during the second season. These results were supported by the findings of Battacharjee (1984) and Dua et al.

(1984). In Friendship, the control treatment and in True Yellow, CCC at 250 ppm produced the maximum number of cormels during the second season. In most of the varieties NAA and TIBA were found to inhibit cormel development. NAA at 100 ppm produced the minimum number of cormels in True Yellow during both the seasons and in American beauty during the first season. TIBA was found to be inferior in True Yellow and Friendship during the second season.

Weight of cormels depends on the number of cormels as well as the size of the cormels. As in the case of the number of cormels, the weight of cormels was also seen affected by the nutrients rather than the growth regulators in the study discussed here. Superiority of sulphate of potash over muriate of potash in increasing the cormel production was reported by Armitage (undated). In the present study, however, both the salts of potassium brought about significant improvement in cormel weight. K_2SO_4 was found to produce the maximum weight of cormels in Mansoer Red during the first season and in American Beauty during both the seasons. KNO_3 was found to be superior in Friendship and in Agnirekha, during the second season. $CaSO_4$ was superior in Agnirekha and True Yellow during the first season. Application of lime, which resulted in the increased weight of cormels, has also been reported by Fernandes and Lima (1974). In Friendship, during the first season, CCC at 500 ppm was found to be superior. In this case also TIBA was inferior in Mansoer Red during the first season and in Agnirekha and Friendship during the second season. The control treatment produced the minimum weight in American Beauty and in Friendship during the first season.

When the effect of seasons was considered irrespective of the treatments, the performance of gladiolus was better during the first season (November planting) with respect to most of the selected characters than during the second season (April planting). November planting produced more leaf area, took minimum time to come to flower, lengthened the blooming period, produced more number of florets per spike, opened more number of florets at a time and produced heavy corms and cormels. Winter at Vellanikkara is mild (Appendix-I) with mild day temperatures and cooler nights, which is reported to be the best suited for gladiolus cultivation. Mukhopadhyay and Banker (1987) reported that more number of florets was obtained from June, October and November plantings when the weather is mild in Bangalore region. They also reported that spikes obtained from April plantings, which opened during hot weather, were of moderate quality whereas the spikes obtained from corms planted in June, October and November, lasted longer.

Among the varieties, with respect to growth and most of the floral characters, American Beauty and Friendship were found to be superior. These two varieties flowered early and produced heavy spikes with more number of florets. Agnirekha was superior in producing long spikes with more number of florets which exhibited longest blooming period and vase life. Longer vase life was obtained in Mansoer Red also, which recorded more number of florets opened at a time. As regards the duration, Friendship was found to be the short duration variety and Mansoer Red and Agnirekha, the long duration varieties. Corm yield was more in True Yellow whereas weight of cormels was more in Agnirekha and Mansoer Red. In general, the performance of all the varieties was good under Vellanikkara conditions. However, to obtain best quality blooms, November planting was better than April planting.

Summary

SUMMARY

A study was conducted at the College of Horticulture, Vellanikkara, during 1989-90 to examine the effect of different growth regulators and nutrients on spike qualities of gladiolus. Four growth regulators (TIBA, NAA, CCC and GA) and two nutrients (calcium and potassium) were tried, each at two levels, in completely randomized design, comprising 17 treatments and three replications. The treatments were imposed on five varieties (Agnirekha, American Beauty, Friendship, Mansoer Red and True Yellow) in two seasons. The results of the study are summarised below:

The treatments could significantly influence the height of the plants. During the first season no significant difference could be seen at six weeks after planting. At eight weeks after planting, T_{16} (K_2SO_4 0.5%) and T_{17} (K_2SO_4 1.0%) were found to be superior in Agnirekha (50.30 cm) and American Beauty (60.43 cm), respectively and T_9 (GA 100 ppm), in Friendship (53.87 cm). During the second season also T_{17} was found to be superior in Agnirekha at both the stages (26.13 cm and 41.38 cm) and in Mansoer Red, at eight weeks after planting (56.80 cm). In Friendship, T_{12} K_2SO_4 0.5%) was found to be the superior treatment (39.77 cm) at six weeks after planting but the influence was insignificant at eight weeks after planting.

The influence of the treatments on the number of leaves was significant only in the first season, at eight weeks after planting, in two varieties. T_3 (TIBA 300 ppm) produced the maximum number of leaves in Friendship (6.67) and T_6 (CCC 250 ppm), in True Yellow (6.00).

Area of the leaves was significantly influenced by the treatments in both the seasons. During the first season no significant difference could be seen at six weeks after planting. At eight weeks after planting, T_{16} (K_2SO_4 0.5%) produced maximum leaf area, in Agnirekha (602.47 cm^2), T_{17} (K_2SO_4 1.0%), in American Beauty (880.23 cm^2), T_3 (TIBA 300 ppm), in Friendship (636.47 cm^2), T_{10} ($Ca(NO_3)_2$ 0.5%), in Mansoer Red (533.10 cm^2) and T_{12} ($CaSO_4$ 0.5%), in True Yellow (550.13 cm^2). During the second season, at six weeks after planting, T_4 (NAA 100 ppm) produced the maximum leaf area (280.07 cm^2) in Friendship and T_9 (GA 100 ppm), in True Yellow (312.47 cm^2). Here the influence of treatments was insignificant at eight weeks after planting.

The treatments could significantly influence the duration from planting to spike emergence in all the varieties in both the seasons. During the first season, early spike emergence (72.33 days) was recorded by T_1 (control), in Agnirekha, T_{14} (KNO_3 0.5%), in American beauty (88.00 days), T_9 (GA 100 ppm), in Friendship (66.67 days), T_{12} ($CaSO_4$ 0.5%), in Mansoer Red (85.00

days) and T_{16} (K_2SO_4 0.5%), in True Yellow (58.67 days). During the second season, earliest flowering was recorded by T_{17} (K_2SO_4 1.0%), in Agnirekha (94.00 days), American Beauty (80.67 days), Friendship (69.33 days) and Mansoer Red (80.00 days) and T_9 (GA 100 ppm) recorded the minimum duration (74.67 days), in True Yellow.

The treatments influenced the duration from spike emergence to opening also. During the first season, early spike opening was recorded by T_{10} ($Ca(NO_3)_2$ 0.5%) and T_{16} (K_2SO_4 0.5%), in Mansoer Red (5.67 days, each) and T_6 (CCC 250 ppm), T_{12} ($CaSO_4$ 0.5%) and T_{17} (K_2SO_4 1.0%), in True Yellow (4.00 days, each). During the second season, T_{10} ($Ca(NO_3)_2$ 0.5%), T_{14} (KNO_3 0.5%) and T_{17} (K_2SO_4 1.0%) recorded the shortest duration, in Agnirekha (4.67 days, each), T_{15} (KNO_3 1.0%), in American Beauty (6.33 days) and T_3 (TIBA (300 ppm), in Mansoer Red (4.00 days).

The blooming period was influenced by the treatments in both the seasons. During the first season, in Agnirekha, blooming period was found to be the maximum (14.33 days) in T_9 (GA 100 ppm). T_5 (NAA 200 ppm) and T_9 (GA 100 ppm) recorded the maximum blooming period, in American Beauty (17.67 days), T_{10} ($Ca(NO_3)_2$ 0.5%), in Mansoer Red (13.67 days) and T_9 (GA 100 ppm), in True Yellow (11.67 days). During the second season, longest blooming period was exhibited by T_{16} (K_2SO_4 0.5%), in Agnirekha (11.33

days), T_{11} ($Ca(NO_3)_2$ 1.0%), in American Beauty (12.33 days), T_8 (GA 50 ppm), in Friendship (12.00 days) and T_{15} (KNO_3 1.0%), in True Yellow (8.33 days).

In the case of total duration also, the treatments could exert significant influence. During the first season the minimum duration was recorded by T_6 (CCC 250 ppm), in Agnirekha (88.33 days) T_9 (GA 100 ppm), in Friendship (83.00 days), T_{12} ($CaSO_4$ 0.5%), in Mansoer Red (103.67 days) and T_{16} (K_2SO_4 0.5%), in True Yellow (73.44 days). During the second season, T_{17} (K_2SO_4 1.0%) recorded the minimum duration in Agnirekha (108.67 days), American Beauty (97.67 days) and Mansoer Red (91.67 days) and T_9 (GA 100 ppm) in the case of True Yellow (90.33 days).

The treatments significantly influenced the spike length in all varieties in both seasons, except in True Yellow during the first season. The longest spike was produced by T_{16} (K_2SO_4 0.5%), in Agnirekha, (65.7 cm) and in Friendship (76.1 cm), T_8 (GA 50 ppm), in American Beauty (73.6 cm) and T_{12} ($CaSO_4$ 0.5%), in Mansoer Red (72.40 cm), during the first season. T_4 (NAA 100 ppm) produced the longest spike in Agnirekha, (84.67 cm), T_5 (NAA 200 ppm) in American Beauty (73.33 cm), T_3 (TIBA 300 ppm) in Friendship (79.00 cm) and T_6 (CCC 250 ppm) in Mansoer Red (76.67 cm) and True Yellow (77.67 cm), during the second season.

Significant difference could be observed in the diameter of spike as influenced by the treatments. In Friendship, during the first season, T_9 (GA 100 ppm) recorded the maximum diameter (0.95 cm). During the second season, T_3 (TIBA 300 ppm) and T_{13} ($CaSO_4$ 1.0%) recorded maximum diameter, in Agnirekha (0.90 cm), T_6 (CCC 250 ppm) in American Beauty (0.95 cm), T_6 (CCC 250 ppm), T_{11} ($Ca(NO_4)_2$ 1.0%) and T_{17} (K_2SO_4 1.0%) in Friendship (0.73 cm, each), T_9 (GA 100 ppm) in Mansoer Red (0.77 cm) and T_{11} ($Ca(NO_3)_2$ 1.0%) in True Yellow (0.78 cm).

The treatments could significantly influence the length of rachis, in both the seasons. During the first season, T_8 (GA 50 ppm) produced the longest rachis in American Beauty (56.3 cm) and T_{13} ($CaSO_4$ 1.0%) in Friendship (55.7 cm). During the second season, longest rachis was produced by T_7 (CCC 500 ppm), in Agnirekha (53.0 cm), T_{14} (KNO_3 0.5%), in American Beauty (46.0 cm), T_{17} (K_2SO_4 1.0%), in Friendship (51.7 cm), T_8 (GA 50 ppm), in Mansoer Red (48.3 cm) and T_{10} ($Ca(NO_3)_2$ 0.5%), in True Yellow (51.7 cm).

Significant influence was produced on the number of florets per spike in all the varieties, during both the seasons. During the first season, T_8 (GA 50 ppm) was found to be the best in Agnirekha (17.3 florets) and in American Beauty (16.7 florets); T_8 (GA 50 ppm) and T_{13} ($CaSO_4$ 1.0%) in Friendship (16.0 florets),

T_{12} ($CaSO_4$ 0.5%) in Mansoer Red (18.3 florets) and T_4 (NAA 100 ppm) in True Yellow (10.7 florets). During the second season, maximum number of florets per spike was produced by T_{13} ($CaSO_4$ 1.0%) in Agnirekha (17.0), T_1 (control) and T_9 (GA 100 ppm) in American Beauty (14.0), T_6 (CCC 250 ppm) in Friendship (15.0), T_9 (GA 100 ppm) in Mansoer Red (14.7) and T_{11} ($Ca(NO_3)_2$ 1.0%) in True Yellow (13.0).

The length and size of the florets were not significantly influenced by the treatments in any of the varieties during the two seasons.

The treatments exerted significant influence on the fresh weight of spike. In Mansoer Red, during the first season, T_6 (CCC 250 ppm) recorded the maximum weight (50.60 g). During the second season, T_4 (NAA 100 ppm) recorded the maximmum weight in Agnirekha (31.95 g), T_{11} ($Ca(NO_3)_2$ 1.0%) in American Beauty (35.77 g), T_6 (CCC 250 ppm) in Friendship (42.43 g), T_1 (control) in Mansoer Red (47.70 g) and T_{14} (KNO_3 0.5%) in True Yellow (28.05 g).

Vase life was also significantly influenced by the treatments in both the seasons. During the first season, T_2 (TIBA 150 ppm) and T_{12} ($CaSO_4$ 0.5%) recorded the maximum vase life in Agnirekha, (8.00 days, each), T_8 (GA 50 ppm) in American Beauty (8.67 days) and True Yellow (9.67 days), T_{11} ($Ca(NO_3)_2$ 1.0%) and T_{16} (K_2SO_4 0.5%) in Friendship, (9.00 days, each) and T_{11} ($Ca(NO_3)_2$ 1.0%) in Mansoer Red (11.00 days). During the second season, T_4 (NAA 100 ppm) recorded maximum vase life in Agnirekha (11.33 days), T_1 (control) in American Beauty (8.33 days), T_2 (TIBA 150 ppm), T_{12} ($CaSO_4$ 0.5%) and T_{16} (K_2SO_4 0.5%) in Friendship (8.00 days, each) and T_7 (CCC 500 ppm) in Mansoer Red (9.00 days).

The opening behaviour of florets was influenced by the treatments during both the seasons. In Friendship, during the first season, T_7 (CCC 500 ppm) recorded the maximum percentage of fully opened florets (62.50). During the second season, the maximum percentage of florets opened was recorded by T_4 (NAA 100 ppm) in Agnirekha (74.33) and T_8 (GA 50 ppm) in Friendship (51.67). The maximum percentage of partially opened florets was recorded by T_7 (CCC 500 ppm) in Agnirekha (44.67), T_5 (NAA 200 ppm) in American Beauty (31.00), T_9 (GA 100 ppm) in Friendship (23.33) and T_{14} (KNO_3 0.5%) in Mansoer Red (47.33). In the case of percentage of unopened florets in vase, T_{10} ($Ca(NO_3)_2$ 0.5%) recorded the minimum in American Beauty (37.00), T_8 (GA 50 ppm) in Friendship (30.00) and T_9 (GA 100 ppm) in True Yellow (11.33).

The treatments exerted significant influence on the longevity of individual floret too. In Friendship, during the first season, maximum longevity (3.59 days) was recorded by T_{16} (K_2SO_4 0.5%). During the second season, the maximum longevity was recorded by T_{10} ($Ca(NO_3)_2$ 0.5%), in American Beauty (5.80 days), T_{16} (K_2SO_4 0.5%), in Mansoer Red (3.51 days) and by T_9 (GA 100 ppm); in True Yellow (3.13 days).

Significant difference on the number of florets opened at a time could be observed, as influenced by the treatments. During the first season, T_2 (TIBA 150 ppm) and T_8 (GA 50 ppm) recorded the maximum number of florets opened at a time in Agnirekha (4.33, each), T_9 (GA 100 ppm) in American Beauty (4.67), T_7 (CCC 300 ppm) in Friendship (4.50), T_{11} ($Ca(NO_3)_2$ 1.0%) in Mansoer Red (7.00) and T_8 (GA 50 ppm) and T_9 (GA 100 ppm) in True Yellow (3.67, each). During the second season, T_{15} (KNO_3 1.0%) recorded the maximum number in Friendship (4.00) and T_{16} (K_2SO_4 0.5%) in Mansoer Red (4.67).

The treatments tried could not significantly influence the nature of bending in any of the varieties in the seasons tried.

The treatments exerted significant influence on the water uptake during both the seasons. During the first season, maximum water uptake (86.67 ml) was recorded in T_8 (GA 50 ppm) in the variety American Beauty. During the second season, T_4 (NAA 100 ppm) recorded the maximum water uptake, in Agnirekha (40.00 ml), T_1 (control), in American Beauty (35.33 ml), T_{15} (KNO_3 1.0%), in Friendship (55.00 ml) and T_{10} ($Ca(NO_3)_2$ 0.5%) in Mansoer Red and True Yellow (38.00 ml, each).

The treatments could significantly influence the corm weight in all the varieties in the first season and three varieties, in the second season. During the first season, T_5 (NAA 200 ppm) recorded maximum corm weight in Agnirekha (33.46 g), T_8 (GA 50 ppm) in American Beauty (82.99 g), T_4 (NAA 100 ppm) in Friendship (70.20 g) and T_{12} ($CaSO_4$ 0.5%) in Mansoer Red (52.86 g) and True Yellow (88.23 g). During the second season, T_{17} (K_2SO_4 1.0%) produced the heaviest corms in Agnirekha (46.34 g), T_{11} ($Ca(NO_3)_2$ 1.0%) in American Beauty (45.97 g) and T_5 (NAA 200 ppm) in True Yellow (64,98 g).

The treatments exerted significant influence on the size (volume) of the cormes in both the seasons. During the first season, T_6 (CCC 250 ppm) recorded the maximum corm size in Agnirekha (33.67 cc), T_8 (GA 50 ppm) in American Beauty (85.50 cc), T_4 (NAA 100 ppm) in Friendship (71.06 cc) and T_{12} ($CaSO_4$ 0.5%) in Mansoer Red (49.00 cc) and True Yellow (89.33 cc). During the second season, T_{17} (K_2SO_4 1.0%) recorded the maximum corm size in Agnirekha (29.00 cc), T_{11} ($Ca(NO_3)_2$ 1.0%) in American Beauty (39.67 cc) and T_5 (NAA 200 ppm) in True Yellow (59.67 cc).

In producing cormels, significant influence of the treatments was observed in both the seasons. During the first season, the maximum number of cormels was recorded by T_{13} ($CaSO_4$ 1.0%), in Agnirekha (14.33), T_{14} (KNO_3 0.5%), in American Beauty (68.00)

T_{16} (K_2SO_4 0.5%), in Friendship (99.00), T_{10} ($Ca(NO_3)_2$ 0.5%), in Mansoer Red (48.67) and by T_{12} ($CaSO_4$ 0.5%) in True Yellow (31.00). During the second season, T_9 (GA 100 ppm) recorded the maximum number of cormels in Agnirekha (13.38), T_1 (control) in Friendship (60.33) and T_6 (CCC 250 ppm) in True Yellow (29.00).

The treatments significantly influenced the weight of cormels also. During the first season, T_{13} ($CaSO_4$ 1.0%) recorded the maximum in Agnirekha (17.65 g), T_{17} (K_2SO_4 1.0%) in American Beauty (21.07 g) and Mansoer Red (24.7 g), T_7 (CCC 500 ppm) in Friendship (17.57 g) and T_{12} ($CaSO_4$ 0.5%) in True Yellow (17.16g). During the second season, T_{14} (KNO_3 0.5%) recorded the highest cormel weight Agnirekha (5.37 g), T_{16} (K_2SO_4 0.5%) in American Beauty (1.80 g) and T_{15} (KNO_3 1.0%) in Friendship (5.09 g).

The effect of season, considered irrespective of the treatments, revealed that the performance of gladiolus was better during the first season in terms of most of the selected characters such as leaf area, earliness to flower, blooming period, total duration, number of florets per spike, number of florets opened at a time, corm weight and weight of cormels. But spike length was more during the second season. Regarding fresh weight of spike, there was not much difference between the seasons. The response of varieties to season was not uniform in the case of vase life.

Mansoer Red and True Yellow performed well during the first season whereas Agnirekha was better during the second season. The performance of Friendship and American Beauty was similar under both the seasons.

Among the varieties, American Beauty was the most superior regarding the leaf area (681 cm^2 and 412 cm^2 during the first season and second season, respectively). American Beauty and Friendship were the early flowering varieties (74 days, each) during the first season. During the second season this was shifted to Friendship (76 days). American Beauty had the longest blooming period (14.7 days) during the first season whereas Agnirekha recorded longest blooming period (9.0 days) during the second season. Total duration was the shortest in Friendship (92 days and 91 days, respectively) during the first season and second season. Spike length was maximum in Friendship (62 cm) during the first season and in Agnirekha (74 cm) during the second season. Number of florets per spike was the maximum in American Beauty (15.6) during the first season and in Agnirekha (14.1) during the second season. Maximum fresh weight (31 g) was recorded by American Beauty during the first season and American Beauty and Friendship (29 g, each) during the second season. Mansoer Red exhibited maximum vase life (9.0 days) during the first season. During the second season, Agnirekha recorded the maximum vase life (8.7 days). Number of florets opened at a time was the maximum in Mansoer Red (4.8 and 3.2, during the first season and second season, respectively). Corm weight was the highest in True Yellow (61.0 g and 40.0 g, during the first season and second season, respectively). Weight of cormels was the maximum in Agnirekha (9.7 g) during the first season and in Mansoer Red (3.8 g) during the second season.

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Appendices

APPENDIX-I

Meteorological parameters of the experimental site at the College of Horticulture, Vellanikkara, for the period from November 1989 to September 1990

Year and Month	Mean temperature (°C) Maximum	Mean temperature (°C) Minimum	Mean relative humidity (%)	Rain-fall (mm)	Number of rainy days	Mean sun-shine (hours)
1989						
November	32.5	22.7	63	8.1	2	8.5
December	32.7	23.2	60	0.0	0	9.7
1990						
January	33.5	20.8	50	3.5	0	9.0
February	34.9	21.9	58	0.0	0	10.0
March	36.0	23.8	64	4.4	1	9.7
April	35.8	25.4	68	38.8	2	8.3
May	31.5	24.1	82	583.9	18	4.5
June	29.7	23.3	85	467.3	25	3.4
July	28.4	22.5	88	759.3	28	2.4
August	29.0	23.0	85	356.4	22	2.5
September	30.7	23.4	79	87.5	8	6.2

APPENDIX-II

Abstract of analysis of variance for the effect of different treatments

Sl. No.	Character	Treatment MSS	Error MSS	Level of significance
1	2	3	4	5
A.	First season			
1.	Vegetative characters			
a.	Plant height			
	V_1			
	6 weeks after planting	27.179	18.981	NS
	8 weeks after planting	26.163	6.520	1%
	V_2			
	6 ,,	55.653	41.849	NS
	8 ,,	54.468	19.555	1%
	V_3			
	6 ,,	152.587	81.291	NS
	8 ,,	64.575	17.450	1%
	V_4			
	6 ,,	18.692	15.340	NS
	8 ,,	20.098	16.904	NS
	V_5			
	6 ,,	42.352	27.174	NS
	8 ,,	49.985	37.177	NS
b.	Number of leaves			
	V_1			
	6 ,,	1.211	0.569	NS
	8 ,,	0.895	0.843	NS
	V_2			
	6 ,,	0.978	0.706	NS
	8 ,,	1.422	1.020	NS

Contd.

Appendix-II. Continued

1	2	3	4	5
V_3				
6	weeks after planting	1.351	1.000	NS
8	,,	2.502	1.118	5%
V_4				
6	,,	0.314	0.314	NS
8	,,	0.385	0.588	NS
V_5				
6	,,	0.792	1.157	NS
8	,,	3.985	2.030	5%
c. Total leaf area				
V_1				
6	,,	3681.109	3228.765	NS
8	,,	13545.625	2709.120	1%
V_2				
6	,,	14094.219	8285.044	NS
8	,,	39037.005	9737.913	1%
V_3				
6	,,	14383.039	9535.593	NS
8	,,	30608.065	14339.970	5%
V_4				
6	,,	5040.727	3705.364	NS
8	,,	18299.938	4357.127	1%
V_5				
6	,,	5530.984	8956.140	NS
8	,,	8158.190	2039.550	1%

Contd.

Appendix-II. Continued

1	2	3	4	5
2. Spike characters				
a. Duration from planting to spike emergence				
	V_1	43.064	15.843	1%
	V_2	47.713	19.510	5%
	V_3	61.910	12.380	1%
	V_4	97.354	48.292	5%
	V_5	124.713	29.824	1%
b. Duration from spike emergence to opening				
	V_1	2.123	1.196	NS
	V_2	0.953	1.255	NS
	V_3	1.047	0.608	NS
	V_4	3.417	1.172	1%
	V_5	4.500	2.000	5%
c. Blooming period				
	V_1	10.145	1.145	1%
	V_2	10.343	2.510	1%
	V_3	1.395	4.804	NS
	V_4	9.000	1.687	1%
	V_5	4.172	0.937	1%
d. Total duration				
	V_1	66.545	19.059	1%
	V_2	54.502	28.431	NS
	V_3	67.144	12.912	1%
	V_4	112.796	39.166	1%
	V_5	140.686	27.588	1%

Contd.

Appendix-II. Continued

1	2	3	4	5
e. Spike length				
	V_1	168.620	31.820	1%
	V_2	114.670	19.110	1%
	V_3	288.985	90.386	1%
	V_4	221.744	94.474	5%
	V_5	75.589	104.148	NS
f. Diameter of spike				
	V_1	0.013	0.014	NS
	V_2	1.331	1.294	NS
	V_3	0.017	0.008	5%
	V_4	0.579	0.590	NS
	V_5	0.021	0.110	NS
g. Length of rachis				
	V_1	102.973	70.443	NS
	V_2	912.322	35.381	1%
	V_3	183.896	55.837	1%
	V_4	108.021	66.972	NS
	V_5	56.836	55.417	NS
h. Number of florets per spike				
	V_1	9.574	1.922	1%
	V_2	4.610	1.150	1%
	V_3	8.167	3.667	5%
	V_4	7.194	3.298	5%
	V_5	2.700	0.680	1%
i. Length of floret				
	V_1	1.004	0.611	NS
	V_2	0.313	0.404	NS
	V_3	1.343	1.669	NS
	V_4	1.466	0.973	NS
	V_5	1.285	1.327	NS

Contd.

Appendix-II. Continued

1	2	3	4	5
j.	Size of floret			
	V_1	0.842	1.124	NS
	V_2	0.953	0.889	NS
	V_3	1.935	1.156	NS
	V_4	2.375	1.870	NS
	V_5	0.830	0.815	NS
3.	Post harvest observations			
a.	Fresh weight of spike			
	V_1	48.591	26.759	NS
	V_2	93.196	59.333	NS
	V_3	75.314	23.018	NS
	V_4	187.884	52.566	5%
	V_5	38.710	21.893	NS
b.	Vase life			
	V_1	1.863	0.466	1%
	V_2	5.394	1.348	1%
	V_3	2.716	0.566	1%
	V_4	2.719	0.544	1%
	V_5	2.920	0.487	1%
c.	Percentage of fully opened florets in vase			
	V_1	145.067	132.908	NS
	V_2	674.572	476.478	NS
	V_3	151.190	31.500	1%
	V_4	318.671	173.690	NS
	V_5	325.090	222.782	NS

Contd.

Appendix-II

1	2	3	4	5
d. Percentage of partially opened florets in vase				
	V_1	63.844	45.070	NS
	V_2	313.518	176.311	NS
	V_3	49.881	36.391	NS
	V_4	84.238	47.341	NS
	V_5	82.898	45.519	NS
e. Percentage of unopened florets in vase				
	V_1	137.240	83.317	NS
	V_2	147.887	121.722	NS
	V_3	121.527	110.971	NS
	V_4	176.817	128.611	NS
	V_5	235.345	177.795	NS
f. Longevity of individual floret				
	V_1	0.616	0.447	NS
	V_2	1.236	0.777	NS
	V_3	0.164	0.043	1%
	V_4	0.366	0.298	NS
	V_5	0.275	0.209	NS
g. Number of florets opened at a time				
	V_1	0.750	0.150	1%
	V_2	2.994	0.637	1%
	V_3	1.392	0.278	1%
	V_4	3.762	0.752	1%
	V_5	1.063	0.266	1%
h. Nature of bending Days to spike bending				
	V_1	21.198	27.177	NS
	V_2	24.741	27.532	NS
	V_3	14.949	25.410	NS
	V_4	17.891	16.794	NS
	V_5	17.551	21.917	NS

Contd.

Appendix-II. Continued

1	2	3	4	5
[illegible]	Bending from which floret			
	V_1	22.646	30.656	NS
	V_2	30.877	16.594	NS
	V_3	20.206	29.493	NS
	V_4	17.769	27.532	NS
	V_5	27.235	32.462	NS
i.	Water uptake			
	V_1	301.165	282.616	NS
	V_2	574.974	127.770	1%
	V_3	433.855	373.159	NS
	V_4	769.235	526.214	NS
	V_5	259.155	260.800	NS
4.	Corm and cormel yield			
a.	Corm weight			
	V_1	228.81	38.13	1%
	V_2	728.44	145.69	1%
	V_3	597.10	112.66	1%
	V_4	370.87	97.60	1%
	V_5	918.86	155.74	1%
b.	Corm size			
	V_1	88.85	22.21	1%
	V_2	756.86	151.37	1%
	V_3	414.79	82.96	1%
	V_4	334.26	77.73	1%
	V_5	854.51	137.82	1%

Contd.

Appendix-II. Continued

1	2	3	4	5
c.	Number of cormels			
	V_1	32.91	8.23	1%
	V_2	759.45	165.09	1%
	V_3	3130.22	782.56	1%
	V_4	373.66	93.42	1%
	V_5	159.12	30.02	1%
d.	Weight of cormels			
	V_1	53.79	13.45	1%
	V_2	75.29	15.06	1%
	V_3	109.71	21.51	1%
	V_4	92.56	15.58	1%
	V_5	57.91	12.58	1%
B.	Second Season			
1.	Vegetative characters			
a.	Plant height			
	V_1			
	6 weeks after planting	134.72	36.36	1%
	8 ,,	143.71	69.27	5%
	V_2			
	6 ,,	44.45	34.50	NS
	8 ,,	100.76	88.58	NS
	V_3			
	6 ,,	175.95	62.39	1%
	8 ,,	104.53	89.49	NS
	V_4			
	6 ,,	69.78	76.38	NS
	8 ,	227.04	97.31	5%

Contd.

Appendix-II. Continued

1	2	3	4	5
	V_5			
	6 weeks after planting	44.973	20.940	5%
	8 ,,	98.218	68.005	NS
b. Number of leaves				
	V_1			
	6 ,,	0.463	0.588	NS
	8 ,,	1.311	0.882	NS
	V_2			
	6 ,,	0.419	0.450	NS
	8 ,,	1.080	0.921	NS
	V_3			
	6 ,,	1.414	1.000	NS
	8 ,,	2.164	1.352	NS
	V_4			
	6 ,,	1.240	0.784	NS
	8 ,,	1.948	1.745	NS
	V_5			
	6 ,,	0.270	0.352	NS
	8	0.365	0.725	NS
c. Total leaf area				
	V_1			
	6 ,,	916.183	1414.463	NS
	8 ,,	2956.545	2202.127	NS
	V_2			
	6 ,,	2053.305	2965.503	NS
	8 ,,	15312.688	11141.089	NS

Contd.

Appendix-II. Continued

1	2	3	4	5
V_3				
6	weeks after planting	9433.462	4561.680	5%
8	,,	9417.297	12989.647	NS
V_4				
6	,,	2573.742	3339.805	NS
8	,,	13693.672	9236.942	NS
V_5				
6	,,	6902.312	2585.037	1%
8	,,	6722.845	7677.044	NS
2. Spike characters				
a. Duration from planting to spike emergence				
V_1		146.957	15.608	1%
V_2		46.842	20.255	5%
V_3		65.377	30.765	5%
V_4		436.145	62.961	1%
V_5		129.744	16.588	1%
b. Duration from spike emergence to opening				
V_1		3.922	0.294	1%
V_2		1.593	0.510	1%
V_3		2.936	1.471	5%
V_4		3.458	0.902	1%
V_5		1.949	1.294	NS
c. Blooming period				
V_1		5.353	0.333	1%
V_2		6.669	1.627	1%
V_3		7.490	0.725	1%
V_4		1.395	0.961	NS
V_5		3.551	1.627	5%

Contd.

Appendix-II. Continued

1	2	3	4	5
d. Total duration				
	V_1	132.996	17.412	1%
	V_2	51.273	21.333	5%
	V_3	50.646	32.745	NS
	V_4	455.258	69.491	1%
	V_5	224.434	80.156	1%
e. Spike length				
	V_1	112.937	28.902	1%
	V_2	285.479	92.627	1%
	V_3	263.662	60.882	1%
	V_4	355.412	30.157	1%
	V_5	188.260	61.647	1%
f. Diameter of spike				
	V_1	0.016	0.003	1%
	V_2	0.034	0.006	1%
	V_3	0.018	0.004	1%
	V_4	0.014	0.003	1%
	V_5	0.018	0.009	5%
g. Length of rachis				
	V_1	72.814	17.490	1%
	V_2	248.287	43.451	1%
	V_3	140.583	25.588	1%
	V_4	222.414	26.882	1%
	V_5	208.787	51.039	1%
h. Number of florets per spike				
	V_1	5.199	1.392	1%
	V_2	16.662	2.863	1%
	V_3	11.824	2.627	1%
	V_4	10.755	1.863	1%
	V_5	8.907	2.176	1%

Contd.

Appendix-II. Continued

1	2	3	4	5
i. Length of floret				
	V_1	1.080	0.652	NS
	V_2	0.840	0.642	NS
	V_3	0.846	0.441	NS
	V_4	0.814	0.492	NS
	V_5	0.980	0.542	NS
j. Size of floret				
	V_1	0.807	0.501	NS
	V_2	0.453	0.267	NS
	V_3	0.520	0.325	NS
	V_4	0.649	0.382	NS
	V_5	0.805	0.866	NS
3. Post harvest observations				
a. Fresh weight of spike				
	V_1	49.222	21.830	5%
	V_2	117.719	35.377	1%
	V_3	179.431	8.830	1%
	V_4	262.028	51.751	1%
	V_5	68.561	21.843	1%
b. Vase life				
	V_1	4.814	0.784	1%
	V_2	6.495	1.824	1%
	V_3	3.498	1.431	5%
	V_4	3.270	1.196	1%
	V_5	5.502	3.529	NS

Contd.

Appendix-II. Continued

1	2	3	4	5
c.	Percentage of fully opened florets in vase			
	V_1	365.354	152.098	5%
	V_2	230.728	129.392	NS
	V_3	226.230	47.725	1%
	V_4	438.125	259.882	NS
	V_5	529.245	338.196	NS
d.	Percentage of partially opened florets in vase			
	V_1	568.002	25.882	1%
	V_2	135.760	69.235	5%
	V_3	60.718	24.510	5%
	V_4	370.282	91.490	1%
	V_5	155.135	81.235	NS
e.	Percentage of unopened florets in vase			
	V_1	206.865	120.961	NS
	V_2	131.356	52.176	5%
	V_3	199.044	49.647	1%
	V_4	230.647	155.176	NS
	V_5	386.836	145.020	1%
f.	Longevity of individual floret			
	V_1	0.305	0.165	NS
	V_2	2.359	1.169	5%
	V_3	0.817	0.485	NS
	V_4	0.621	0.059	1%
	V_5	0.403	0.158	5%
g.	Number of florets opened at a time			
	V_1	0.248	0.314	NS
	V_2	0.880	1.157	NS
	V_3	1.252	0.431	1%
	V_4	1.623	0.490	1%
	V_5	0.449	0.451	NS

Contd.

Appendix-II. Continued

1	2	3	4	5
h.	Nature of bending			
	Days to spike bending			
	V_1	0.156	0.120	NS
	V_2	0.311	0.172	NS
	V_3	0.225	0.132	NS
	V_4	0.138	0.076	NS
	V_5	0.399	0.235	NS
	Bend from which floret			
	V_1	0.285	0.172	NS
	V_2	0.371	0.218	NS
	V_3	0.276	0.173	NS
	V_4	0.145	0.097	NS
	V_5	0.418	0.252	NS
i.	Water uptake			
	V_1	159.270	46.392	1%
	V_2	151.086	59.490	5%
	V_3	330.189	27.784	1%
	V_4	197.395	34.373	1%
	V_5	154.145	59.608	5%
4.	Corm and cormel yield			
a.	Corm weight			
	V_1	203.647	33.785	1%
	V_2	206.384	59.940	1%
	V_3	161.035	193.253	NS
	V_4	74.711	62.669	NS
	V_5	709.231	170.244	1%

Contd.

Appendix-II. Continued

1	2	3	4	5
b. Corm size				
	V_1	98.199	20.863	1%
	V_2	138.926	49.216	1%
	V_3	178.755	108.137	NS
	V_4	52.620	34.549	NS
	V_5	571.706	182.098	1%
c. Number of cormels				
	V_1	23.978	10.569	5%
	V_2	3.333	2.235	NS
	V_3	534.047	34.529	1%
	V_4	9.086	7.314	NS
	V_5	285.127	92.882	1%
d. Weight of cormels				
	V_1	4.492	0.817	1%
	V_2	0.758	0.248	1%
	V_3	5.513	2.213	5%
	V_4	8.733	5.211	NS
	V_5	4.485	3.064	NS

V_1 - Agnirekha
V_2 - American Beauty
V_3 - Friendship
V_4 - Mansoer Red
V_5 - True Yellow

APPENDIX-III

LIST OF PLATES

Plate I & 2. General Views of the experiment plot

Plate 3. Gladiolus variety 'Agnirekha'

Plate 4. Gladiolus variety 'American Beauty'

Plate 5. Gladiolus variety 'Friendship'

Plate 6. Gladiolus variety 'Mansoer Red'

Plate 7. Gladiolus variety 'True Yellow'

Plate 8 & 9. Stages in the bending of gladiolus spike


Plate 10 & 11. Stages in the bending of gladiolus spike (Continued)

EFFECT OF GROWTH REGULATORS AND NUTRIENTS ON SPIKE QUALITIES OF GLADIOLUS

By

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ABSTRACT OF A THESIS

Submitted in partial fulfilment of the requirement for the degree of

Master of Science in Horticulture

Faculty of Agriculture
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Department of Horticulture
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COLLEGE OF HORTICULTURE
Vellanikkara, Thrissur

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ABSTRACT

Studies were carried out at the College of Horticulture, Vellanikkara during 1988-89 to examine the effect of growth regulators and nutrients on the growth parameters and spike qualities of five varieties of gladiolus, in two seasons.

The treatments significantly influenced all the vegetative characters, duration, most of the spike characters as well as corm and cormel yield in one variety or other.

Growth retardants TIBA and CCC and salts of Ca recorded least height. TIBA 300 ppm and CCC 250 ppm produced the maximum number of leaves, followed by GA 100 ppm and salts of Ca and K. In leaf area, K_2SO_4 caused a significant increase. TIBA 300 ppm, NAA 100 ppm, GA 100 ppm and salts of Ca were the other superior treatments.

While K_2SO_4 and GA 100 ppm reduced the duration till the appearance of flower spike, that from spike emergence to opening was the shortest with salts of Ca and K, in general. GA and $Ca(NO_3)_2$ lengthened the blooming period, whereas K_2SO_4 and GA 100 ppm reduced the total duration.

In general, K_2SO_4 0.5%, $CaSO_4$ 0.5% and GA 50 ppm were superior in increasing the spike length. Diameter of spike was

the maximum with growth inhibitors, in most of the varieties. GA and salts of Ca were also superior. Ga 50 ppm as well as salts of Ca and K helped in producing the longest rachis.

Salts of Ca at 1.0% level and GA produced the highest number of florets. However, the length and size of the florets were not affected by the treatments. CCC, $Ca(NO_3)_2$ 1.0% and KNO_3 0.5% recorded the maximum fresh weight of the spike.

TIBA 150 ppm, CCC, GA, $Ca(NO_3)_2$ 1.0% and $CaSO_4$ lengthened the vase life. GA, NAA 100 ppm, CCC 500 ppm and $Ca(NO_3)_2$ were superior with respect to the opening behaviour of the florets.

Longevity of individual floret was improved by GA 100 ppm, K_2SO_4 and $Ca(NO_3)_2$. Salts of K and $Ca(NO_3)_2$ 1.0% enhanced the number of florets opened at a time. NAA 100 ppm and GA 50 ppm exhibited maximum water uptake. However, the treatments could not influence the nature of bending.

NAA, GA and salts of Ca and K increased the corm yield. Number of cormels was mostly affected by the nutrients. K improved the weight of cormels too.

In general, floral characters were superior in the varieties American Beauty and Friendship, whereas vase life was the maximum in Agnirekha and Mansoer Red. True Yellow produced heavy corms. Weight of cormels was the maximum in Agnirekha and Mansoer Red.

November plantin was found to be better than April planting, in order to obtain quality spikes as well as good corm and cormel yield in gladiolus nder Vellanikkara conditions.